CITY OF WATERBURY



Energy-Savings Performance Contract with Noresco,LLC for Energy Efficient Building Upgrades RFP No.5167

July 5, 2016



DEPARTMENT OF FINANCE

THE GITY OF WATERBURY

CONNECTICUT

Date: July 5, 2016

To: Paul Pernerewski, President, Board of Aldermen

Members, Board of Aldermen

Board of Education Commissioners

Mayor Neil M. O'Leary

Dr. Kathleen M. Ouellette, Superintendent of Schools

From: Michael LeBlanc, Director of Finance

Subject: \$29,133,741 Energy-Savings Performance Contract with Noresco, LLC

For Energy Efficient Building Upgrades - RFP No. 5167

Kindly give favorable consideration by approving the attached guaranteed energy savings performance contract for Energy Efficient Building Upgrades with Noresco, LLC. This guaranteed energy savings performance contract will provide for the implementation of fourteen (14) comprehensive energy savings measures effecting nearly every school and general government building.

Energy Savings Measures (ESMs)	Implementation Price	Estimated Incentives	Annual Cost Savings
Interior Lighting Improvements	\$2,099,731	\$489,680	\$344,408
Exterior Lighting Improvements	\$986,752	\$264,504	\$127,455
Variable Speed Chillers/ Pumps	\$1,205,930	\$35,049	\$43,149
AHU Damper Refurbishments	\$321,887	\$46,024	\$29,038
EMS Upgrades & Expansion	\$5,346,414	\$1,536,964	\$621,167
Building Weatherization	\$584,745	\$146,921	\$47,528
Pipe & Fitting Insulation	\$804,567	\$268,882	\$79,239
Steam Traps & TRVs	\$784,363	\$272,573	\$93,420
Plug Load Controls	\$176,855	\$60,372	\$27,543
Walk-In Cooler Controls	\$147,462	\$29,329	\$13,115
Steam Boilers	\$5,985,553	\$103,757	\$69,948
Hot Water Boilers & Pool Heating Systems	\$7,409,455	\$445,829	\$153,827
Solar Photovoltaics	\$305,489	\$0	\$27,863
New Electrical Switchgear & Backup Power Generation	\$1,255,855	\$0	\$0
Project Totals	\$27,415,059	\$3,699,854	\$1,677,700

This energy savings performance contract will provide for significant reductions in energy consumption and building energy costs in addition to improving building comfort, reducing the risk of system failures, extending the useful life of replaced equipment through enhanced building management systems and providing for critical back-up equipment. These energy conservation measures will qualify for an estimated \$3.7 million comprehensive energy efficiency incentive that will reduce the capital cost amount to be financed. The guaranteed energy cost savings will fund the annual debt service on the capital investment financing and still provide for a positive cash flow exceeding \$80,000 each year. The projected savings will grow substantially once the financing repayment period ends.

The City previously engaged ECG Engineering, P.C. to work closely with the City's Energy Task Force and to serve as the City's Owner Representative throughout the planning, evaluation, selection, contracting and implementation of a guaranteed energy savings performance contract. The responses to the City's request for proposal for Energy-Savings Performance Contract Services, RFP No. 5167, were received on April 30, 2015. Responses were received from the following Energy Service Providers:

Ameresco, ConEd, Honeywell, Johnson Controls & Noresco.

On May 8, 2015, the City's Energy Consultant, ECG Engineering, P.C. (ECG) provided the results of a preliminary evaluation of the proposals. ECG determined that all five respondents met the minimum qualifications called for in RFP No. 5167. ECG was instructed to proceed forward with a comprehensive detailed analysis of each of the proposals.

The Purchasing Director established a Selection Committee comprised of the following members that met on several occasions to review and discuss the responses to this RFP with ECG representatives.

City Committee Representatives:

- Director of Public Works Dave Simpson
- Battalion Chief Jim Peplau
- Staff Attorney Lynn McHale
- Director of Purchasing Rocco Orso
- Director of Finance Michael LeBlanc

Board of Education Committee Members:

- Education Chief of Staff & Chief Operating Officer Paul Guidone & Gary Miller
- School Facilities Manager John Cross

During the summer of 2015 the Selection Committee & ECG Representatives completed the proposal review process and interviewed all five (5) respondents in September 2015. The Selection Committee & ECG met subsequently to assess both ECG's and each of the Selection Committee Member's summary of findings. Past relevant experience, the proposed project team, quality of presentation, proposed project scope and several other factors were considered by ECG and the Selection Committee throughout the evaluation process. The Selection Committee unanimously concluded that Noresco was the best qualified Energy Service Provider to most effectively provide the desired services for this energy efficiency project initiative and should therefore be awarded the contract.

Over the past seven months Noresco performed an at-risk Investment Grade Energy Audit (IGEA) which would be used to establish the agreed upon detailed scope of work to be included in energy savings performance contract. The IGEA was revised & finalized on June 29, 2016 and is incorporated into the Contract with Noresco as Exhibit B: Investment Grade Energy Audit and Project Development Proposal. As the Exhibit B - IGEA document contains 1870 pages,

the following Exhibit B – IGEA Appendixes have been excluded from the attached bound contract documents provided for your review.

Exhibit B: IGEA Report Revised June 29, 2016 Appendixes – Not Included:

Appendix 1: CalculationsAppendix 2: 35% Drawings

Appendix 3: Cutsheets

Appendix 4: Audit Data

One complete copy of the IGEA including the Exhibit B Appendixes has been filed with the City Clerk and is available for review.

CONTRACT

Between

THE CITY OF WATERBURY

AND

NORESCO, LLC

FOR ENERGY- SAVINGS PERFORMANCE CONTRACTING SERVICES

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Exhibit A: Energy-Savings Performance Project Statement of Work

Exhibit B: Investment-Grade Energy Audit and Project Development Proposal

This Contract (the "Contract") is made by and between, NORESCO, LLC, a duly registered foreign limited liability company with a principal place of business at 1 Research Drive, Suite 400C, Westborough, Massachusetts, 01581, acting by and through David G. Mannherz, its Executive Vice President and CFO (the "Contractor" or "QESP"), and the City of Waterbury, acting herein by and through Neil M. O'Leary, Mayor of the City of Waterbury, City Hall, 235 Grand Street, Waterbury, Connecticut 06702 (the "City" or "Owner" or "Municipality").

The Contractor and the City agree as follows:

- 1. <u>Definitions</u>. Unless otherwise indicated, the following terms shall have the following corresponding definitions for this Contract and all exhibits, unless otherwise noted in the exhibits, in which case the definition in the exhibit controls:
 - (a) Acts: Those acts of commission and omission.
 - (b) Amend (in any part of speech, however conjugated): Any altering, by addition, deletion, modification or otherwise, of any part of this Contract, including extensions, or its exhibits or Final Exhibits.
 - (c) Claims: All actions, suits, claims, demands, investigations and proceedings of any kind, open, pending or threatened, whether mature, unmatured, contingent, known or unknown, at law or in equity, in any forum.
 - (d) Confidential Information: Any information about a client, including but not limited to first name and last name, or first initial and last name, in combination with any one or more of the following related to such client: (a) Social Security Number; (b) driver's license number or State-issued identification card number; (c) date of birth; and (d) financial account number, or credit or debit card number, with or without any required security code, access code, personal identification number or password, that would permit access to a client's financial account. Without limiting the foregoing, Confidential Information shall also include any information that the Owner classifies as "confidential" or "restricted." Confidential Information shall not include information that may be lawfully obtained from publicly available sources or from federal, state, or local government records which are lawfully made available to the general public.
 - (e) Confidential Information Breach: An instance where an unauthorized person or entity accesses Confidential Information in any manner, including but not limited to the following occurrences: (1) any Confidential Information that is not encrypted or protected is misplaced, lost, stolen or in any way compromised; (2) one or more third parties have had access to or taken control or possession of any Confidential Information that is not encrypted or protected without prior written authorization from the State; (3) the unauthorized acquisition of encrypted or protected Confidential Information together with the confidential process or key that is capable of compromising the integrity of the Confidential Information; or. (4) if there is a substantial risk of identity theft or fraud to the client, the Contractor, the Owner or State.
 - (f) Contract: In addition to this agreement and all exhibits, schedules, and appendices thereto, the following are incorporated by reference and made a part hereof this Contract:
 - i. RFP No. 5167 (acknowledged by the Contractor as having been received),

- ii. RFP Addendum #1 to RFP No. 5167, dated February 25, 2015; Addendum #2 to RFP No. 5167, dated February 25, 2015; Addendum #3 to RFP No. 5167, dated March 12, 2015; Addendum #4 to RFP No. 5167, dated March 30, 2015; Addendum #5 to RFP No. 5167, dated April 2, 2015; and Addendum #6 to RFP No. 5167, dated April 9, 2016 (acknowledged by the Contractor as having been received),
- iii. Contractor's response to RFP No. 5167 dated April 30, 2015 (acknowledged by the Contractor as having been received),
- iv. Annual Statement of Financial Interests; Disclosure and Affidavit Re:
 Outstanding Obligations to the City; Debarment Certification; Corporate
 Resolution (incorporated by reference).
- v. Certificates of Insurance (incorporated by reference),
- vi. Performance Bond and Payment Bond (incorporated by reference),
- vii. Any and all amendment(s) and Change Orders issued by the City after execution of Contract (incorporated by reference),
- viii. All applicable Federal, State and local statutes, regulations, charter and ordinances (incorporated by reference),
- ix. All permits (including, but not limited to, City of Waterbury Building permit(s)) and licenses (incorporated by reference).
- (g) Contractor Parties: A Contractor's members, directors, officers, shareholders, partners, managers, principal officers, representatives, agents, servants, consultants, employees or any one of them or any other person or entity with whom the Contractor is in privity of oral or written contract and the Contractor intends for such other person or entity to Perform under the Contract in any capacity.
- (h) Cost Effective: The savings resulting from the energy-savings measures outweigh the costs of the measures, including, but not limited to, any financing costs, provided the payback period for any financing provided pursuant to 2011 Conn. Pub. Acts 80, Section 23 ("Public Act 11-80") is less than the functional life of the proposed energy-savings measures and the payback period does not exceed eighteen years.
- (i) Day: consecutive calendar day unless otherwise specified.
- (j) Owner: The City of Waterbury.
- (k) Energy-Savings Measure (ESM): Any improvement to facilities or other energy-consuming systems designed to reduce energy or water consumption and operating costs and increase the operating efficiency of facilities or systems for their appointed functions. "Energy-savings measure" includes, but is not limited to, one or more of the following:
 - 1. Replacement or modification of lighting and electrical components, fixtures or systems, including daylighting systems, improvements in street lighting efficiency or computer power management software;

- 2. Class I renewable energy or solar thermal systems;
- 3. Cogeneration systems that produce steam or forms of energy, such as heat or electricity, for use primarily within a building or complex of buildings;
- 4. Automated or computerized energy control systems;
- 5. Heating, ventilation or air conditioning system modifications or replacements;
- 6. Indoor air quality improvements that conform to applicable building code requirements;
- 7. Water-conserving fixtures, appliances and equipment or the substitution of non-water- using fixtures, appliances and equipment, or water-conserving landscape irrigation equipment; and
- 8. Changes in operation and maintenance practices;
- 9. Replacement or modification of windows or doors; and
- 10. Installation or addition of insulation.
- (l) Energy Savings Performance Contract (ESPC): A contract between the State Agency or Municipality and a qualified energy service provider for evaluation, recommendation and implementation of one or more energy-savings measures. An energy-savings performance contract shall be a guaranteed energy-savings performance contract, which shall include, but not be limited to, (A) the design and installation of equipment and, if applicable, operation and maintenance of any of the measures implemented; and (B) a guarantee of annual energy savings.
- (m) Equipment: Goods which the QESP is to install in accordance with and as set forth in **Schedule R (Equipment to Be installed by QESP)**, to **Exhibit A** to this Contract, Energy-Savings Performance Project Statement of Work ("SOW").
- (n) Exhibits: The Exhibits attached to this Contract either (a) in completed form as of the effective date of this Contract or (b) in blank or template form and which the Owner and Contractor subsequently negotiate, fill in, finalize, sign and date, which become effective upon execution thereof.
- (o) Force Majeure: Events that materially affect the cost of the Work or the time schedule within which to Perform and are outside the control of the party asserting that such an event has occurred, including, but not limited to, labor troubles unrelated to the Contractor, failure of or inadequate permanent power, unavoidable casualties, fire not caused by the Contractor, extraordinary weather conditions, disasters, riots, acts of God, insurrection or war.
- (p) Goods: All things which are movable, including, but not limited to, supplies, materials, equipment, hardware, software, specially manufactured things, a component incorporated into another thing and things that are attached to real property and that may be severed from the real property without material harm to the things, together and with any and all additions, modifications, attachments, replacements and parts.
- (q) Investment-Grade Energy Audit or (IGEA): A study by the QESP selected for a particular energy-savings performance contract project which includes detailed descriptions of the improvements recommended for the project, the costs of the improvements, and the utility and operations and maintenance cost savings projected to result from the recommended improvements.
- (r) Municipality: The City of Waterbury, including its local board of education.

- (s) Operation and Maintenance Cost Savings: A measurable decrease in operation and maintenance costs and future replacement expenditures that is a direct result of the implementation of one or more utility cost savings measures. Such savings shall be calculated in comparison with an established baseline of operation and maintenance costs.
- (t) Perform (in any part of speech, however conjugated): All Acts and things of the Contractor and Contractor Parties necessary or appropriate to execute, fulfill or accomplish fully this Contract and the Exhibits according to their terms.
- (u) Qualified Energy Service Provider (QESP): A corporation with a record of successful energy performance contract projects experienced in the design, implementation and installation of energy efficiency and facility improvement measures, the technical capabilities to ensure such measures generate energy and operational cost savings, and the ability to secure the financing necessary to support energy savings guarantees.
- (v) Records: All working papers and such other information and materials as may have been accumulated by the Contractor in performing the Contract, including but not limited to, documents, data, plans, books, computations, drawings, specifications, notes, reports, records, estimates, summaries and correspondence, kept or stored in any form.
- (w) Services: The performance of labor or work, as specified in the applicable Exhibits.
- (x) Solicitation: The Municipality request inviting proposals for Work resulting in this Contract. This Contract shall be governed by the statutes, regulations and procedures of the State of Connecticut and City of Waterbury.
- (y) State Agency: has the same meaning as provided in Conn. Gen. Stat. Sec. 1-79 and means any office, department, board, council, commission, institution, constituent unit of the state system of higher education, vocational-technical school or other agency in the executive, legislative or judicial branch of state government.
- (z) Termination: An end to the Contract or SOW, as applicable, prior to the end of their respective terms whether effected pursuant to a right which the Contract or SOW creates or for a breach.
- (aa) Title: all ownership, title, licenses, rights and interest, including, but not limited to, perpetual use, of and to the Work or Goods, as applicable.
- (bb) Utility Cost Savings: Any utility expenses eliminated or avoided on a long-term basis as a result of equipment installed or modified, or services performed by a qualified energy service provider; "utility cost savings" does not include merely shifting personnel costs or similar short-term cost savings.
- (cc) Work: Equipment or Services or both to be performed in accordance with the Exhibits.

2. Contract Time: Contract Extension.

(a) Subject to the remainder of this provision, and unless Terminated in accordance with any other provision of this Contract or extended by amendment, the Contractor shall Substantially Complete all Work and Services under this Contract (except for the Work and Services included within QESP's Annual Services) within SEVEN HUNDRED AND THIRTY (730)

consecutive calendar days of the City's issuance of a written notice to proceed, shall meet all Project Milestones identified within the City's written notice to proceed, and shall reach Final Completion (except for the Work and Services included within QESP's Annual Services) within ONE THOUSAND AND NINETY-FIVE (1095) consecutive calendar days of the City's issuance of a written notice to proceed. All Work and Services included within QESP's Annual Services shall be completed within five (5) years of the Commencement Date.

- (b) Time is and shall be of the essence for all Project Milestones, Substantial Completion Date and the Final Completion Date for the Project. The Contractor further agrees that the Project shall be prosecuted regularly, diligently and uninterruptedly and at such rate of progress as will insure full completion thereof within the Contract Time stated above. It is expressly understood and agreed, by and between the Contractor and City, that the Contract Time is reasonable for the completion of the Project.
- (c) The Contractor shall pay to the City the sum of **FIVE HUNDRED DOLLARS AND ZERO CENTS (\$500.00)** per calendar day for each and every calendar day for which the Contractor is in default in completing the Work beyond the time for Substantial Completion as set forth in this Article 2 as it may be amended from time to. The preceding sum is hereby agreed upon not as a penalty, but as liquidated damages that the City shall suffer due to such default. The City shall have the right to deduct the amount of any such damages from any monies due the Contractor under this Contract.
- (d) The parties may extend this Contract, prior to Termination, and only in accordance with the Contract Amendments Section in this Contract.

3. Rejected Items; Abandonment.

- (a) The Contractor may deliver, cause to be delivered, or, in any other way, bring or cause to be brought, to any premises or other destination, Equipment, as samples or otherwise, and other supplies, materials, equipment or other tangible personal property. Provided that the Owner has paid the Contractor for the work performed to date, the Owner may, by written notice and in accordance with the terms and conditions of the Contract, direct the Contractor to remove any or all such Equipment (the "Rejected Equipment") and any or all other supplies, materials, equipment or other tangible personal property (collectively, the "Contractor Property") from and out of Owner premises and any other location which the Owner manages, leases or controls. The Contractor shall remove the Rejected Equipment and the Contractor Property in accordance with the terms and conditions of the written notice. Failure to remove the Rejected Equipment or the Contractor Property in accordance with the terms and conditions of the written notice shall mean, for itself and all Contractor Parties that:
 - they have voluntarily, intentionally, unconditionally, unequivocally and absolutely abandoned and left unclaimed the Rejected Equipment and Contractor Property and relinquished all Title to the Rejected Equipment and Contractor Property with the specific and express intent of (A) terminating all of their Title to the Rejected Equipment and Contractor Property, (B) vesting Title to the Rejected Equipment and Contractor Property in the Owner and (C) not ever reclaiming Title or any future rights of any type in and to the Rejected Equipment and Contractor Property;
 - there is no ignorance, inadvertence or unawareness to mitigate against the intent to abandon the Rejected Equipment or Contractor Property;

- (3) they vest authority, without any further act required on their part or the Owner's part, in the Owner to use or dispose of the Rejected Equipment and Contractor Property, in the Owner's sole discretion, as if the Rejected Equipment and Contractor Property were the Owner's own property and in accordance with law, without incurring any liability or obligation to the Contractor or any other party;
- (4) if the Owner incurs any costs or expenses in connection with disposing of the Rejected Equipment and Contractor Property, including, but not limited to, advertising, moving or storing the Rejected Equipment and Contractor Property, auction and other activities, the Owner shall invoice the Contractor for all such cost and expenses and the Contractor shall reimburse the Owner no later than thirty (30) days after the date of invoice; and
- (5) they do remise, release and forever discharge the Owner and its employees, departments, commissions, boards, bureaus, agencies, instrumentalities or political subdivisions and their respective successors, heirs, executors and assigns (collectively, the "Owner and Its Agents") of and from all Claims which they and their respective successors or assigns, jointly or severally, ever had, now have or will have against the Owner and Its Agents arising from the use or disposition of the Rejected Equipment and Contractor Property.
- (b) The Contractor shall secure from each Contractor Party, as appropriate, such document or instrument as necessary or appropriate as will vest in the Contractor plenary authority to bind the Contractor Parties to the full extent necessary or appropriate to give full effect to all of the terms and conditions of this Section. The Contractor shall provide, no later than fifteen (15) days after receiving a request from the Owner, such information as the Owner may require to evidence, in the Owner's sole determination, compliance with this Section.

4. Not Used.

5. IGEA Process.

The IGEA Report, dated June 29, 2016, is attached as Exhibit B and made a part hereof.

6. Energy-Savings Performance Project Statement of Work.

The Owner and QESP have used the IGEA Report as the basis for negotiating the SOW, which is attached hereto as **Exhibit A** and made a part hereof.

7. Order and Delivery.

The Contract shall bind the Contractor to furnish and deliver the Work in accordance with all applicable Exhibits.

8. Contract Amendments.

No amendment to or modification or other alteration of the Contract, including extensions, shall be valid or binding upon the parties unless made in writing, duly authorized and signed by the parties hereto.

9. Assignments.

(a) The Contractor shall not assign any of its rights or obligations under the Contract, voluntarily or otherwise, in any manner without the prior written consent of the Owner. Owner may void any purported assignment in violation of this Assignments Section and declare the Contractor in Material Breach. Any Termination by Owner for a Material Breach is without prejudice to the Owner's rights or possible Claims.

10. Termination.

- (a) Notwithstanding any provisions in this Contract, Owner, through a duly authorized employee, may terminate this Contract at any time for the convenience of the City, ("Termination for Convenience") by a notice in writing from the City to the Contractor. If this Contract is terminated by the City as provided herein, the Contractor will be paid an amount which bears the same ratio to the total compensation as the services actually performed bear to the total services of the Contractor covered by this Contract, less payments of compensation previously made.
- (b) Notwithstanding any provisions in this Contract, Owner, through a duly authorized employee, may Terminate the Contract for a Material Breach, but only after making a written determination that the Contractor is in Material Breach under the Material Breach Section of this Contract and providing Contractor the right to cure as delineated in that section.
- (c) Notwithstanding any provisions in this Contract, Owner, through a duly authorized employee, may terminate the Contract for a breach other than a Material Breach, but only after making a written determination that the Contractor is in breach of Contract and has failed to cure the breach in accordance with the Other Breaches Section of this Contract.
- (d) Termination for Non-Appropriation or Lack of Funding. The Contractor acknowledges that the City is a municipal corporation and that this Contract is subject to the appropriation and disbursement of funds by the City sufficient for this Contract for each budget year in which this Contract is in effect. The Contractor therefore agrees that the City shall have the right to terminate this Contract in whole or in part without penalty to the City in the event that sufficient funds to provide for City payment(s) under this Contract is not appropriated, not authorized, or not made available, or such funding has been reduced. In the event this Contract is subject, in whole or in part, to the appropriation and disbursement of Federal and/or State funds and those Federal and/or State funds are not appropriated or are not disbursed to the City, the Contractor hereby agrees that the City shall have the right to terminate this Contract in whole or in part without penalty to the City.
 - (1) **Effects of Nonappropriation.** If funds to enable the City to effect continued payment under this Contract are not appropriated, authorized or otherwise made available by law, the City shall have the right to terminate this Contract without penalty at the end of the last period for which funds have been appropriated, authorized or otherwise made available by law by giving written notice of termination to the Contractor.
 - (2) **Effects of Reduced Levels of Funding**. If funding is reduced by law, or funds to pay the Contractor for the agreed to level of the products, services and functions to be provided by the Contractor under this Contract are not appropriated, authorized or otherwise made available by law, the City may,

- upon seven (7) business days written notice to the Contractor, reduce the level of the products, services or functions in such manner and for such periods of time as the City may elect. The charges payable under this Contract shall be equitably adjusted to reflect such reduced level of products, services or functions and the parties shall be afforded the rights set forth in this Contract.
- (3) **No Payment for Lost Profits.** In no event shall the City be obligated to pay or otherwise compensate the Contractor for any lost or expected future profits.
- (4) Rights Upon Termination-Termination for Lack of Funding. In the event of termination by the City for lack of funding (or per Section 10(a) above), the City shall pay the Contractor for all labor, services, equipment, materials, reports, plans, specifications, drawings, deliverables, incidentals, etc. (including any holdbacks) installed and delivered to the City as of the Termination Date and the Contractor shall relinquish to the City any applicable interest, title and ownership including, but not limited to perpetual use of any proprietary rights in and to said labor, services, equipment, materials, reports, plans, specifications. drawings, deliverables, incidentals, etc. delivered to, in possession of and paid for by the City (except to the extent any invoiced amount is disputed). The Contractor shall be required to exercise commercially reasonable efforts to mitigate damages. In the event of a termination for Lack of Funding or Convenience the City and the Contractor may negotiate a mutually acceptable payment to the Contractor for reasonable demobilization expenses. Said demobilization expenses, if any, shall be handled in accordance with the provision of this Contract pertaining to changes in the Work.
- (e) Owner shall send the notice of Termination via certified mail, return receipt requested, to the Contractor at the most current address which the Contractor has furnished to Owner for purposes of correspondence, or by hand delivery. Upon receiving the notice from Owner, the Contractor shall immediately discontinue all services affected in accordance with the notice, undertake all commercially reasonable efforts to mitigate any losses or damages, and deliver to the appropriate department all Records. The Records are deemed to be the property of the Owner and the Contractor shall deliver them to the Owner no later than thirty (30) days after the Termination of the Contract or fifteen (15) days after the Contractor receives a written request from Owner for the Records. The Contractor shall deliver those Records that exist in electronic, magnetic or other intangible form in a non-proprietary format, such as, but not limited to, ASCII or .TXT.
- (f) Upon receipt of a written notice of Termination from Owner, the Contractor shall cease operations as Owner directs in the notice, and take all actions that are necessary or appropriate, or that Owner may reasonably direct, for the protection, and preservation of the Equipment and any other property. Except for any work which Owner directs the Contractor to Perform in the notice prior to the effective date of Termination, and except as otherwise provided in the notice, the Contractor shall terminate or conclude all existing subcontracts and purchase orders and shall not enter into any further subcontracts, purchase orders or commitments.
 - 1. **Assumption of Subcontracts.** In the event of termination, the City shall have the right to assume, at its option, any and all subcontracts for products, services and functions provided exclusively under this Contract.

- (g) Owner shall, within forty-five (45) days of the effective date of Termination, and if appropriate in accordance with **Exhibit A**, reimburse the Contractor for its Performance to the extent rendered and accepted by the Owner and that is appropriate in accordance with the applicable Exhibits. However, the Contractor is not entitled to receive and the Owner is not obligated to tender to the Contractor any payments for anticipated or lost profits. Upon request by the Owner and after payment is made by the Owner to Contractor for any outstanding invoices or costs listed the Contractor shall assign to the Owner, or any replacement contractor which the Owner designates, all subcontracts, purchase orders and other commitments, deliver to the Owner all Records and other information pertaining to its Performance, and remove from Owner premises, whether leased or owned, all of Contractor's property, equipment, waste material and rubbish related to its Performance, all as the Owner may request.
- (h) For breach or violation of any of the provisions in the Representations and Warranties Section, Owner may Terminate the Contract in accordance with its terms and revoke any consents to assignments given as if the assignments had never been requested or consented to, without liability to the Contractor or Contractor Parties or any third party.
- (i) Upon Termination of the Contract, all rights and obligations shall be null and void, so that no party shall have any further rights or obligations to any other party, except with respect to the sections, which survive Termination.
- (j) Termination of the Contract pursuant to this Section shall not be deemed to be a breach of contract by Owner.
- 11. Events of Material Breach; Right to Cure. The occurrence of any one or more of the following events shall constitute a material breach ("Material Breach") of this Contract; this section shall apply to Contractor Parties, such that if a Contractor Party commits a Material Breach then the Contractor shall be responsible in all respects for that Material Breach and its consequences under this Contract as if the Contractor itself had committed the Material Breach:
 - (a) The failure of Contractor or Owner to comply, respectively, with any material covenant or condition of this Contract, which failure is not cured within fifteen (15) days after receipt of notice of such failure from the non-failing party; provided that if such failure is one that cannot be cured within fifteen (15) days with the exercise of reasonable diligence, such failure shall not be deemed to be a Material Breach if the failing party is diligently proceeding to cure such failure; provided further that such extended cure period shall not exceed an additional thirty (30) days beyond the fifteen (15) days without the prior written consent of the non-failing party, which consent shall not be unreasonably withheld.
 - (b) The failure of Contractor to Perform materially, including, but not limited to, complying fully with all terms and conditions of the Contract, including applicable Exhibits, which failure is not cured within fifteen (15) days after receipt of notice of such failure from the Owner; provided that if such failure is one that cannot be cured within fifteen (15) days with the exercise of reasonable diligence, such failure shall not be deemed to be a Material Breach if the Contractor is diligently proceeding to cure such failure; provided further that such extended cure period shall not exceed an additional thirty (30) days beyond the fifteen (15) days without the prior written consent of the Owner, which consent shall not be unreasonably withheld.

- (c) The appointment of any receiver for the Contractor, or the execution of any other process or any action by a court of competent jurisdiction against the Contractor which is not vacated, dismissed or set aside or for which the Contractor fails to take steps and diligently prosecute, toward the vacation, dismissal or set aside, within a period of thirty (30) days from such appointment or execution and which materially interferes with the Contractor's ability to Perform under this Contract.
- (d) A writ of attachment or execution is levied on any part of the Equipment, and is attributable to the Contractor, and is not vacated, dismissed or set aside, or for which the Contractor fails to take steps and diligently prosecute, toward the vacation, dismissal or set aside, within thirty (30) days from such levy.
- (e) The filing of any vendor's, mechanic's, laborer's, materialman's or other similar lien or encumbrance (collectively, "Liens") based upon furnishing of Work, which the QESP does not discharge within one hundred twenty (120) calendar days after it receives notice of the Liens.
- (f) Any representation or warranty of the Contractor or Owner that is false or misleading (collectively, "Falsehood") in any material respect and which Falsehood is not cured within fifteen (15) days of receipt of notice of such Falsehood from the other party; provided that, if such Falsehood fails to be cured within fifteen (15) days with the exercise of reasonable diligence, such failure shall not be deemed to be a Material Breach if the party who made the representation or warranty is diligently proceeding to cure such Falsehood; provided further that such extended cure period shall not exceed an additional thirty (30) days beyond the fifteen (15) days without the prior written consent of the other party, which consent shall not be unreasonably withheld.
- (g) The Contractor abandons Performance, or, in the reasonable judgment of the Owner, fails to provide sufficient materials or qualified workers to adequately prosecute the work in accordance with the applicable Exhibits A & B.
- (h) Any proceeding is instituted against the Contractor seeking to adjudicate it as bankrupt or insolvent, and the Contractor is not appointed debtor in possession by the court.
- (i) (1) the Contractor makes a general assignment for the benefit of creditors, (2) a receiver is appointed on account of the insolvency of the Contractor, or (3) the Contractor files a petition seeking to take advantage of any other law relating to bankruptcy, insolvency, reorganization, winding up or composition or reorganization of debts and, in the case of any proceeding in referred to in this subsection, such proceeding is not dismissed, or as to which the Contractor fails to take steps and diligently prosecute toward a dismissal, within sixty (60) days after such filing.
- (j) There is a material adverse change in the financial condition or operations or the business of the Contractor that substantially affects its ability to Perform in accordance with this Contract.
- (k) An assignment or purported assignment, in whole or in part, of the Contract or any Final Exhibit, including specifically **Exhibit A**, without the prior written approval of the Owner, as appropriate.
- (I) Any other event or condition, which **Exhibit A** identifies as a Material Breach.

- 12. Other Breaches; Right to Cure; Exercise of Remedies. This Section governs all breaches except Material Breaches. If either party breaches the Contract in any respect, the non breaching party shall provide written notice of such breach to the breaching party and afford the breaching party an opportunity to cure the breach within ten (10) days from the date that the breaching party receives such notice. Any greater time period provided for in the notice shall trump such ten (10) days. Such right to cure period shall be extended if the non-breaching party is satisfied that the breaching party is making a good faith effort to cure but the nature of the breach is such that it cannot be cured within the right to cure period. If a breach remains uncured after the expiration of a right to cure period, including any allowed extensions, then the following remedies are available to the parties:
 - (a) if the QESP breaches, then the Owner may exercise and any all remedies at law or equity, including the filing of any Claim;
 - (b) if a Municipality breaches, then the QESP may exercise and any all remedies at law or equity, including the filing of any Claim, subject, however, to the Municipality's governmental immunity privilege, as applicable; and
- 13. Notice of Breach. Any notice of breach under either the Material Breach or Other Breaches provisions may include an effective Contract Termination date if the breach is not cured by the stated date and, unless otherwise modified by the non-breaching party in writing prior to the Termination date, no further action shall be required of any party to effect the Termination as of the stated date. If the notice does not set forth an effective Contract Termination date, then the non-breaching party may Terminate the Contract after the cure period has lapsed by giving the breaching party no less than twenty four (24) hours' prior written notice.
- 14. Withholding of Payment. This Section shall not be interpreted to be a limitation on or adversely affect the rights of the Owner in "Events of Material Breach; Right to Cure" or the "Other Breaches; Right to Cure; Exercise of Remedies" Sections of this Contract. If QESP is in Material Breach or Other Breach of this Contract, then, the Owner may withhold payment in whole or in part that is due or will become due under any of the Exhibits pending resolution of the Material Breach or Other Breach issue. However, the Owner may do so only provided, that, the Owner notifies the Contractor in writing prior to the date that the payment would have been due and provided further that withholding payment does not create a default or breach under the documents comprising **Schedule I** of **Exhibit A**.

15. Waivers.

- (a) No waiver of any breach of the Contract shall be interpreted or deemed to be a waiver of any other or subsequent breach.
- (b) A party's failure to insist on strict performance of any provision of the Contract shall only be deemed to be a waiver of rights and remedies concerning that specific instance of Performance and shall not be deemed to be a waiver of any subsequent rights, remedies or breach.
- 16. <u>Remedies.</u> All remedies afforded in the Contract shall be taken and construed as cumulative, that is, in addition to every other remedy provided in the Contract or at law or in equity.
- 17. Purchase Orders.

- (a) The fully executed Contract itself is not an authorization for the Contractor to begin Performance in any way. The Contractor may begin Performance only upon issuance of a written notice to proceed issued by Owner, and only after it has received a duly issued purchase order against the Contract for Performance in accordance with the applicable Exhibits.
- (b) The Owner shall issue a purchase order against the Contract, and only in accordance with an applicable Exhibit, directly to the Contractor and to no other party. The Contractor may not commence Performance unless the purchase order and written notice to proceed are issued directly to the Contractor and to no other party.
- (c) A Contractor making delivery without a duly issued purchase order in accordance with this Section does so at the Contractor's own risk.
- (d) The Owner may, in its sole discretion, deliver to the Contractor any or all duly issued purchase orders via electronic means only, such that the Owner shall not have any additional obligation to deliver to the Contractor a "hard copy" of the purchase order or a copy bearing any hand-written signature or other "original" marking.

18. Indemnification.

- (a) The Contractor shall indemnify, defend and hold harmless the Owner and its officers, representatives, agents, servants, employees, successors and assigns from and against any and all (1) Claims arising, directly, or indirectly, in connection with the Contract and all applicable Exhibits, including the negligent Acts of the Contractor or Contractor Parties; and (2) liabilities, damages, losses, costs and expenses, including but not limited to, attorneys' and other professionals' fees, arising, directly or indirectly, in connection with Claims, Acts or the Contract. The Contractor shall use counsel reasonably acceptable to the Owner in carrying out its obligations under this Section. The Contractor's obligations under this Section to indemnify, defend and hold harmless against Claims includes Claims concerning confidentiality of any part of or all of the Contractor's bid, proposal or any Records, any intellectual property rights, other proprietary rights of any person or entity, copyrighted or uncopyrighted compositions, secret processes, patented or unpatented inventions, articles or appliances furnished or used in the Performance.
- (b) The Contractor shall not be responsible for indemnifying or holding the Owner harmless from any liability arising due to the negligence or intentional misconduct of the Owner or any other person or entity acting under direct control or supervision of the Owner.
- (c) The Contractor shall reimburse the Owner for any and all damages to the real or personal property of the Owner caused by the Acts of the Contractor or any Contractor Parties. The Owner shall give the Contractor reasonable notice of any such Claims.
- (d) The Contractor's duties under this Section shall remain fully in effect and binding in accordance with the terms and conditions of the Contract, without being lessened or compromised in any way, even where the Contractor is alleged or is found to have merely contributed in part to the Acts giving rise to the Claims and/or where the Owner is alleged or is found to have contributed to the Acts giving rise to the Claims
- (e) The Contractor shall carry and maintain at all times during the term of the Contract, and during the time that any provisions survive the term of the Contract, sufficient general

liability insurance to satisfy its obligations under this Contract. The Contractor shall name the Owner as an additional insured on the policy and shall provide a copy of the policy to the Owner prior to the effective date of the Contract. The Contractor shall not begin Performance until the delivery of the policy to the Owner. The Owner shall be entitled to recover under the insurance policy even if a body of competent jurisdiction determines that the Owner is contributorily negligent.

- (f) This Section shall survive the Termination of the Contract and shall not be limited by reason of any insurance coverage.
- 19. Forum and Choice of Law. The parties deem the Contract to have been made in the City of Waterbury, State of Connecticut. Both parties agree that it is fair and reasonable for the validity and construction of the Contract to be, and it shall be, governed by the laws and court decisions of the State of Connecticut, without giving effect to its principles of conflicts of laws. To the extent that any immunities provided by Federal law or the laws of the State of Connecticut do not bar an action against the Owner, and to the extent that these courts are courts of competent jurisdiction, for the purpose of venue, the complaint shall be made returnable to the Judicial District of Waterbury only or shall be brought in and shall not be transferred to any other court. The Contractor waives any objection which it may now have or will have to the laying of venue of any Claims in any forum and further irrevocably submits to such jurisdiction in any suit, action or proceeding.

20. Contractor Guaranties.

Contractor shall:

- (a) Perform fully under the Contract, including but not limited to Section 63 and any and all Exhibits hereto;
- (b) Guarantee the Work against defective material or workmanship and to repair any damage or marring occasioned in transit or, at the Owner's reasonable option, replace them;
- (c) Furnish adequate protection from damage for all work and to repair damage of any kind, for which its workers are responsible, to the premises, Equipment, the Contractor's work or that of Contractor Parties;
- (d) With respect to the provision of Services, pay for all permits, licenses and fees and give all required or appropriate notices; and
- (e) Adhere to all Contractual provisions ensuring the confidentiality of Records that the Contractor has access to and are exempt from disclosure under the State's Freedom of Information Act or other applicable law.
- 21. <u>Implied Warranties</u>. The implied warranty of fitness for a particular purpose and the warranty of merchantability are not disclaimed, excluded or modified for any of the Equipment.
- 22. Equipment, Standards, and Appurtenances. Any Equipment delivered must be standard new Equipment, latest model, except as otherwise specifically stated in the SOW. Remanufactured, refurbished or reconditioned equipment may be accepted but only to the extent allowed under the SOW. Where the SOW does not specifically list or describe any part or nominal appurtenances of equipment for the Equipment, it shall be understood that the Contractor shall deliver such parts and appurtenances as are usually provided with the manufacturer's stock model.

23. Delivery.

- (a) Delivery shall be made as ordered and in accordance with the provisions of the applicable Exhibits. Unless otherwise specified in the provisions of Exhibit A, delivery shall be to a loading dock or receiving platform. The Contractor or Contractor's shipping designee shall be responsible for removal of Equipment from the carrier and placement on the Owner loading dock or receiving platform. The receiving personnel of the Owner are not required to assist in this process. The decision of Owner as to reasonable compliance with delivery terms shall be final and binding. The burden of proof of proper receipt of the order shall rest with the Contractor.
- (b) In order for the time of delivery to be extended, the Owner must first approve a request for extension from the time specified in the Contract, such extension applying only to the particular item or shipment.
- (c) Equipment shall be securely and properly packed for shipment, according to accepted standard commercial practice, without extra charge for packing cases, baling or sacks. The containers shall remain the property of the Owner unless otherwise stated in QESP's proposal.
- (d) All risk of loss and damage to the Equipment transfers to the Owner upon Title vesting in the Owner.
- 24. Equipment Inspection. The Owner shall determine the manner and prescribe the inspection of all Equipment and the tests of all samples submitted to determine whether they comply with all of the specifications in the Contract. If any equipment fails in any way to meet the specifications in the Contract, the Owner may, in its sole discretion, either reject it and owe nothing or accept it and pay for it on an adjusted price basis, depending on the degree to which the Equipment meets the specifications. Any decision pertaining to any such failure or rejection shall be final and binding.
- 25. Setoff. In addition to all other remedies that the Owner may have, the Owner, in its sole discretion, may setoff any costs or expenses that the Owner incurs resulting from the Contractor's unexcused non-Performance under the Contract and under any other agreement or arrangement that the Contractor has with the Owner, and (2) any other amounts that are due or may become due from the Owner to the Contractor, against amounts otherwise due or that may become due to the Contractor under the Contract, or under any other agreement or arrangement that the Contractor has with the Owner. The Owner's right of setoff shall not be deemed to be the Owner's exclusive remedy for the Contractor's or Contractor Parties' breach of the Contract, all of which shall survive any setoffs by the Owner.
- 26. <u>Force Majeure.</u> The Owner and the Contractor shall not be excused from their obligation to Perform in accordance with the Contract except in the case of Force Majeure events and as otherwise provided for in the Contract. In the case of any such exception, the nonperforming party shall give immediate written notice to the other, explaining the cause and probable duration of any such nonperformance. Contractor shall be entitled to an extension of the time for Substantial and Final Completion in the case of an event of Force Majeure.
- 27. <u>Advertising.</u> The Contractor shall not refer to the City or any State Agency for advertising or promotional purposes, including, but not limited to, posting any material or data on the Internet, without Owner's prior written approval.

- 28. Americans With Disabilities Act. The Contractor shall be and remain in compliance with the Americans with Disabilities Act of 1990 ("ADA Act"), to the extent applicable, during the term of the Contract. Owner may Terminate the Contract if the Contractor fails to comply with the ADA Act.
- 29. Representations and Warranties. The **Exhibit A** may include additional representations and warranties that are in addition to, and do not modify or abrogate, the ones in this Representation and Warranties Section. The Contractor represents and warrants to Owner for itself and Contractor Parties, as appropriate, that:
 - (a) if they are entities, they are duly and validly existing under the laws of their respective states of organization and authorized to conduct business in the State of Connecticut in the manner contemplated by the Contract. Further, as appropriate, they have taken all necessary action to authorize the execution, delivery and Performance and the Contract and have the power and authority to execute, deliver and Perform their obligations under the Contract;
 - (b) they will comply with all applicable State and Federal laws and municipal ordinances in satisfying their obligations to the Owner under and pursuant to the Contract;
 - (c) the execution, delivery and Performance of the Contract will not violate, be in conflict with, result in a breach of or constitute (with or without due notice and/or lapse of time) a default under any of the following, as applicable: (1) any provision of law; (2) any order of any court or the State; or (3) any indenture, agreement, document or other instrument to which it is a party or by which it may be bound;
 - (d) they are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from entering into a contract with any governmental entity:
 - (e) as applicable, they have not, within the three years preceding the Contract, in any of their current or former jobs, been convicted of, or had a civil judgment rendered against them or against any person who would Perform under the Contract, for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a transaction or contract with any governmental entity. This includes, but is not limited to, violation of Federal or state antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
 - (f) they are not presently indicted for or otherwise criminally or civilly charged by any governmental entity with commission of any of the offenses listed above;
 - (g) they have not within the three years preceding the Contract had one or more contracts with any governmental entity terminated;
 - (h) they have not employed or retained any entity or person, other than a bona fide employee working solely for them, to solicit or secure the Contract and that they have not paid or agreed to pay any entity or person, other than a bona fide employee working solely for them, any fee, commission, percentage, brokerage fee, gifts, or any other consideration contingent upon or resulting from the award or making of the Contract or any assignments made in accordance with the terms of the Contract;

- (i) to the best of their knowledge, there are no Claims involving the Contractor or Contractor Parties that might reasonably be expected to materially adversely affect their businesses, operations, assets, properties, financial stability, business prospects or ability to Perform fully under the Contract;
- (j) they shall disclose, to the best of their knowledge, to the Owner in writing any Claims involving them that might reasonably be expected to materially adversely affect their businesses, operations, assets, properties, financial stability, business prospects or ability to Perform fully under the Contract, no later than ten (10) Days after becoming aware or after they should have become aware of any such Claims. For purposes of the Contractor's obligation to disclose any Claims, the ten (10) Days in the Disclosure of Contractor Parties Litigation Section of this Contract shall run consecutively with the ten (10) Days provided for in this representation and warranty;
- (k) their participation in the Solicitation process is not a conflict of interest or a breach of ethics under the provisions of the Ethics and Conflict of Interest provisions set forth in Chapter 39 of the City of Waterbury Code of Ordinances.
- (1) the proposal in response to the Solicitation was not made in connection or concert with any other person, entity or proposer, including any affiliate (as the term "Affiliate" is defined in the Tangible Personal Property Section of this Contract) of the QESP, submitting a proposal for the same Work, and is in all respects fair and without collusion or fraud;
- (m) they are able to Perform under the Contract using their own resources;
- (n) the Contractor shall obtain in a written contract all of the representations and warranties in this Section from any Contractor Parties and to require that provision to be included in any contracts and purchase orders with Contractor Parties;
- (o) they have paid all applicable workers' compensation second injury fund assessments concerning all previous work done in Connecticut;
- (p) they have a record of compliance with Occupational Health and Safety Administration regulations without any unabated, willful or serious violations;
- (q) they owe no unemployment compensation contributions;
- (r) they are not delinquent in the payment of any taxes owed, or, that they have filed a sales tax security bond, and they have, if and as applicable, filed for motor carrier road tax stickers and have paid all outstanding road taxes;
- (s) all of their vehicles have current registrations and, unless such vehicles are permanently removed from service, they shall not allow any such registrations to lapse;
- (t) each Contractor Party has vested in the Contractor plenary authority to bind the Contractor Parties to the full extent necessary or appropriate to ensure full compliance with and Performance in accordance with all of the terms and conditions of the Contract and that all appropriate parties shall also provide to Owner, no later than fifteen (15) days after receiving a request from Owner, such information as Owner may require to evidence, in Owner's sole determination, compliance with this Section;

- (u) except to the extent set forth in **Exhibit A**, all Title shall pass to the Owner upon complete installation, testing and acceptance of the Work and payment by the Owner;
- (v) if either party Terminates the Contract, for any reason, they shall relinquish to the Owner all Title to the Equipment delivered, accepted and paid for (except to the extent any invoiced amount is disputed) by the Owner;
- (w) with regard to third party products provided with the Equipment, they shall transfer all licenses which they are permitted to transfer in accordance with the applicable third party license;
- (x) they shall not copyright, register, distribute or claim any rights in or to the Equipment after the effective date of the Contract without Owner's prior written consent;
- (y) they either own or have the authority to use all Title of and to the Equipment, and that such Title is not the subject of any encumbrances, liens or claims of ownership by any third party;
- (z) the Equipment does not infringe or misappropriate any patent, trade secret or other intellectual property right of a third party;
- (aa) the Owner's use of any Equipment shall not infringe or misappropriate any patent, trade secret or other intellectual property right of a third party;
- (bb) if they procure any Equipment, they shall sub-license such Equipment and that the Owner shall be afforded the full benefits of any manufacturer or subcontractor licenses for the use of the Equipment;
- (cc) they shall assign or otherwise transfer to the Owner, or afford the Owner the full benefits of any manufacturer's warranty for the Equipment, to the extent that such warranties are assignable or otherwise transferable to the Owner; and
- (dd) at all times during the term of the Contract, including especially the term of the SOW, QESP shall maintain employed staff who is licensed by the State of Connecticut as Professional Engineers in mechanical and electrical engineering.
- 30. Representations and Warranties Concerning Motor Vehicles. If in the course of Performance or in any other way related to the Contract the Contractor at any time uses or operates "motor vehicles," as that term is defined by Conn. Gen. Stat. §14-1(53) (including, but not limited to such services as snow plowing, sanding, hauling or delivery of materials, freight or merchandise, or the transportation of passengers), the Contractor, represents and warrants for itself and the Contractor Parties, as appropriate, that:
 - (a) It is the owner of record or lessee of record of each such motor vehicle used in the Performance of the Contract, and each such motor vehicle is duly registered with the Connecticut Owner of Motor Vehicles ("ConnDMV") in accordance with the provisions of Chapter 246 of the Connecticut General Statutes. Each such registration shall be in valid status, and shall not be expired, suspended or revoked by ConnDMV, for any reason or cause. If such motor vehicle is not registered with ConnDMV, then it shall be duly registered with another state or commonwealth in accordance with such other state's or commonwealth's applicable statutes. Each such registration shall be in valid status, and shall not be expired, suspended or revoked by such other state or commonwealth for any reason or cause.

- (b) Each such motor vehicle shall be fully insured in accordance with the provisions of Sections 14-12b, 14-112 and 38a-371 of the Connecticut General Statutes, as amended, in the amounts required by the said sections or in such higher amounts as have been specified by the Owner as a condition for the award of the Contract, or in accordance with all substantially similar provisions imposed by the law of the jurisdiction where the motor vehicle is registered.
- (c) Each Contractor Party who uses or operates a motor vehicle at any time in the Performance of the Contract shall have and maintain a motor vehicle operator's license or commercial driver's license of the appropriate class for the motor vehicle being used or operated. Each such license shall bear the endorsement or endorsements required by the provisions of Section 14-36a of the Connecticut General Statutes, as amended, to operate such motor vehicle, or required by substantially similar provisions imposed by the law of another jurisdiction in which the operator is licensed to operate such motor vehicle. The license shall be in valid status, and shall not be expired, suspended or revoked by ConnDMV or such other jurisdiction for any reason or cause.
- (d) Each motor vehicle shall be in full compliance with all of the terms and conditions of all provisions of the Connecticut General Statutes and regulations, or those of the jurisdiction where the motor vehicle is registered, pertaining to the mechanical condition, equipment, marking and operation of motor vehicles of such type, class and weight, including, but not limited to, requirements for motor vehicles having a gross vehicle weight rating of 18,000 pounds or more or motor vehicles otherwise described by the provisions of Conn. Gen. Stat. § 14-163c(a) and all applicable provisions of the Federal Motor Carrier Safety Regulations, as set forth in Title 49, Parts 382 to 399, inclusive, of the Code of Federal Regulations.
- 31. <u>Disclosure of Contractor Parties Litigation</u>. The Contractor shall require that all Contractor Parties, as appropriate, disclose to the Contractor, to the best of their knowledge, any Claims involving the Contractor Parties that might reasonably be expected to materially adversely affect their businesses, operations, assets, properties, financial stability, business prospects or ability to Perform fully under the Contract, no later than ten (10) Days after becoming aware or after they should have become aware of any such Claims. Disclosure shall be in writing.
- 32. Entirety of Contract. The Contract is the entire agreement between the parties with respect to its subject matter, and supersedes all prior agreements, proposals, offers, counteroffers and understandings of the parties, whether written or oral. The Contract has been entered into after full investigation, neither party relying upon any statement or representation by the other unless such statement or representation is specifically embodied in the Contract.

33. Exhibits.

All exhibits referred to herein and attached hereto this Contract are incorporated into this Contract and made a part hereof by such reference. Said Exhibits are:

Exhibit A: Energy-Savings Performance Project Statement of Work Including the following Schedules attached thereto:

Attachment 1: Schedules

Schedule A: Energy Savings Guarantee

Schedule B: Baseline Energy Consumption

Schedule C: Measurement & Verification Plan

Schedule D: Warranties
Schedule E: Not Used
Schedule F: Not Used
Schedule G: Not Used

Schedule H: Final Project Cost & Project Cash Flow Analysis

Schedule I: Payment Schedule

Schedule J: Compensation to QESP for Annual Services

Schedule K: Rebates, Incentives, and Grants

Schedule L: Not Used
Schedule M: Not Used
Schedule N: Not Used
Schedule O: Not Used
Schedule P: Not Used

Schedule Q: Description of Project Sites

Schedule R: Equipment to Be Installed by QESP
Schedule S: Construction and Installation Schedule
Schedule T: Systems Start-Up and Commissioning

Schedule U: Standards of Comfort

Schedule V: QESP's Training Responsibilities

Schedule W: Not Used
Schedule X: Not Used
Schedule Y: Not Used
Schedule X: Not Used
Schedule AA: Not Used

Schedule BB: QESP's Maintenance Responsibilities
Schedule CC: City's Maintenance Responsibilities
Schedule DD: Facility Maintenance Checklist

Schedule EE: Certificate of Final Acceptance of all ESMs/Final Completion
Schedule FF: Certificate of Substantial Completion of all ESMs/Substantial

Completion

Schedule GG: Notice of Substantial Completion of ESM

Schedule HH: Not Used Schedule II: Not Used

Exhibit B: Investment-Grade Energy Audit & Project Development Proposal

Including the following Appendices attached thereto:

Appendix 1: Calculations Appendix 2: 35% Drawings Appendix 3: Cutsheets Appendix 4: Audit Data

Some of said Exhibits, including Schedules and Appendices thereto, attached to this Contract are blank forms or templates. When said Exhibits, including Schedules and Appendices thereto, are completed, they too are deemed part of this Contract.

- 34. Executive Orders. This Contract is subject to the provisions of Executive Order No. Three of Governor Thomas J. Meskill, promulgated June 16, 1971, concerning labor employment practices, Executive Order No. Seventeen of Governor Thomas J. Meskill, promulgated February 15, 1973, concerning the listing of employment openings and Executive Order No. Sixteen of Governor John G. Rowland promulgated August 4, 1999, concerning violence in the workplace, all of which are incorporated into and are made a part of the Contract as if they had been fully set forth in it. The Contract may also be subject to Executive Order No. 7C of Governor M. Jodi Rell, promulgated July, 13, 2006, concerning contracting reforms and Executive Order No. 14 of Governor M. Jodi Rell, promulgated April 17, 2006, concerning procurement of cleaning products and services, in accordance with their respective terms and conditions. If Executive Orders 7C and 14 are applicable, they are deemed to be incorporated into and are made a part of the Contract as if they had been fully set forth in it. At the Contractor's request, the Owner shall provide a copy of these orders to the Contractor.
- 35. Not Used.
- 36. Not Used.
- 37. Whistleblowing. This Contract may be subject to the provisions of Section 4-61dd of the Connecticut General Statutes. In accordance with this statute, if an officer, employee or appointing authority of the Contractor takes or threatens to take any personnel action against any employee of the Contractor in retaliation for such employee's disclosure of information to any employee of the contracting state or quasi-public agency or the Auditors of Public Accounts or the Attorney General under the provisions of subsection (a) of such statute, the Contractor shall be liable for a civil penalty of not more than five thousand dollars for each offense, up to a maximum of twenty per cent of the value of this Contract. Each violation shall be a separate and distinct offense and in the case of a continuing violation, each calendar day's continuance of the violation shall be deemed to be a separate and distinct offense. The State may request that the Attorney General bring a civil action in the Superior Court for the Judicial District of Hartford to seek imposition and recovery of such civil penalty. In accordance with subsection (f) of such statute, each large state contractor, as defined in the statute, shall post a notice of the provisions of the statute relating to large state contractors in a conspicuous place which is readily available for viewing by the employees of the Contractor.
- 38. Notice. All notices, demands, requests, consents, approvals or other communications required or permitted to be given or which are given with respect to this Contract (for the purpose of this Section collectively called "Notices") shall be deemed to have been effected at such time as the notice is placed in the U.S. mail, first class and postage pre-paid, return receipt requested or placed with a recognized, overnight express delivery service that provides for a return receipt.

As to Contractor: NORESCO, LLC:

One Research Drive

Suite 400C

Westborough, MA 01581

Attention:

David G. Mannherz Executive Vice President

As to City: Mayor

City of Waterbury City Hall Building 235 Grand Street Waterbury, CT 06702

With a copy to:

Corporation Counsel City of Waterbury City Hall Building 235 Grand Street, 3rd Floor Waterbury, CT 06702

and:

Director of Finance City Hall Building 235 Grand Street Waterbury, CT 06702

39. Insurance.

- (a) The Contractor shall not commence work under this Contract until all insurance required under this Section 39 has been obtained by the Contractor and such insurance has been approved by the City. The Contractor shall not allow any subcontractor to commence work on any subcontract until all insurance required of any such subcontractor has been so obtained and approved by the City. Insurance shall be provided by insurers, satisfactory to the City and authorized to do business in the State of Connecticut, an "A-" Best's Rating and at least a Class V3 or better financial size category as shown in the most current A.M. Best Company ratings.
- (b) At no additional cost to the City, the Contractor shall purchase and maintain the insurance coverages set forth below which shall protect the City from claims which may arise out of or result from the Contractor's obligation under this Contract, whether such obligations are the Contractor's or subcontractor or person or entity directly or indirectly employed by said Contractor or subcontractor, or by any person or entity for whose acts said Contractor or subcontractor may be liable.
- (c) Each insurance policy shall state that the insurance company shall agree to investigate and defend the insured against all claims for damages, even if groundless. If any insurance required herein is to be issued or renewed on a claims made form as opposed to an occurrence form, the retroactive date for coverage shall be no later than the commencement date of this Contract and shall provide that in the event of cancellation or non-renewal, the discovery period for insurance claims ("Tail Coverage") shall be available for at least 36 months.
- (d) The following policies with stated limits shall be maintained, in full force and effect, at all times during which the services are to be performed by the Contractor:
- (e) General Liability Insurance: \$1,000,000.00 per Occurrence, \$2,000,000.00 General Aggregate and \$2,000,000.00 Products and Completed Operations Aggregate Providing coverage to protect the City for all damages arising out of bodily injuries, sickness to or death of all persons in any one accident or occurrence and for all damages arising out of destruction of property in any one accident or occurrence.
- (f) Automobile Liability Insurance: \$1,000,000.00 Combined Single Limit each accident (CSL)

Providing coverage to protect the City with respect to claims for damage for bodily injury and or property damage arising out of ownership, maintenance, operation, use or loading and unloading of any auto including hired & non-owned autos.

(g) Workers' Compensation: Statutory Limits within the State of Connecticut: Employers' Liability:

EL Each Accident \$500,000.00

EL Disease Each Employee \$500,000.00

EL Disease Policy Limit \$500,000.00

Contractor shall comply with all State of Connecticut statutes as it relates to workers' compensation.

- (h) Excess/Umbrella Liability Insurance: Excess or Umbrella insurance coverage that follows form or sits over General Liability, Automobile Liability and Workers Compensation insurances. \$5,000,000.00 each Occurrence and \$5,000,000.00 Aggregate.
- (i) Builder's Risk Insurance: coverage equaling \$27,415,059.00, the monetary value of the construction component of the Project.

"All Risk" Builders Risk insurance (also known as "course of construction") coverage with limits equal to or better than the maximum possible loss of all materials of construction used or contemplated under this Contract, including all materials in transit and all materials in storage wherever stored and the value of any and all subsequent Contract changes. This insurance shall include the interests of the City, the Contractor and any and all subcontractors. If deemed necessary by the City's Risk Manager, this insurance shall also include coverage for the total value of the Project's constructed property and shall be valid until a certificate of occupancy is issued. Upon the issuance of said certificate, the City will assume responsibility for insuring said property.

(j) Contractors Pollution Liability Insurance: \$1,000,000.00 each Claim, \$2,000,000.00 Aggregate

Policy shall contain no exclusion for hazardous materials, including Lead and Asbestos. Pollution Liability Insurance shall be in the amounts stated and shall be provided by NORESCO's hazardous materials abatement subcontractor(s). Such insurance shall name the City and NORESCO as additional insureds. NORESCO shall provide the City evidence of the requisite insurance prior to commencing any hazardous abatement work on the project.

- (k) Failure to Maintain Insurance: In the event the Contractor fails to maintain the minimum required coverage as set forth herein, the City may at its option purchase same, and offset the Contractor's invoices for the cost of said insurance.
- (1) Cancellation: The City of Waterbury shall receive written notice of cancellation from the Contractor at least thirty (30) calendar days prior to the date of actual cancellation, regardless of the reason for such cancellation.
- (m) Certificates of Insurance: All of Contractor's above required policies, except Workers
 Compensation and Professional Liability, shall be endorsed to add the City as an Additional
 Insured on a primary and non-contributory basis. All policies shall include a Waiver of
 Subrogation and be written on an Occurrence basis, with the exception of Professional Liability
 insurance that shall be on a claims made basis. The insurance afforded the additional insured shall
 be primary and non-contributory insurance and the coverage and limits provided under the

Contractor's policies shall not be reduced or prorated by the existence of any other insurance applicable to any loss the additional insured may have suffered. Prior to the execution of this Contract by the City, the Contractor shall furnish to the City, subject to City approval, certificate(s) of insurance and Additional Insured Endorsement and Waiver of Subrogation Endorsement verifying the above coverages, including the naming of the City of Waterbury, as follows: "The City of Waterbury is listed as Additional Insured on all lines of coverage except Workers Compensation and Professional Liability and all policies include a Waiver of Subrogation and are written on an Occurrence basis". The City's Invitation to Bid Number must be shown on the certificate of insurance to assure correct filing. The Contractor must supply replacement/renewal certificates at least 30 days prior to the expiration of the policy(ies).

- (n) No later than thirty (30) calendar days after Contractor receipt, the Contractor shall deliver to the City a copy of the Contractor's certificates of insurance and required endorsements.
- 40. <u>Headings.</u> The headings given to the sections in the Contract are inserted only for convenience and are in no way to be construed as part of the Contract or as a limitation of the scope of the particular section to which the heading refers.
- 41. <u>Number and Gender.</u> Whenever the context so requires, the plural or singular shall include each other and the use of any gender shall include all genders.
- 42. <u>Parties.</u> To the extent that any Contractor Party is to participate or Perform in any way any projects under the Contract, any reference in the Solicitation or the Contract to "Contractor" shall also be deemed to include "Contractor Parties" as if such reference had originally specifically included "Contractor Parties" since it is the parties' intent for the term "Contractor Parties" to be vested with the same respective rights and obligations as the term "Contractor."
- 43. <u>Contractor Changes.</u> The Contractor shall notify the Owner in writing no later than ten (10) Days from the effective date of any change in:
 - a) its certificate of incorporation or other organizational document:
 - b) more than a controlling interest in the ownership of the Contractor; or
 - c) the individual(s) in charge of the Performance.

This change shall not relieve the Contractor of any responsibility for the accuracy and completeness of the Performance. The Owner, after receiving written notice by the Contractor of any such change, may require such agreements, releases and other instruments evidencing, to their satisfaction, that any individuals retiring or otherwise separating from the Contractor have been compensated in full or that provision has been made for compensation in full, for all work performed under terms of the Contract. The Contractor shall deliver such documents to the Owner in accordance with the terms of the Owner's written request. The Owner may also require, and the Contractor shall deliver, a financial statement showing that solvency of the Contractor is being maintained. The death of any Contractor Party, as applicable, shall not release the Contractor from the obligation to Perform under the Contract; the surviving Contractor Parties, as appropriate, must continue to Perform under the Contract until Performance is fully completed.

- 44. <u>Further Assurances.</u> The parties shall provide such information, execute and deliver any instruments and documents and take such other actions as may be necessary or reasonably requested by the other party which are not inconsistent with the provisions of this Contract and which do not involve the vesting of rights or assumption of obligations other than those provided for in the Contract, in order to give full effect to the Contract and to carry out the intent of the Contract.
- 45. Audit and Inspection of Plants, Places of Business, and Records.
 - (a) The Owner and its agents may, at reasonable hours, inspect and examine all of the parts of the Contractor's and Contractor Parties' plants and places of business which, in any way, are related to, or involved in, the performance of this Contract.
 - (b) The Contractor shall maintain, and shall require each of the Contractor Parties to maintain, accurate and complete Records. The Contractor shall make all of its and the Contractor Parties' Records available at all reasonable hours for audit and inspection by the Owner and its agents.
 - (c) The Owner shall make all requests for any audit or inspection in writing and shall provide the Contractor with at least seventy-two (72) hours' notice prior to the requested audit and inspection date. If the Owner suspects fraud or other abuse, or in the event of an emergency, the Owner is not obligated to provide any prior notice.
 - (d) All audits and inspections shall be at the Contractor's expense.
 - (e) The Contractor shall keep and preserve or cause to be kept and preserved all of its and Contractor Parties' Records until three (3) years after the latter of (i) final payment under this Contract, or (ii) the earlier termination of this Contract, as the same may be modified for any reason. The Owner may, request an audit or inspection at any time during this period. If any Claim or audit is started before the expiration of this period, the Contractor shall retain or cause to be retained all Records until all Claims or audit findings have been resolved.
 - (f) The Contractor shall cooperate fully with the Owner and its agents in connection with an audit or inspection. Following any audit or inspection, the Owner may conduct and the Contractor shall cooperate with an exit conference.
 - (g) The Contractor shall incorporate this entire Section verbatim into any contract or other agreement that it enters into with any Contractor Party.
- 46. <u>Background Checks.</u> The Owner may require that the Contractor and Contractor Parties undergo criminal background checks as provided for in the State of Connecticut Owner of Emergency Services and Public Protection Administration and Operations Manual or such other City or State document as governs procedures for background checks. The Contractor and Contractor Parties shall cooperate fully as necessary or reasonably requested with the Owner and its agents in connection with such background checks.
- 47. <u>Continued Performance.</u> The Contractor and Contractor Parties shall continue to perform their obligations under the Contract while any dispute concerning the Contract is being resolved.
- 48. <u>Working and Labor Synergies.</u> The Contractor shall be responsible for maintaining a tranquil working relationship between and among the Contractor work force, the Contractor Parties and their work force, Owner employees, and any other parties present at the work site. The Contractor shall quickly

resolve all labor disputes which result from the Contractor's or Contractor Parties' presence at the work site, or other action under their control. Labor disputes, except to the extent they constitute a Force Majeure, shall not be deemed to be sufficient cause to allow the Contractor to make any claim for additional compensation for cost, expenses or any other loss or damage, nor shall those disputes be deemed to be sufficient reason to relieve the Contractor from any of its obligations under the Contract.

49. <u>Contractor Responsibility.</u>

- (a) The Contractor shall be responsible for the entire Performance under the Contract regardless of whether the Contractor itself performs. The Contractor shall be the sole point of contact concerning the management of the Contract, including Performance and payment issues. The Contractor is solely and completely responsible for adherence by the Contractor Parties to all applicable provisions of the Contract. Notwithstanding any provisions in the Contract, the Exhibits or any subcontract, nothing shall be interpreted as establishing privity of contract between the Owner and any subcontractor.
- (b) The Contractor shall exercise all reasonable care to avoid damage to the Owner's property or to property being made ready for the Owner's use, and to all property adjacent to any work site. The Contractor shall promptly report any damage, regardless of cause, to the Owner.
- 50. <u>Severability.</u> If any term or provision of the Contract or its application to any person, entity or circumstance shall, to any extent, be held to be invalid or unenforceable, the remainder of the Contract or the application of such term or provision shall not be affected as to persons, entities or circumstances other than those as to whom or to which it is held to be invalid or unenforceable. Each remaining term and provision of the Contract shall be valid and enforced to the fullest extent possible by law.
- 51. Confidentiality of Contractor Information. The Owner will afford due regard to the Contractor's request for the protection of proprietary or confidential information which the Owner receives. However, all materials associated with any Contractor submittal to a Owner or the Contract are subject to the terms of the Connecticut Freedom of Information Act ("FOIA") and all corresponding rules, regulations and interpretations. In making such a request for protection, the Contractor may not merely state generally that the materials are proprietary or confidential in nature and not, therefore, subject to release to third parties. Those particular sentences, paragraphs, pages or sections that the Contractor believes are exempt from disclosure under the FOIA must be specifically identified as such. Convincing explanation and rationale sufficient to justify each exemption consistent with the FOIA must accompany the request. The rationale and explanation must be stated in terms of the prospective harm to the competitive position of the Contractor that would result if the identified material were to be released and the reasons why the materials are legally exempt from release pursuant to the FOIA. To the extent that any other provision or part of the Contract, especially including the Exhibits, and the Records, conflicts or is in any way inconsistent with this Section, this Section controls and shall apply and the conflicting provision or part shall not be given effect. If the Contractor indicates that certain documentation is submitted in confidence, by specifically and clearly marking said documentation as CONFIDENTIAL, the Owner will endeavor to keep said information confidential to the extent permitted by law. The Owner, however, has no obligation to initiate, prosecute or defend any legal proceeding or to seek a protective order or other similar relief to prevent disclosure of any information that is sought pursuant to a FOIA request. The Contractor shall have the burden of establishing the availability of any FOIA exemption in any proceeding where it is an issue. In no event shall a Owner have any liability for, the disclosure of any documents or information in its possession which the Owner believes are required to be disclosed pursuant to the FOIA or other requirements of law.

52. <u>Interpretation.</u> The Contract contains numerous references to statutes, ordinances and regulations. For all purposes, the content of those statutes and regulations shall govern over the content of the reference in the Contract to those statutes and regulations.

53. Cross-Default.

- (a) If the Contractor or Contractor Parties breach, default or in any way fail to Perform satisfactorily under the Contract, then Owner may, in its sole discretion, without more and without any action whatsoever required of an Owner, treat any such event as a breach, default or failure to Perform under any or all other agreements or arrangements ("Other Agreements") that the Contractor and Contractor Parties may have with the Owner. Accordingly, Owner may then exercise at its sole option any and all of its rights or remedies provided for in the Contract or Other Agreements, either selectively or collectively and without such election being deemed to prejudice any rights or remedies of Owner, as if the Contractor or Contractor Parties had suffered a breach, default or failure to Perform under the Other Agreements.
- (b) If the Contractor or Contractor Parties breach, default or in any way fail to Perform satisfactorily under any or all Other Agreements, then Owner may, in its sole discretion, without more and without any other action whatsoever being required, treat any such event as a breach, default or failure to Perform under the Contract. Accordingly, Owner may then exercise at its sole option any and all of rights or remedies provided for in the Other Agreements or the Contract, either selectively or collectively and without such election being deemed to prejudice any rights or remedies of an Owner or the State, as if the Contractor or Contractor Parties had suffered a breach, default or failure to Perform under the Contract.
- Disclosure of Records. This Contract may be subject to the provisions of section 1-218 of the Connecticut General Statutes. In accordance with this statute, each contract in excess of two million five hundred thousand dollars between a public agency and a person for the performance of a governmental function shall (a) provide that the public agency is entitled to receive a copy of records and files related to the performance of the governmental function, and (b) indicate that such records and files are subject to FOIA and may be disclosed by the public agency pursuant to FOIA. No request to inspect or copy such records or files shall be valid unless the request is made to the public agency in accordance with FOIA. Any complaint by a person who is denied the right to inspect or copy such records or files shall be brought to the Freedom of Information Commission in accordance with the provisions of sections 1-20 and -206 of the Connecticut General Statutes.
- 55. <u>City Ethics Laws.</u> Chapter 39: Ethics and Conflicts of Interest of the City of Waterbury Code of Ordinances is incorporated by reference into and made a part of the Contract as if the ordinance had been fully set forth in the Contract.
- Sovereign Immunity. The parties acknowledge and agree that nothing in the Solicitation or the Contract shall be construed as a modification, compromise or waiver by the State or City of any rights or defenses of any immunities provided by Federal law or the laws of the State of Connecticut to the Owner or any of its officers and employees, which they may have had, now have or will have with respect to all matters arising out of the Contract. To the extent that this Section conflicts with any other Section, this Section shall govern.
- 57. <u>Time of the Essence.</u> Time is of the essence with respect to all provisions of this Contract that specify a time for Performance; provided, however, that this provision shall not be construed to limit or deprive a party of the benefits of any grace or use period allowed in this Contract. See also paragraph 2.

58, <u>Prevailing Wages.</u> Some or all of the Performance in the **Exhibit A** may be subject to prevailing wages. Accordingly, the following provision is included in this Contract in accordance with the requirements of Conn. Gen. Stat. Sec. 31-53(a):

The wages paid on an hourly basis to any person performing the work of any mechanic, laborer or worker on the work herein contracted to be done and the amount of payment or contribution paid or payable on behalf of each such person to any; employee welfare fund, as defined in subsection (i) of this section, shall be at a rate equal to the rate customary or prevailing for the same work in the same trade or occupation in the town in which such public works project is being constructed. Any contractor who is not obligated by agreement to make payment or contribution on behalf of such persons to any such employee welfare fund shall pay to each mechanic, laborer or worker as part of such person's wages the amount of payment or contribution for such person's classification on each pay day.

Without modifying the foregoing, or affecting QESP's obligation to pay prevailing wages, if QESP is unable to secure the prevailing wage rates from the Connecticut Owner of Labor, then the Owner shall do and perform all that is necessary to do the same and forward the rates to the OESP.

- 59. Not Used.
- 60. Not Used.
- 61. Not Used.
- 62. Governmental Enactments. All references in this Contract to any ordinance, statute, public act, regulation, code or executive order shall mean such ordinance, statute, public act, regulation, code or executive order, respectively, as it has been amended, replaced or superseded at any time through substantial completion of all ESMs. Notwithstanding any language in this Contract that relates to such ordinance, statute, public act, regulation, code or executive order, and notwithstanding a lack of a formal amendment to this Contract, this Contract shall always, through substantial completion of all ESMs, be read and interpreted as if it contained the most current and applicable wording and requirements of such ordinance, statute, public act, regulation, code or executive order as if their most current language had been used in and requirements incorporated into this Contract at the time of its execution.

In the event a change in any City ordinance (or other local law of the City, other than a local change to comply with a federal or state law or regulation) increases NORESCO's cost or time for performance NORESCO shall be entitled to an equitable adjustment to its Compensation or time for completion or both.

63. Required City of Waterbury Provisions.

- (a) **Permits, Laws, Taxes and Regulations.** Permits and licenses necessary for the delivery and completion of the Contractor's work and services shall be secured in advance and paid for by the Contractor. The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the Work and Services as specified.
- (b) **Working Hours.** To the extent the Contractor is required to be on City property to render its Services hereunder, the Contractor shall coordinate its schedule so that Work on the Premises is performed during those hours the City sets forth in a written notice to the Contractor, unless

written permission is obtained from the City to work during other times. This condition shall not excuse Contractor from timely performance under the Contract. The work schedule must be agreed upon by the City and the Contractor.

- (c) Contractor Staff. For the duration of this Contract, Mark Tantillo, shall be Contractor's on-site Project Manager for this Contract. If there is a need to replace said Project Manager, Contractor shall give the City thirty (30) calendar days prior written notice, a temporary replacement shall be immediately provided by Contractor, and a permanent replacement shall be retained in a time period acceptable to the City and subject to the City's prior written approval.
- (d) **Energy Savings Guarantee.** Contractor shall, subject to the following sentence, guarantee to the City annual unit energy savings for the Guarantee Term as follows:

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The Energy Savings Guarantee is further detailed in Exhibit A (SOW), Schedule A (Energy Savings Guarantee), and the savings will be measured and verified in accordance with Exhibit A, Schedules B and C.

- (e) **Compensation.** The City shall compensate the Contractor for satisfactory provision of all of the Work and Services set forth in this Contract as follows:
 - (i) No claims for additional compensation will be considered for conditions made known to the Contractor prior to bidding. No claims for additional compensation will be considered on account of failure of the Contractor to completely inform itself as required herein above.
 - (ii) Fee Schedule. Subject to retainage, limitations, etc. set forth below in this Section 63, the fee payable to the Contractor shall not exceed TWENTY-NINE MILLION ONE HUNDRED THIRTY-THREE THOUSAND AND SEVEN HUNDRED FORTY-ONE DOLLARS AND ZERO CENTS (\$29,133,741.00) which is comprised of the following:

SOW Sum = \$27,415,059.00 plus

Total QESP Annual Services Fee = \$1,218,682.00

Owner's Controlled Contingency = \$500,000.00 (which shall be used at the sole discretion of the City and only upon delivery to Contractor of a

written City authorization detailing the scope, necessity, and cost of the expenditures for which the contingency may be used)

All as further detailed in Exhibit A, Schedules I & J.

(iii) Retainage. At the City's sole discretion, it hereby reserves the right to withhold as retainage five (5 %) percent of any payment (or monetary sum otherwise required by

- law) owed to the Contractor to be withheld from payments to the Contractor otherwise payable to the Contractor until such time as the Contractor's work and services to be provided under this Contact are fully completed and accepted in writing by the City. The retainage does not does not include additional sums that the City may withhold due to the Contractor's failure to comply with provisions of this Contract.
- (iv) Limitation of Payment. Compensation payable to the Contractor is limited to those fees set forth in this Section 63. Such compensation shall be paid by the City upon review and approval of the Contractor's invoices for payment and review of the work, services, deliverables, etc. required in this agreement and review as may be further required by the Charter and Ordinances of the City. Contractor's invoices shall describe the work, services, reports, plans, specifications, drawings, deliverables, etc. rendered and the compensation sought therefore in a form, and with detail and clarity, acceptable to the City.
- (v) The Contractor and its affiliates are hereby provided with notice that the City reserves the right, in the City's sole discretion, to offset, withhold, or otherwise reduce City payment(s) to the Contractor, in an amount equaling the sum or sums of money the Contractor and/or its affiliates is/are, or become delinquent or in arrears on, regarding the Contractor's and/or its affiliates real and personal property taxes and other payment obligations to the City.
- (vi) In the event of a delay caused by the City that increases the cost of the Work the parties shall negotiate an equitable adjustment in the Contractor's compensation, which shall require a duly authorized written and executed Amendment to this Contract.
- (f). **Review of Work.** The Contractor shall permit the City to review, at any time, all work performed under the terms of this agreement at any stage of the work. The Contractor shall maintain or cause to be maintained all records, books or other documents relative to charges, costs, expenses, fees, alleged breaches of the agreement, settlement of claims or any other matter pertaining to the Contractor's demand for payment. The City shall not certify fees for payment to the Contractor until the City has determined that the Contractor has completed the work in accordance with the requirements of this agreement.
- (g). **Qualifications Costs.** All costs of the Contractor in preparing its response for RFP No. 5167 shall be solely borne by the Contractor and are not included in the compensation to be paid by the City to the Contractor under this agreement or any other agreement.
- (h). Payment for Services, Materials, Employees. The Contractor shall be fully and solely responsible for the suitability, and compliance with the agreement, of all labor, services, equipment, materials, reports, plans, specifications, drawings, deliverables, incidentals, etc. furnished to the City under this agreement. The Contractor shall promptly pay all employees as their pay falls due, shall pay promptly as they fall due all bills for labor, services, equipment, materials, reports, plans, specifications, drawings, deliverables, incidentals, etc. going into the work, and all bills for insurance, bonds, Worker's Compensation coverage, Federal and State Unemployment Compensation, and Social Security charges applicable to this project. Before final payment is made, the Contractor shall furnish a legal statement to the City that all payments required under this subparagraph have been made.

(i). Liens. Neither the final payment nor any part of the retained percentage, if any, shall become due until the Contractor, if requested by the City, shall deliver to the City a complete release of all liens arising out of this agreement, or receipts in full in lieu thereof, and, if required, in either case, an affidavit that so far as the Contractor has knowledge or information, the releases and receipts include all the labor and material for which a lien could be filed; but the Contractor may, if any subcontractor refuses to furnish a release or receipt in full, furnish a bond satisfactory to the City, to indemnify it against any lien. If any lien remains unsatisfied after all payments are made, the Contractor shall refund to the City all moneys that the City may be compelled to pay in discharging such a lien, including all costs and a reasonable attorney's fee.

(j). 13.3. Affirmative Action.

13.3.1. Pursuant to CONN. GEN. STAT. § 4a-60, as amended by June 2015 Special Session Public Act 15-5:

- (a) Every contract to which an awarding agency is a party, every quasi-public agency project contract and every municipal public works contract shall contain the following provisions:
 - (1) The contractor agrees and warrants that in the performance of the contract such contractor will not discriminate or permit discrimination against any person or group of persons on the grounds of race, color, religious creed, age, marital status, national origin, ancestry, sex, gender identity or expression, intellectual disability, mental disability or physical disability, including, but not limited to, blindness, unless it is shown by such contractor that such disability prevents performance of the work involved, in any manner prohibited by the laws of the United States or of the state of Connecticut; and the contractor further agrees to take affirmative action to insure that applicants with jobrelated qualifications are employed and that employees are treated when employed without regard to their race, color, religious creed, age, marital status, national origin, ancestry, sex, gender identity or expression, intellectual disability, mental disability or physical disability, including, but not limited to, blindness, unless it is shown by such contractor that such disability prevents performance of the work involved;
 - (2) The contractor agrees, in all solicitations or advertisements for employees placed by or on behalf of the contractor, to state that it is an "affirmative action-equal opportunity employer" in accordance with regulations adopted by the Commission on Human Rights and Opportunities;
 - (3) The contractor agrees to provide each labor union or representative of workers with which such contractor has a collective bargaining agreement or other contract or understanding and each vendor with which such contractor has a contract or understanding, a notice to be provided by the Commission on Human Rights and Opportunities advising the labor union or workers' representative of the contractor's commitments under this section, and to post copies of the notice in conspicuous places available to employees and applicants for employment;
 - (4) The contractor agrees to comply with each provision of this section and sections 46a-68e and 46a-68f and with each regulation or relevant order issued by said commission pursuant to sections 46a-56, as amended by this act, 46a-68e, 46a-68f and 46a-86; and

- (5) The contractor agrees to provide the Commission on Human Rights and Opportunities with such information requested by the commission, and permit access to pertinent books, records and accounts, concerning the employment practices and procedures of the contractor as relate to the provisions of this section and section 46a-56, as amended by this act.
- (b) If the contract is a public works contract, municipal public works contract or contract for a quasi-public agency project, the contractor agrees and warrants that he or she will make good faith efforts to employ minority business enterprises as subcontractors and suppliers of materials on such public works or quasi-public agency project.

13.3.2. Pursuant to CONN. GEN. STAT. § 4a-60a, as amended by June 2015 Special Session Public Act 15-5:

- (a) Every contract to which an awarding agency is a party, every contract for a quasipublic agency project and every municipal public works contract shall contain the following provisions:
 - (1) The contractor agrees and warrants that in the performance of the contract such contractor will not discriminate or permit discrimination against any person or group of persons on the grounds of sexual orientation, in any manner prohibited by the laws of the United States or of the state of Connecticut, and that employees are treated when employed without regard to their sexual orientation;
 - (2) The contractor agrees to provide each labor union or representative of workers with which such contractor has a collective bargaining agreement or other contract or understanding and each vendor with which such contractor has a contract or understanding, a notice to be provided by the Commission on Human Rights and Opportunities advising the labor union or workers' representative of the contractor's commitments under this section, and to post copies of the notice in conspicuous places available to employees and applicants for employment:
 - (3) The contractor agrees to comply with each provision of this section and with each regulation or relevant order issued by said commission pursuant to section 46a-56; and
 - (4) The contractor agrees to provide the Commission on Human Rights and Opportunities with such information requested by the commission, and permit access to pertinent books, records and accounts, concerning the employment practices and procedures of the contractor which relate to the provisions of this section and section 46a-56.

(k) 14.1. Conformance With An Ordinance Concerning The Hiring Of Waterbury Residents On Certain Publicly-Funded Construction Projects.

14.1.1 The Contractors and its Subcontractors shall comply with the specific requirements of "An Ordinance Concerning the Hiring of Waterbury Residents on Certain Publicly-Funded Construction Projects" (the "Good Jobs Ordinance"), as may be amended from time to time and as set forth in Chapter 34 of the Code of Ordinances of the City. While the principal provisions of the ordinance are summarized as set forth in

paragraphs C-H below, the Contractor does hereby acknowledge that it has reviewed a copy of the Good Jobs Ordinance and that it has read the Ordinance and that Contractor is familiar with the obligations imposed on the Contractor and each Subcontractor by the Good Jobs Ordinance.

- **14.1.2** Failure of the Contractor or its Subcontractors to comply with the Good Jobs Ordinance shall be a material breach of this Agreement.
- **14.1.3** This paragraph shall apply to a Covered Project, as that term is defined in the Good Jobs Ordinance, in the City with a value of \$500,000.00 or greater and only to the extent permitted by federal and state law.
- **14.1.4 Definitions.** For purposes of this paragraph:
 - i. "Administrator" shall be defined as it is in the Good Jobs Ordinance.
 - ii. "Apprentice" shall be defined as it is in the Good Jobs Ordinance.
 - **iii.** "Basic Skilled Worker" shall be defined as it is in the Good Jobs Ordinance.
 - iv. "Contractor" shall be defined as it is in the Good Jobs Ordinance.
 - v. "Covered Project" shall be defined as it is in the Good Jobs Ordinance.
 - vi. "Hiring Goal" shall be defined as it is in the Good Jobs Ordinance.
 - vii. "Resident" shall be defined as it is in the Good Jobs Ordinance.
 - **viii.** "Subcontractor" shall be defined as it is in the Good Jobs Ordinance and shall include the Contractor's direct subcontractor providing construction work and all lower tiered (level) providers of construction work.
- **14.1.5 Hiring Goals.** If this Agreement requires the Contractor to perform work on a Covered Project, the Contractor and each Subcontractor shall have as its hiring goals:
 - i. at least thirty percent (30%) of its total worker hours performed by City Residents, and
 - **ii.** at least twenty-five percent (25%) of construction trade jobs shall go to Apprentices and/or Basic Skilled Workers, and
 - iii. at least seventy percent (70%) of all "new hires" (as that term is defined in the Good Jobs Ordinance) shall be "economically disadvantaged" individuals (as that term is defined in the Good Jobs Ordinance), and
 - iv. a minimum of five percent (5%) of the construction workforce labor hours will be local resident, minority artisans, and
 - v. a minimum of five percent (5%) of the construction workforce labor hours will be women, and

- vi. a minimum of ten percent (10%) of the total work hours shall be allocated for minorities, or
- vii. as may otherwise be required by any superseding Federal or State employment discrimination prohibition laws.
- **14.1.6** Good Faith Efforts. The Contractor and each Subcontractor shall engage in Good Faith Efforts to comply with the Hiring Goals. For the purposes of this paragraph, the term "Good Faith Efforts" shall have the same meaning as it does in the Good Jobs Ordinance.

The Contractor and each Subcontractor shall individually implement Good Faith efforts to satisfy the Hiring Goals.

- 14.1.7 Action Plan and Pre-Construction Meeting. Not later than fourteen (14) business days prior to the scheduled commencement date for construction, the Contractor shall submit a written plan-of-action to the City and to the Administrator of the Good Jobs Ordinance defining how the Contractor, and each Subcontractor, shall implement Good Faith Efforts to fulfill the Hiring Goals. Each plan-of-action shall include the anticipated number of job positions required for the Work. Not later than five (5) business day prior to the commencement date of construction, the Contractor must attend a mandatory "pre-construction" meeting with the City to review all plans-of-action and other relevant materials. No construction work shall proceed absent this pre-construction meeting.
- **14.1.8** Other Contractor Obligations. In addition to the foregoing, the Contractor shall ensure that all Subcontractor contracts and agreements expressly set forth and state as binding obligations therein, subject to appropriate party name change, the above Hiring Goals and Good Faith Efforts. The Contractor shall be accountable for, and liable to the City for, Contractor and each Subcontractor compliance with Hiring Goals and Good Faith efforts.
 - i. The Contractor shall meet with the Administrator no less than four (4) weeks prior to the commencement of construction on a Covered Project and provide the Administrator with the number of job positions to be created by the project by trade and the qualifications by job tile.
 - ii. The Contractor shall be required to produce Contractor and Subcontractor documentation that may be required under the provisions of the Good Jobs Ordinance or that the City or the Administrator reasonably believes will assist the City or the Administrator with their evaluation of Hiring Goals and Good Faith Efforts.
 - **iii.** The Contractor shall deliver weekly certified payroll records to the City within five (5) working days of the end of each payroll period. Moreover, the Contractor shall require each Subcontractor to create weekly certified payroll records.
 - iv. The Contractor's and each Subcontractor's payroll records shall include the person-hours, the residential address, race, gender, hiring date, and apprentice

(job) classification of all personnel employed under this Agreement and all Contracts and Sub-Contracts thereunder. The Contractor and each Subcontractor shall mark their respective final payroll period records as being final and be signed by an authorized officer or employee.

14.2 Liquidated Damages Applicable To Section 14.1

- **14.2.1** If the City finds that the Contractor, or a Subcontractor, has failed to achieve Hiring Goals during any five (5) day work period (Monday through Friday), the City shall:
 - i. issue a written notice to the Contractor specifying the matters constituting such failure and the time period within which Good Faith Efforts documentation must be delivered to the City for its evaluation.
 - **ii.** if the Good Faith documentation is not provided or, if provided, it fails to demonstrate compliance with Good Faith Efforts, the Contractor shall, for each failure by the Contractor or a Subcontractor to achieve the Hiring Goals during a full five day work period, pay to the City one thousand dollars (\$1,000.00) as liquidated damages.
- **14.2.2** If the City finds that the Contractor, or a Subcontractor, has failed to deliver weekly certified payroll records to the City within five (5) working days of the end of each payroll period the Contractor shall, as liquidated damages pay one hundred dollars (\$100.00) to the City for each week of ongoing violation.
- **14.2.3** The City shall provide the Contractor with an invoice identifying all sums due the City, as liquidated damages, as a result of the Contractor or a Subcontractor's failure to comply with the Good Jobs Ordinance as set forth above.
- **14.2.4** No portion of any invoice submitted by a Contractor that is subject to liquidated damages shall be paid by the City until such time as all liquidated damages relating to that invoice have been paid to the City.
- **14.2.5** The foregoing liquidated damages provisions shall be expressly set forth, subject to appropriate party name adjustments, as material provisions in all Contracts that the Contractor has with Subcontractors and the Contractor is obligated hereunder to enforce compliance in such Contracts with Subcontractors.
- **14.2.6** Any payment of liquidated damages hereunder shall not preclude a later claim, nor any later finding of a breach, or any payment of additional damages related to such later claim.
- (l). **16. Housing and Urban Development Section 3 Clause.** In the event this agreement is funded, in whole or in part, through Housing and Urban Development assistance, 24 C.F.R. §135.38 may apply and the Contractor shall then be required to comply with the following (referred to as the "Section 3 clause"):
- A. The work to be performed under this contract is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. § 1701u (Section 3). The purpose of Section 3 is to ensure that employment and other economic

opportunities generated by HUD assistance or HUD-assisted Projects covered by Section 3, shall, to the greatest extent feasible, be directed to low and very low-income persons, particularly persons who are recipients of HUD assistance for housing.

- B. The parties to this contract agree to comply with HUD's regulations in 24 C.F.R. part 135, which implement Section 3. As evidenced by their execution of this contract, the parties to this contract certify that they are under no contractual or other impediment that would prevent them from complying with the part 135 regulations.
- C. The contractor agrees to send to each labor organization or representative of workers with which the contractor has a collective bargaining agreement or other understanding, if any, a notice advising the labor organization or workers' representative of the contractor's commitments under this Section 3 clause, and will post copies of the notice in conspicuous places at the work site where both employees and applicants for training and employment positions can see the notice. The notice shall describe the Section 3 preference, shall set forth minimum number and job titles subject to hire, availability of apprenticeship and training positions, the qualifications for each; and the name and location of the person(s) taking applications for each of the positions; and the anticipated date the work shall begin.
- D. The contractor agrees to include this Section 3 clause in every subcontract subject to compliance with regulations in 24 C.F.R. part 135, and agrees to take appropriate action, as provided in an applicable provision of the subcontract or in this Section 3 clause, upon a finding that the subcontractor is in violation of the regulations in 24 C.F.R. part 135. The contractor will not subcontract with any subcontractor where the contractor has notice or knowledge that the subcontractor has been found in violation of the regulations in 24 C.F.R. part 135.
- E. The contractor will certify that any vacant employment positions, including training positions, that are filled (1) after the contractor is selected but before the contract is executed, and (2) with persons other than those to whom the regulations of 24 C.F.R. part 135 require employment opportunities to be directed, were not filled to circumvent the contractor's obligations under 24 C.F.R. part 135.
- F. Noncompliance with HUD's regulations in 24 C.F.R. part 135 may result in sanctions, termination of this contract for default, and debarment or suspension from future HUD assisted contracts.
- G. With respect to work performed in connection with Section 3 covered Indian housing assistance, section 7(b) of the Indian Self-Determination and Education Assistance Act (25 U.S.C. § 450e) also applies to the work to be performed under this contract. Section 7(b) requires that to the greatest extent feasible (i) preference and opportunities for training and employment shall be given to Indians, and (ii) preference in the award of contracts and subcontracts shall be given to Indian organizations and Indian-owned Economic Enterprises. Parties to this contract that are subject to the provisions of Section 3 and section 7(b) agree to comply with Section 3 to the maximum extent feasible, but not in derogation of compliance with section 7(b).
- (m). City Code of Ordinances, Ethics and Conflict of Interest Code, Provisions.

 The Person (the term "Person" shall herein be as defined in Section 38 of the City's Code of Ordinances) supplying the labor, services, equipment, materials, reports, plans, specifications, drawings, deliverables, incidentals, etc. under this Contract shall comply with all applicable

Federal, State and Municipal statutes, regulations, charters, ordinances, and rules, in effect at the time the Contract is executed, Should a change in law or regulations occur subsequent to the date of execution of the Contract that increases Contractor's project costs, the parties shall, to the extent allowed by law, negotiate an equitable resolution. Under these specified conditions, the Person referenced herein agrees to comply with all applicable laws whether or not they are expressly stated in this Contract, including but not limited to the following:

- 1. It shall be a material breach of this Contract, and, except as may be permitted by regulations or rulings of the City of Waterbury Board of Ethics it shall be a violation of the City's Code of Ordinances, for any Public Official, City Employee or Member of a Board or Commission who is participating directly or indirectly in the procurement process as set forth in the City's Code of Ordinances, including those participating in exempt transactions, to become or be the employee of any person contracting with the governmental body by whom the Official, Employee, or Board or Commission member is employed or is a member.
- 2. It shall be a material breach of this Contract, and it shall be a violation of the City's Code of Ordinances for any Person to offer, give, or agree to give any current or former Public Official, Employee or Member of a Board or Commission, or for such current or former Public Official, Employee or Member of a Board or Commission to solicit, demand, accept or agree to accept from another Person, a gratuity or an offer of employment in connection with any: decision; approval; disapproval; recommendation; preparation of any part of a program requirement or a requisition; influencing the content of any specification or procurement standard; or rendering of advice, investigation, auditing, or in any other advisory capacity in any proceeding or application, request for ruling, determination, claim or controversy, or other particular matter, pertaining to any program requirement or a Contract or Purchase Order, or to any solicitation or qualifications therefore.
- 3. It shall be a material breach of this Contract and it shall be a violation of the City's Code of Ordinances for any payment, Gratuity, or offer of employment to be made as an inducement for the award of a subcontract or order, by or on behalf of a subcontractor, the prime Contractor or higher tier subcontractor or any Person associated therewith, under a Contract or Purchase Order to the City.
- 4. The value of anything transferred or received in violation of the City's Charter, Code of Ordinances, and/or regulations promulgated there under, by any Person subject to said Charter and/or Ordinances may be recovered by the City.
- 5. Upon a showing that a subcontractor made a kickback to the City, a prime Contractor or a higher tier subcontractor in connection with the award of a subcontract or order there under, it shall be conclusively presumed that the amount thereof was included in the price of the subcontract or order and ultimately borne by the City and will be recoverable hereunder from the recipient. In addition, said value may also be recovered from the subcontractor making such kickbacks. Recovery from one offending party shall not preclude recovery from other offending parties.
- 6. It shall be a material breach of this Contract and it shall be a violation of the City's Code of Ordinances for a Person to be retained, or to retain a Person, to solicit or secure a contract with the City upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee; and every Person, before being awarded a City Contract, shall deliver to the City, on a City authored form, a representation that such Person has not retained anyone in violation of this subsection 6, the failure to deliver said form being a material breach of

this Contract and a violation of the City's Code of Ordinances. Note, however, this subsection f shall not apply to full-time Employees who, as a condition of their employment, may be entitled to bonuses or other fees in accordance with their employment relationship.

- 7. The Person hereby expressly represents that he/she/it has complied with those sections of the City's Code of Ordinances requiring that said Person has (a) delivered to the City an affidavit, on a City authored form, stating that the Person and its affiliates have no delinquent taxes or other financial obligations owned to the City; (b) filed the City authored financial disclosure statement form as set forth in the City's Code of Ordinances regarding disclosure of financial interests; (c) delivered to the City a written acknowledgement, on a City authored form, evidencing receipt of a copy of the "Ethics and Conflict of Interest" ordinance for the City of Waterbury and hereby expressly represents that said Person is in full compliance with the entirety of said Code of Ordinance; and (d) filed a current list of all taxable personal and real property as required by the State of Connecticut General Statutes. Any violation of this subsection 7 shall be deemed a material breach of this Contract and shall be a violation of the City's Code of Ordinances.
- 8. The definitions set forth in the City's Code of Ordinances shall be the primary source for interpretation of the forgoing subsections 1-7.
- 9. The Contractor is hereby charged with the requirement that it shall have knowledge of, and shall fully comply will, all relevant provisions of the City's Charter and all relevant provisions of the City's Code of Ordinances, including without limitation Chapters 93, titled "Discriminatory Practices", Chapter 38 titled "Centralized Procurement System", and Chapter 39 titled "Ethics and Conflict of Interest", of said Code as may be amended from time to time.
- 10. The Contractor hereby acknowledges receipt of a copy of the Chapters 38 and 39 of City's Ordinance regarding Procurement, Ethics, and Conflicts of Interest and has familiarized itself with said Code and hereby agrees to adhere to said Code. The text of Chapters 38 and 39 of said Code may be obtained from the Office of the City Clerk of the City and on the internet at the City Clerk's web site: http://www.waterburyct.org/cityclerk, click link titled "The City of Waterbury Code of Ordinances *Passed 8/24/2009*". For Chapter 38, click on "TITLE III: ADMINISTRATION", then click on "CHAPTER 38: CENTRALIZED PROCUREMENT SYSTEM". For Chapter 39, click on "TITLE III: ADMINISTRATION", then click on "CHAPTER 39: ETHICS AND CONFLICTS OF INTEREST".
- 11. The Contractor is hereby charged with the requirement that it shall have knowledge of, and shall fully comply with, the City's Ordinance Sections 34.15 through 34.99 entitled, "Ordinance Concerning the Hiring of Waterbury Residents on Certain Publicly-Funded Construction Projects" and the State of Connecticut Legislature's Special Act No. 01-1.
- 12. Every Person who conducts business with, contracts with, or provides commodities or services to the City, is charged with notice of the extent of the powers and authority, and the limitations thereon, of the Public Officials and Employees of the City, as set forth in the charter of the City, the Code of Ordinances and any Regulations or Policies pertaining thereto. In particular, and without implying any limitation as to its applicability, it applies to all Persons who participate in the procedures pertaining to the Centralized Procurement System as set forth in Chapter 38, and the Ethics and Conflict of Interest provisions set forth in Chapter 39 of the Code of Ordinances.

- 13. INTEREST OF CITY OFFICIALS. No member of the governing body of the City, and no other officer, employee, or agent of the City who exercises any functions or responsibilities in connection with the carrying out of the project, to which this agreement pertains, shall have any personal interest, direct or indirect, in this agreement.
- 14. PROHIBITION AGAINST CONTINGENCY FEES. The Contractor hereby represents that it has not retained anyone to solicit or secure a contract with the City upon an agreement or understanding for a commission, percentage, brokerage or contingency fee.

The parties are signing this Contract on the date below their respective signatures.

Witnesses (Two (2) Witness, sign and print names below)		NORESCO, LLC
	Ву:	(sign name {duly authorized})
		(print name)
		(print title of signer)
		Date:
Witnesses (Two (2) Witness, sign and print names below)		CITY OF WATERBURY
	Ву:	Neil M. O'Leary, Mayor
	Date:	

Exhibit A

Energy-Savings Performance Project Statement of Work

ENERGY-SAVINGS PERFORMANCE PROJECT STATEMENT OF WORK

ARTICLE 1. DE	EFINITIONS, A	CCEPTANCE	OF DOCUMENTS
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- Section 1.1. Definitions.
- Section 1.2. Acceptance of Investment-Grade Energy Audit Report and Other Documents

PAYMENTS AND SCHEDULES

ARTICLE 2. PURCHASE AND SALE; COMMENCEMENT DATE AND TERMS; INTERIM PERIOD

- Section 2.1. Purchase and Sale
- Section 2.2. Commencement Date
- Section 2.3. Term of SOW; Interim Period

ARTICLE 3. ENERGY SAVINGS GUARANTEE; ANNUAL RECONCILIATION; PAYMENTS TO QESP

- Section 3.1. Rebates and Incentives
- Section 3.2. Energy Savings Guarantee
- Section 3.3. Annual Review and Reimbursement/Reconciliation
- Section 3.4. QESP Compensation and Fees
- Section 3.5. Billing Information Procedure
- Section 3.6. Effective Date of Payment Obligation

ARTICLE 4. NOT USED

DESIGN AND CONSTRUCTION PHASE

- ARTICLE 5. ENERGY USAGE RECORDS AND DATA
- ARTICLE 6. LOCATION AND ACCESS

ARTICLE 7. PERMITS AND APPROVALS; COORDINATION

- Section 7.1. Permits and Approvals
- Section 7.2. Coordination During Installation

ARTICLE 8. CONSTRUCTION SCHEDULE AND EQUIPMENT INSTALLATION; APPROVAL

- Section 8.1. Construction Schedule; Equipment Installation
- Section 8.2. Systems Startup and Equipment Commissioning

ARTICLE 9. EQUIPMENT WARRANTIES

ARTICLE 10. STANDARDS OF COMFORT

ARTICLE 11. ENVIRONMENTAL REQUIREMENTS

- Section 11.1. Excluded Material and Activities
- Section 11.2. Polychlorinated Biphenyl (PCB) Ballasts; Mercury Lamps

ARTICLE 12. TRAINING BY QESP

POST-CONSTRUCTION PHASE

ARTICLE 13. EQUIPMENT SERVICE

- Section 13.1. Actions by QESP
- Section 13.2. Malfunctions and Emergencies
- Section 13.3. Actions by Owner

ARTICLE 14. MODIFICATION, UPGRADE OR ALTERATION OF THE EQUIPMENT

- Section 14.1. Modification or Other Handling of Equipment
- Section 14.2. Upgrade or Alteration of Equipment

ARTICLE 15. MATERIAL CHANGES

- Section 15.1. Reported Material Changes; Notice by Owner
- Section 15.2. Other Adjustments

ARTICLE 16. PERFORMANCE BY QESP

- Section 16.1. Corrective Action; Accuracy of the Services
- Section 16.2. Annual Reporting Requirements; Annual ENERGY STAR Rating

ADMINISTRATION

ARTICLE 17. OWNERSHIP OF CERTAIN PROPRIETARY RIGHTS; EXISTING EQUIPMENT

- Section 17.1. Ownership of Certain Proprietary Proper Rights
- Section 17.2. Ownership and Removal of Existing Goods

ARTICLE 18. MATERIAL BREACH

- Section 18.1. Not Used
- Section 18.2. Events of Material Breach by QESP

ARTICLE 19. NOT USED

ARTICLE 20. ADDITIONAL REPRESENTATIONS AND WARRANTIES OF THE PARTIES

- Section 20.1. Not Used
- Section 20.2. QESP Warranty

ARTICLE 21. MISCELLANEOUS DOCUMENTATION PROVISIONS

- Section 21.1. Waiver of Liens, Construction Performance and Payment Bonds, Labor and Material Payment Bonds
- Section 21.2. Owner's Responsibilities
- Section 21.3. Liens and Waiver of Liens

ARTICLE 22. NOT USED

ARTICLE 23. COMPLETE SOW

ATTACHMENT 1: SCHEDULES

Schedule A: Energy Savings Guarantee
Schedule B: Baseline Energy Consumption
Schedule C: Measurement & Verification Plan

Schedule D: Warranties
Schedule E: Not Used
Schedule F: Not Used
Schedule G: Not Used

Schedule H: Final Project Cost & Project Cash Flow Analysis

Schedule I: Payment Schedule

Schedule J: Compensation to QESP for Annual Services

Schedule K: Rebates, Incentives, and Grants

Schedule L: Not Used
Schedule M: Not Used
Schedule N: Not Used
Schedule O: Not Used
Schedule P: Not Used

Schedule Q: Description of Project Sites

Schedule R: Equipment to Be Installed by QESP
Schedule S: Construction and Installation Schedule
Schedule T: Systems Start-Up and Commissioning

Schedule U: Standards of Comfort

Schedule V: QESP's Training Responsibilities

Schedule W: Not Used
Schedule X: Not Used
Schedule Y: Not Used
Schedule X: Not Used
Schedule AA: Not Used

Schedule BB: QESP's Maintenance Responsibilities
Schedule CC: City's Maintenance Responsibilities
Schedule DD: Facility Maintenance Checklist

Schedule EE: Certificate of Final Acceptance of all ESMs/Final Completion

Schedule FF: Certificate of Substantial Completion of All ESMs/Substantial Completion

Schedule GG: Notice of Substantial Completion of ESM

Schedule HH: Not Used Schedule II: Not Used

ARTICLE 1. DEFINITIONS, ACCEPTANCE OF DOCUMENTS

Section 1.1 <u>Definitions</u>

Any capitalized terms not defined in this SOW shall have the same meaning as those terms have in the Contract.

Certificate of Acceptance of All Installed Equipment: A certificate signed by the Owner, acknowledging acceptance of all installed equipment, to be attached as **Schedule EE**.

Commencement Date: The date described in Section 2.2 (Commencement Date).

Energy-Savings Measures (ESMs): Any improvement to facilities or other energy-consuming systems designed to reduce energy or water consumption and operating costs and increase the operating efficiency of facilities or systems for their appointed functions. For the purposes of this SOW, Energy-Savings Measures for this project are those listed in **Schedule A** (Energy Savings Guarantee).

Energy Savings Guarantee: The guarantee that is achieved as a result of the installation and operation of the Equipment and provision of services provided for in this SOW and in accordance with the Savings Calculation Formula as set forth in **Schedule C** (Measurement & Verification Plan).

Equipment: Goods which the QESP is to install in accordance with and as set forth in Schedule R (Equipment to Be Installed by QESP).

Energy Use Intensity (EUI): A unit of measurement that describes a building's energy use and represents the energy consumed by a building relative to its size.

Environmental Laws: any Federal, State or local statute, law, ordinance, code, rule, regulation, order, or decree regulating or relating to the protection of human health or the environment, or imposing liability or standards of conduct concerning any hazardous, toxic or waste, substance, element, compound, mixture or material, as now or at any time hereafter in effect including, without limitation, the Federal Comprehensive Environmental Response, Compensation and Liability Act, as amended, 42 U.S.C. Sec. 9601 et seq., the Superfund Amendments and Reauthorization Act, 42 U.S.C. Secs. 9601 et seq., the Federal Oil Pollution Act of 1990, §§ 2701, et seq., the Federal Toxic Substance Control Act, 15 U.S.C. §§ 6901 et seq., the Federal Hazardous Material Transportation Act, 49 U.S.C. §§ 1801 et seq., the Federal Clean Air Act, 42§ 7401 et seq., the Federal Water Pollution Control Act, 33 U.S.C. § 1251 et seq., the River and Harbors Act of 1899, 33 U.S.C. §§ 401 et seq., and all rules and regulations of the Environmental Protection Agency, or any other state or federal department, board, or agency, or any other agency or governmental board or entity having jurisdiction over environmental or health and safety matters, as such have been amended.

Goods: All things which are movable, including, but not limited to, supplies, materials, equipment, hardware, software, specially manufactured things, a component incorporated into another thing and things that are attached to real property and that may be severed

from the real property without material harm to the things, together and with any and all additions, modifications, attachments, replacements and parts.

Interim Period: The period from SOW execution until the Commencement Date.

Material Change: Any change in or to the Project Site(s), whether structural, operational or otherwise in nature which reasonably could be expected, in the sole judgment of the Owner, to increase or decrease annual energy consumption in accordance with the provisions and procedures set forth in **Schedule B** (Baseline Energy Consumption) and **Schedule C** (Measurement & Verification Plan) by at least five (5 %) percent after adjustments for climatic variations. Those changes may include, but are not limited to, any one of the following:

- (i) manner of use of the Project Site(s) by the Owner;
- (ii) hours of operation for the Project Site(s) or for any Equipment or energy using systems operating at the Project Site(s);
- (iii) permanent changes in the comfort and service parameters set forth in Schedule U (Standards of Comfort);
- (iv) occupancy of the Project Site(s);
- (v) structure of the Project Site(s), including total square footage of the buildings;
- (vi) types and quantities of Equipment used at the Project Site(s)
- (vii) modification, renovation or construction at the Project Site(s);
- (viii) the Owner's failure to provide maintenance of and repairs to the Equipment in accordance with Schedule CC (City's Maintenance Responsibilities);
- (ix) the replacement, addition or removal of energy and water consuming devices whether plug-in or fixed assets;
- (x) casualty or condemnation of the Project Site(s) or Equipment;
- (xi) changes in utility provider or utility rate classification or number of days in utility billing cycle;
- (xii) modifications, alterations or overrides of the energy management system schedules or hours of operation, set back/start up or holiday schedules; or
- (xiii) any other conditions other than weather affecting energy or water use or energy costs at the Project Site(s).

Project Site(s): The facilities of the Owner in need of energy and water saving equipment and services designed to reduce consumption and associated costs, as identified in **Schedule Q**.

SOW: This Energy-Savings Performance Project Statement of Work and all Schedules and Exhibits attached hereto.

SOW Sum: The dollar value sum of all materials, labor, auditing, design, engineering, project construction management fees, overhead, profit, contingency and subcontracted services related to the project, as set forth in Schedule H, Final Project Cost and Project Cash Flow Analysis.

Substantial Completion of ESM: The stage in the progress of the Work where the

installation of an ESM, or portion thereof, is sufficiently complete in accordance with the SOW documents so that the Owner can utilize and take beneficial use of the subject ESM, or portion thereof, for its intended use or purpose. Substantial Completion of ESM shall not be deemed to have occurred until the ESM has been commissioned, accepted, and the Owner executes the Notice of Substantial Completion of ESM, which shall not be unreasonably withheld.

Work: The Equipment or Services or both to be Performed under the SOW.

Section 1.2. <u>Acceptance of Investment-Grade Energy Audit Report and Other Documents</u>

The completed and accepted IGEA Report is attached as Exhibit B.

For purposes of Performance and synergy between or among documents, the provisions of this SOW and its schedules and exhibits shall take precedence and govern over those in the IGEA Report.

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PAYMENTS AND SCHEDULES

ARTICLE 2. PURCHASE AND SALE; COMMENCEMENT DATE AND TERMS; INTERIM PERIOD

Section 2.1. Purchase and Sale

QESP shall provide the Equipment and Services as provided in Schedule R (Equipment to Be Installed by QESP) and Schedule J (Compensation to QESP for Annual Services) in accordance with the terms and conditions set forth in Schedule I (Payment Schedule).

The SOW Sum for the Work is \$27,415,059.00 as set forth in Schedule H (Final Project Cost & Project Cash Flow Analysis). Payment terms are described in Schedule I (Payment Schedule). The SOW Sum does not include the Compensation to QESP for Annual Services as detailed in Schedule J.

QESP shall Perform the Work, or cause the Work to be Performed, and all related Services identified in Schedule R (Equipment to be Installed by QESP) and the Services detailed in Schedule BB (QESP's Maintenance Responsibilities) and Schedule J (Compensation to QESP for Annual Services). QESP shall supervise and direct the Work and shall be responsible for all construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work under this SOW. QESP shall pay for all Equipment, Services and transportation necessary or appropriate for the timely and proper Performance of the Work in accordance with all applicable Schedules.

QESP shall be paid the SOW Sum in accordance with **Schedule I** (**Payment Schedule**). Payments will be made on a progress basis in accordance with **Schedule I** (**Payment Schedule**), for Work completed and authorized by Owner during the Interim Period. Retainage of five (5 %) percent will be withheld until the Commencement Date.

Section 2.2. Commencement Date

The Commencement Date shall be the first day of the month after the month in which the last unsatisfied condition of the following conditions shall have been satisfied: (1) QESP shall have installed and commenced operating all of the Equipment specified in **Schedule R** (Equipment to Be Installed by QESP) and in accordance with the provisions of ARTICLE 8 (Construction Schedule and Equipment Installation; Approval), **Schedule S** (Construction and Installation Schedule) and Schedule T (Systems Start-Up and Commissioning; Operating Parameters of Installed Equipment); (2) QESP shall have delivered to Owner a notice that it has installed all of the Equipment and that the Equipment is operating properly, all in accordance with this Section; and (3) Owner has inspected and accepted said installation and operation as evidenced by executing and delivering to QESP the Schedule EE (Certificate of Final Acceptance of all ESMs/Final Completion).

Owner shall have thirty (30) calendar days after receiving the installation notification by

the QESP to inspect the Equipment. If Owner does not reject any of the Equipment, then Owner shall execute and forward the Certificate of Acceptance of All Installed Equipment to the QESP within seven (7) calendar days after concluding the inspection. Owner may reject some or all of the Equipment if either the Equipment or its installation fails to meet reasonably accepted standards of workmanship, does not comply with applicable building codes, or is otherwise not in compliance with the Contract or this SOW. Owner shall not deliver to QESP the Certificate of Acceptance of All Installed Equipment and QESP shall not be paid in full, including retainage, until and after any punch list is completed and QESP has satisfied any and all claims for labor and materials, including, but not limited to, providing Lien waiver certificates. The Certificate of Acceptance of All Installed Equipment will not be unreasonably withheld by the Owner.

Compensation payments due to QESP for on-going Services and maintenance under this SOW as set forth in **Schedule J** (**Compensation to QESP for Annual Services**) shall begin thirty (30) calendar days from the Commencement Date. Compensation payments due to QESP for on-going maintenance services for an ESM and under this SOW as set forth in **Schedule J** (**Compensation to QESP for Annual Services**) shall begin thirty (30) calendar days from the Substantial Completion of ESM date.

Section 2.3. Term of SOW; Interim Period

The term of this SOW shall end on the date which is exactly five (5) years from the Commencement Date. The SOW shall be effective and binding upon the parties upon its execution by the parties. All energy savings achieved during the Interim Period shall be fully credited to Owner.

ARTICLE 3. ENERGY SAVINGS GUARANTEE; ANNUAL RECONCILIATION; PAYMENTS TO QESP

Section 3.1. Rebates and Incentives

As specified in **Schedule K**, QESP shall identify and describe dollar amounts for any eligible rebate and incentive funds from the CT Energy Efficiency Fund, CT Clean Energy Finance and Investment Authority, and other incentive and grant programs, to reduce overall project costs.

Section 3.2. Energy Savings Guarantee

Subject to the adjustments provided for in this **Exhibit A**, including the Schedules attached hereto, QESP guarantees that the annual level of Energy Savings shall be in accordance with the measurement and verification of the Energy-Savings Measures as set forth in **Schedule C** (**Measurement & Verification Plan**). The Energy Savings Guarantee is set forth in annual increments for the term of the SOW as specified in **Schedule A** (**Energy Savings Guarantee**) and QESP guarantees that it is sufficient to cover any and all annual payments required to be made by the Owner as set forth in **Schedule J** (**Compensation to QESP for Annual Services**) and **Schedule I** (**Payment Schedule**).

Section 3.3. Annual Review and Reimbursement/Reconciliation

QESP shall measure and calculate Energy Savings as specified in Schedule C (Measurement & Verification Plan) and Schedule B (Baseline Energy Consumption) and shall prepare and deliver to Owner an annual reconciliation report no later than forty-five (45) days following each (1) twelve-month anniversary of the Commencement Date, or (2) the date that QESP shall have received the last of the energy usage records and data referenced in Articles 3 and 5 of this SOW, whichever is later, for the entire term of this SOW, including the final report due on or before the date which is exactly five (5) years and zero (0) days from the first day of the month following the Commencement Date.

If the reconciliation reveals a shortfall in annual Energy Savings in any one year during the guarantee period, QESP shall make payment to the Owner in the amount of the Verified Energy Cost Savings shortfall no later than sixty (60) days after the Owner receives the reconciliation report. If the reconciliation reveals an excess in annual Energy Savings, the excess savings shall remain with the Owner, and shall not be used to cover potential Energy Savings shortages in subsequent years or actual Energy Savings shortages in previous years.

Section 3.4. OESP Compensation and Fees

QESP has structured the Energy Savings Guarantee referred to in 3.1 above such that it will be at least equal to any and all annual payments, combined, required to be made by the Owner as shown in Schedule I (Payment Schedule), Schedule J (Compensation to QESP for Annual Services) and Schedule BB (QESP's Maintenance Responsibilities).

Section 3.5. Billing Information Procedure

Payments due to QESP under this Section 3 shall be calculated each year in the following manner:

- (i) By 30 days after receipt, Owner shall provide QESP with copies of all energy bills for the Project Site(s) which it shall have received for the preceding month;
- (ii) Upon receipt of the required information, QESP shall calculate the savings in accordance with the agreed-upon calculation formulae in **Schedule C** (Measurement & Verification Plan).
- (iii) Based upon paragraphs (i) and (ii) above, QESP shall prepare and send to Owner monthly invoices beginning in the first month of each Guarantee Period which shall set forth for each year the amounts of the Energy Savings calculated in accordance with Schedule C (Measurement & Verification Plan) and for the services as provided for in Schedule J (Compensation to QESP for Annual Services). The invoice will set forth the total annual payment due from Owner, which shall be paid in 12 equal monthly installments.

Section 3.6. Effective Date of Payment Obligation

Notwithstanding the above provisions in Section 3, Owner shall not be required to begin any of the measurement and verification services payments in **Schedule J** to QESP under this SOW unless and until all Equipment installation is completed by QESP in accordance with the provisions of Article 8 (Construction and Equipment Installation; Approval) and **Schedule T** (**Systems Start-Up and Commissioning**), and accepted by Owner as evidenced by the signed Certificate of Acceptance as set forth in **Schedule EE** (Certificate of Final Acceptance of all ESMs/Final Completion), and unless and until said Equipment is fully and properly functioning.

ARTICLE 4. NON-APPROPRIATION OF FUNDS – NOT USED

DESIGN AND CONSTRUCTION PHASE

ARTICLE 5. ENERGY USAGE RECORDS AND DATA

Owner has furnished and shall continue to furnish (or authorize its energy suppliers to furnish) during the term of this SOW to QESP or its designee, upon its request, all of its records and complete data concerning energy and water usage and related maintenance for the Project Site(s).

ARTICLE 6. LOCATION AND ACCESS

QESP represents and warrants that at time of contract execution there exists sufficient space on the Project Site(s) for the installation and operation of the Equipment for the entire useful life of the Equipment.

Owner shall take reasonable steps to protect such Equipment from harm, theft and misuse during the term of this SOW. Owner shall provide access to the Project Site(s) for QESP to perform any function related to this SOW during regular business hours, or such other reasonable hours as may be requested by QESP and acceptable to the Owner. QESP shall be granted access to make emergency repairs or corrections as it may, in its discretion, determine are needed. The QESP's access to Project Site(s) to make emergency repairs or corrections as it may determine are needed shall not be unreasonably restricted by the Owner. QESP shall immediately notify the Owner when emergency action is taken and follow up with written notice within three (3) business days specifying the action taken, the reasons for the action, and the impact upon the Project Site(s), if any.

ARTICLE 7. PERMITS AND APPROVALS; COORDINATION

Section 7.1. Permits and Approvals

The QESP shall be responsible for developing all required documentation and obtaining all necessary permits and approvals for the work and installation of the Equipment. The Equipment and the operation of the Equipment by QESP shall at all times comply with all federal, state and local code requirements in effect as of the execution date of this **Exhibit A**. Furthermore, all Work shall comply with the Connecticut State Building Code and the City of Waterbury Building Code. The QESP shall be responsible for providing all drawings and documentation necessary to demonstrate compliance. Owner shall be responsible for providing design approval and comments within 15 days of drawing and documentation submittal by QESP. The QESP shall coordinate all required inspections with the authority having jurisdiction.

QESP shall furnish copies of any permit or license which is required to perform the Work to the Owner before the QESP commences the portion of the Work requiring such permit or license. In no event shall Owner be responsible for payment of any permit or similar fees. It being further agreed and understood that the Owner agrees to provide the

information, and approvals which may be reasonably required for permitting.

Section 7.2. Coordination During Installation

The Owner and QESP shall coordinate the activities of QESP's Equipment installers with those of the Owner, its employees, and agents. QESP shall cooperate with Owner when performing Work to minimize conflicts and facilitate usage of Project Site(s). QESP shall not commit or permit any act which will interfere with the performance of business activities conducted by the Owner or its employees without prior written approval of the Owner.

In addition, QESP shall provide adequate building and fire code egress from the Project Site(s) while performing the Work and, if required, shall be responsible for preparing egress plans for Owner and State Fire Marshal approval.

ARTICLE 8. CONSTRUCTION SCHEDULE AND EQUIPMENT INSTALLATION; APPROVAL

Section 8.1. Construction Schedule; Equipment Installation

Construction and Equipment installation shall proceed in accordance with the construction schedule approved by Owner and attached as **Schedule S** (**Construction and Installation Schedule**).

Section 8.2. Systems Startup and Equipment Commissioning

The QESP shall conduct thorough and systematic performance tests of each element and total system of the installed Equipment in accordance with the procedures specified in Schedule T (Systems Start-Up and Commissioning) prior to delivering to the Owner the installation notification indicating that the Equipment is ready for inspection by the Owner. Testing shall be designed to determine if the Equipment is functioning in accordance with both its published specifications and the Schedules to this SOW, and to determine if modified building systems, subsystems or components are functioning properly within the new integrated environment. The QESP shall provide a minimum of 10 days' notice to the Owner and any third-party technical support entity, as requested by DEEP or the Owner, of the scheduled test(s). The Owner shall have the right to be present, and to invite any third party to be present, at any or all such tests conducted by QESP and/or manufacturers of the Equipment. The QESP shall correct and/or adjust all deficiencies in systems and Equipment operations that may be observed during system commissioning procedures as specified in Schedule T (Systems Start-Up and Commissioning). Prior to Owner executing the Schedule EE (Certificate of Final Acceptance of all ESMs/Final Completion), QESP shall provide Owner with documentary evidence that the Equipment installed is the Equipment specified in Schedule R (Equipment to Be Installed by QESP).

ARTICLE 9. EQUIPMENT WARRANTIES

QESP represents and warrants that all Equipment installed as part of this SOW shall be new, materially free from defects in materials or workmanship, installed properly in a good and workmanlike manner, and shall function properly for the warranty periods identified in Schedule D.

After the applicable NORESCO warranty period, QESP shall have no responsibility for performing maintenance, repairs, or making manufacturer warranty claims relating to the Equipment, except as provided in **Schedule BB (QESP's Maintenance Responsibilities)**.

QESP shall cause all available manufacturers' warranties, which shall also be listed in Schedule D, relating to the Equipment to be issued in the name of and delivered to Owner no later than ten (10) business days after the QESP warranty period begins, the QESP shall deliver the warranties applicable to the subject Equipment to the Owner. At the Owner's request, the QESP shall act as the Owner's agent and representative to pursue on the Owner's behalf any available rights and remedies which the Owner may have against the manufacturers under the warranties. QESP shall, during the warranty period, notify the Owner whenever defects in Equipment parts or performance occur which may give rise to such rights and remedies. During this period, if the QESP fails to notify the Owner of Equipment defects or any warranty issues of which it is aware, QESP shall bear the full cost and expenses of any risk of damage or damage to the Equipment and its performance, including damage to property and Equipment of the Owner or the Project Site(s). The cost and expenses shall be limited to the cost to repair or replace, at the City's reasonable option, the installed Equipment with a defect or warranty issue.

The warranties shall specify that new or reconditioned, parts may be used and installed when repair is necessitated by malfunction.

Notwithstanding the above, nothing in this section shall be construed to alleviate/relieve the QESP from complying with its obligations to perform under all terms and conditions of this SOW and as set forth in all attached Schedules.

ARTICLE 10. STANDARDS OF COMFORT

QESP will maintain and operate the Equipment in a manner which will provide the standards of heating, cooling, ventilation, hot water supply, and lighting quality and levels as described in **Schedule U** (**Standards of Comfort**). During the term of this SOW, QESP and Owner will maintain, respectively according to **Schedule BB** (**QESP's Maintenance Responsibilities**) and **Schedule CC** (**City's Maintenance Responsibilities**), and operate the Equipment in a manner that will provide the standards of comfort and levels of operation as described in **Schedule U** (**Standards of Comfort**).

ARTICLE 11: ENVIRONMENTAL REQUIREMENTS

Section 11.1. Excluded Material and Activities

Owner recognizes that in connection with the installation and/or service or maintenance of Equipment at a Project Site(s), QESP may encounter (i) asbestos or materials containing asbestos, (ii) fungus (any type of form of fungi, including mold or mildew, and myotoxins, spores, scents or by-products produced or released by fungi), (iii) incomplete or damaged work or systems or code violations that may be discovered during or prior to the Work of this SOW, or pollutants, hazardous wastes, hazardous materials or other contaminants regulated by the Environmental Laws (collectively "Hazardous Materials"). If QESP discovers any of the conditions listed above or other Hazardous Materials QESP shall immediately cease Work, remove all QESP personnel and Contractor Parties from the Project Site(s), and notify the Owner. QESP shall undertake no further Work on the Project Site(s), except as authorized by the Owner in writing, as the Owner will perform or arrange for the performance of any remediation of the identified condition. Notwithstanding any other provision in this SOW, any such event of discovery or remediation by the Owner shall not constitute a Material Breach or Other Breach by the Owner. If Owner notifies QESP to cease Work pursuant to this Section, then the time for completion of Work will be automatically extended by the amount of time of the Work stoppage and any additional time that may be required to remobilize and reschedule the work. The parties shall negotiate in good faith any increased costs associated with the Work stoppage and shall modify all appropriate exhibits and schedules accordingly.

QESP shall be responsible in all respects for any Hazardous Materials and any other materials regulated by the Environmental Laws, including, without limitation, those listed in this section that it may bring to the Project Site(s). This responsibility includes, but is not limited to, storage, handling, use, transportation, treatment, disposal, discharge, leakage, detection, removal, containment, remediation and all costs and expenses associated with such.

Section 11.2. Polychlorinated Biphenyl (PCB) Ballasts; Mercury Lamps

QESP shall enter into an agreement with a waste transporter that is permitted by DEEP to transport PCB ballasts. The agreement between QESP and the transporter shall require that the transporter (1) transport and dispose of the PCB Ballasts in accordance with all applicable Environmental Laws, (2) provide an informational packet, packing receptacles and instructions, labels and shipping materials, (3) provide transportation, and incineration or disposal services for PCB ballasts, (4) remove all capacitors and asphalt potting compound materials from Owner's PCB ballasts, (5) incinerate or dispose of them at a federally-approved facility, (6) provide to Owner a Certificate of destruction issued by the federally-approved disposal facility and (7) comply with all applicable Environmental Laws.

QESP shall enter into an agreement with an authorized lamp recycling company, pursuant to which the recycling company shall provide all necessary or appropriate goods and services, including but not limited to, approved containers, materials required to label, transportation and recycling, for all manner of handling of mercury lamps and their

removal from the Project Site(s), all in accordance with the Environmental Laws. The QESP shall verify and ensure that the lamp recycling company performs the work or Work only pursuant to and during the term of a validly existing agreement with the QESP. The agreement shall require the recycling company to provide a copy of the required manifest or other shipping documents to QESP and to forward a copy to the Owner. The QESP shall verify and ensure that the lamp recycling company maintains current, throughout the term of that agreement, all appropriate permits from all applicable jurisdictions to Perform any such work or Work.

To the extent required by the Environmental Laws, the Owner shall sign manifests for all PCB ballasts and manifests or other shipping documents for mercury lamps removed from the Project Site(s).

ARTICLE 12. TRAINING BY QESP

The QESP shall conduct the training program described in **Schedule V** (**QESP's Training Responsibilities**). The Owner shall not commence the inspection of the Equipment in preparation for executing the Certificate of Acceptance of All Installed Equipment until QESP completes the training specified in **Schedule V** (**QESP's Training Responsibilities**). The QESP shall provide ongoing training whenever deemed to be needed or appropriate by the Owner and QESP with respect to updated or altered Equipment, including upgraded software. If the QESP provides ongoing training, the cost of such training will be billed to Owner in accordance with **Schedule J** and this training shall have no effect on the prior Certificate of Acceptance of All Installed Equipment.

POST-CONSTRUCTION PHASE

ARTICLE 13. EQUIPMENT SERVICE

Section 13.1. Actions by QESP

QESP shall provide all service, repairs, and adjustments to the Equipment listed in Schedule BB (QESP's Maintenance Responsibilities). Owner shall have no responsibility for any costs or expenses for Equipment service, repairs, and adjustments listed in Schedule BB, except as set forth in Schedule J (Compensation to QESP for Annual Services), provided, however, that when the need for maintenance or repairs principally arises due to damage caused by the Owner or any employee or other agent of Owner, and QESP can demonstrate a causal connection between the damage and the Owner actions, QESP may charge Owner for the actual cost of the maintenance or repair insofar as such cost is not covered by any warranty or insurance proceeds.

Section 13.2. Malfunctions and Emergencies

Owner shall use its best efforts to notify the QESP or its designated sub-contractors within seventy-two (72) hours after the Owner's actual knowledge and occurrence of: (i) any malfunction, alteration or modification in the operation of the Equipment or any preexisting energy related equipment that has a material impact upon the Energy Savings Guarantee or (ii) any interruption or alteration to the energy supply to the Project Site(s).

Where Owner exercises due diligence in attempting to assess the existence of a malfunction, interruption, or alteration, it shall be deemed to be not at fault in failing to correctly identify such conditions as having a material impact upon the Energy Savings Guarantee. Owner shall notify QESP within seventy-two (72) hours upon its having actual knowledge of any such condition affecting the Equipment. QESP shall respond or cause its designee(s) to respond within seventy-two (72) hours and shall proceed immediately with corrective measures. Any telephonic notice of such conditions by Owner shall be followed within five (5) business days by written notice to QESP from Owner. If Owner unreasonably delays in so notifying QESP of a malfunction or

emergency, and the malfunction or emergency is not otherwise corrected or remedied, QESP may charge Owner for its loss, due to the delay, associated with the Energy Cost Savings Guarantee under this SOW for the particular time period, provided that QESP is able to show the direct causal connection between the delay and the loss.

The QESP will provide a written record of all Service performed. This record will indicate the reason for the service, description of the problem and the corrective action performed.

Section 13.3. Actions by Owner

Owner shall not move, remove, modify, alter, or change in any way any part of or all of the Equipment without the prior written approval of QESP except as set forth in **Schedule CC** (City's Maintenance Responsibilities). Notwithstanding the foregoing, Owner may take reasonable steps to protect the Equipment if, due to an emergency, it is not possible or reasonable to notify QESP before taking any such actions. In the event of such an emergency, Owner shall take reasonable steps to protect the Equipment from damage or injury and shall follow instructions for emergency action provided in advance by QESP. Owner agrees to maintain the Project Site(s) in good repair and to protect and preserve all portions which may in any way affect the operation or maintenance of the Equipment.

ARTICLE 14. MODIFICATION, UPGRADE OR ALTERATION OF THE EQUIPMENT

Section 14.1. Modification or Other Handling of Equipment

During the term of this SOW, Owner shall not move, remove, modify, alter, or change in any way any part of or all of the Equipment or the sufficient space necessary for the proper operation of the Equipment, without the prior written approval of QESP except as set forth in Schedule CC (City's Maintenance Responsibilities).

Section 14.2. Upgrade or Alteration of Equipment

QESP shall at all times have the right, subject to Owner's prior written approval, which approval shall not be unreasonably withheld, to change the Equipment, revise any procedures for the operation of the Equipment or implement other ESMs in the Project Site(s), provided that:

(i) the QESP complies with the standards of comfort and services set forth in **Schedule U (Standards of Comfort)**; (ii) such modifications or additions to, or replacement of the Equipment, and any operational changes, or new procedures are necessary to enable the QESP to achieve the Energy Savings Guarantee at the Project Site(s) and; (iii) any cost incurred

relative to such modifications, additions or replacement of the Equipment, or operational changes or new procedures shall be the responsibility of the QESP.

All modifications, additions or replacements of the Equipment or revisions to operating or other procedures shall be described in a supplemental schedule(s) to be provided to the Owner for approval, which shall not be unreasonably withheld, provided that any replacement of the Equipment shall, unless otherwise agreed, be new Equipment and have equal or better potential to reduce energy consumption at the Project Site(s) than the Equipment being replaced. The QESP shall have the right to update any and all software to be used in connection with the Equipment in accordance with the provisions of Section 17.1(Ownership of Certain Proprietary Rights) and Schedule BB (QESP's Maintenance Responsibilities). All replacements of and alterations or additions to the Equipment shall become part the Equipment described in Schedule R (Equipment to Be Installed by QESP) and shall be covered by the provisions and terms of Article 8 (Construction Schedule and Equipment Installation; Approval).

ARTICLE 15. MATERIAL CHANGES

Section 15.1. Reported Material Changes; Notice by Owner

The Owner shall use its best efforts to deliver to the QESP a written notice describing all proposed Material Changes in the Project Site(s) or in the operations of the Project Site(s) at least thirty (30) days before any proposed Material Change is implemented or as soon as is practicable after an emergency or other unplanned event. Notice to the QESP of Material Changes which result from a bona fide emergency or other situation which precludes advance notification shall be deemed to be sufficient notice under this section if given by the Owner within seventy-two (72) hours after having actual knowledge that the event constituting the Material Change occurred or was discovered by the Owner to have occurred. In the event of a Material Change, the Parties will negotiate an equitable adjustment in the baseline or Energy Savings Guarantee in accordance with the terms of **Schedule C** and **Schedule B**.

Section 15.2. Other Adjustments

Both parties have a vested interest in meeting the Energy Savings Guarantee of the SOW. As such, at the request of the Owner the QESP shall cooperate as necessary or appropriate to investigate, identify and correct any changes that prevent the Energy Cost Savings Guarantee from being realized. As a result of such investigation, QESP and Owner shall determine what, if any, adjustments to the baseline will be made in accordance with the provisions set forth in **Schedule C** (**Measurement & Verification Plan**) and **Schedule B** (**Baseline Energy Consumption**).

ARTICLE 16. PERFORMANCE BY QESP

Section 16.1. Corrective Action; Accuracy of the Services

QESP shall perform all Work in such a manner so as not to damage the structural integrity of the Project Site(s) or their operating systems and so as to conform to the standards set forth in **Schedule U** (**Standards of Comfort**) and the construction schedule specified in **Schedule S** (**Construction and Installation Schedule**). QESP shall repair and restore to its original condition any area which it damages or otherwise disturbs in the course of performing Work under this SOW. The Owner reserves the right to review the Work performed by QESP as the Work progresses and to direct QESP to take certain corrective action if, in the opinion of the Owner, the structural integrity of the Project Site(s) or its operating system is or will be damaged. All costs associated with such corrective action to damage caused by QESP's performance of the Work shall be borne by QESP.

QESP shall remain responsible for the professional and technical accuracy of all services performed, whether by the QESP or its subcontractors or others on its behalf, throughout the term of this SOW.

Section 16.2. Annual Reporting Requirements; Annual ENERGY STAR Rating

At the end of each year, as defined in **Schedule A** (Energy Savings Guarantee), during the guarantee period and no later than ninety (90) days thereafter, the QESP shall complete and submit the data required in **Schedule C** (Measurement & Verification Plan).

ADMINISTRATION

ARTICLE 17. OWNERSHIP OF CERTAIN PROPRIETARY RIGHTS; EXISTING EQUIPMENT

Section 17.1. Ownership of Certain Proprietary Proper Rights

Owner shall not, by virtue of this SOW, acquire any interest in any formulas, patterns, devices, secret inventions or processes, copyrights, patents, other intellectual or proprietary rights, or similar items of property which are or may be used in connection with the Equipment. The QESP shall either grant to the Owner or cause the Owner to be granted, as applicable, a perpetual, irrevocable royalty-free license for any and all software or other intellectual property rights necessary for the Owner to continue to operate, maintain, and repair the Equipment in a manner that will yield Energy Cost Savings Guarantee for the specified SOW term. QESP shall not be liable for providing new versions of software or other enhancements if or unless such new versions or enhancements are necessary to achieve the Energy Savings Guarantee.

Section 17.2. Ownership and Removal of Existing Goods

The Owner holds all Title to the Goods located at the Project Site(s) at the time of execution of this SOW. The Owner shall retain Title to the Goods even if the Goods are replaced or their operation made unnecessary by Work pursuant to this SOW. If applicable, QESP shall advise the Owner in writing of all Goods to be replaced at the Project Site(s) and the Owner shall, within ten (10) days, designate in writing to the QESP which Goods the Owner agrees are to be replaced and which the QESP shall remove to a location within the Project Site(s) which the Owner selects. The Owner shall be responsible for and designate the storage site for any Goods that shall remain on the Project Site(s).

ARTICLE 18. MATERIAL BREACH

Section 18.1. NOT USED

Section 18.2. Events of Material Breach by OESP

Each of the following events or conditions shall constitute a Material Breach of the Contract by QESP:

- (i) the standards of comfort and service set forth in **Schedule U** (**Standards of Comfort**) are not met due to failure of QESP to properly design, install, maintain, repair or adjust the Equipment, except that such failure, if corrected or cured within five (5) days after written notice by Owner to QESP demanding that such failure be cured, shall be deemed to be cured for purposes of this SOW;
- (ii) failure to furnish and install the Equipment and make it ready for use within the time specified by this SOW as set forth in Schedule R (Equipment to Be Installed by QESP) and Schedule S (Construction and Installation Schedule); and
- (iii) failure by the QESP to pay any amount due the Owner as set forth in **Schedule A (Energy Savings Guarantee)**.
- (iv) Violation by the QESP, or any of QESP's employees, Subcontractors, agents and/or consultants, or any of QESP's Subcontractors' employees, agents and/or consultants of the following:

No drinking of alcoholic beverages, smoking or use of controlled substances is permitted on the grounds. QESP shall insure that none of its employees, Subcontractors, agents, and/or consultants, or its Subcontractors' employees, agents, and/or consultants (all hereinafter collectively referred to as "QESP Responsible Parties") report to the site impaired by alcohol or controlled substances. QESP bears the responsibility of determining any QESP Responsible Parties are in any way impaired and whether the safety of the public, QESP Responsible Parties, or the Owner, are jeopardized. QESP shall provide drinking water for all QESP Responsible Parties. QESP Responsible Parties are prohibited from any communication or engagement with students and the use of indecent language. All doing so will be immediately removed from the site. Artwork or decoration found on vehicles belonging QESP Responsible Parties parked on or near City of Waterbury school property which contain indecent language or pictures shall either be immediately covered or removed from the location.

ARTICLE 19. ASSIGNMENT – NOT USED

ARTICLE 20. ADDITIONAL REPRESENTATIONS AND WARRANTIES OF THE PARTIES

Section 20.1. Owner Warranty - NOT USED

Section 20.2. **QESP Warranty**

QESP represents and warrants that:

- (i) it shall ensure that any subcontractors that it uses shall be qualified subcontractors who are licensed and bonded in the State of Connecticut to perform the Work subcontracted to them under this SOW;
- (ii) the Equipment will meet or exceed the provisions set forth in Section 8.2 (Systems Start Up and Equipment Commissioning) and in Schedule T (Systems Start-Up and Commissioning); and
- (iii) the Equipment is or will be compatible with all mechanical and electrical systems, subsystems, or components with which the Equipment interacts, and that, as installed, neither the Equipment nor such other systems, subsystems, or components, which are currently compliant with applicable codes, standards, regulations and laws and have been maintained and are fit for service, will materially adversely affect each other as a direct or indirect result of Equipment installation, operation or maintenance.

ARTICLE 21. MICELLANEOUS DOCUMENTATION PROVISIONS

Section 21.1. Waiver of Liens, Construction Performance and Payment Bonds, Labor and Material Payment Bonds

The QESP shall not begin any Performance until the QESP shall have delivered to the Owner such performance and labor and material bonds as the Owner may require.

Section 21.2. Owner's Responsibilities

(a) Owner's Maintenance Responsibilities

Owner agrees that it shall adhere to, follow and implement the energy conservation procedures and methods of operation to be set forth in **Schedule CC** (**City's Maintenance Responsibilities**) after Owner delivers to the QESP a Notice of Substantial Completion of ESM.

(b) Inspection of Project Site(s)

QESP shall have the right once a month, with prior notice, to inspect Project Site(s) to determine if Owner is complying, and shall have complied with its obligations as set forth in this Section. For the purpose of determining Owner's compliance, the checklist set forth in **Schedule DD** (Facility Maintenance Checklist), shall be used to measure and record determination of Owner's said compliance. Owner shall make the Project Site(s) available to QESP for and during each monthly inspection, and shall have the right to witness each inspection alongside QESP and QESP's recordation on the checklist. Owner may complete its own checklist at the same time. QESP shall not interfere with the Owner's operations during any monthly inspection.

Section 21.3. Liens and Waiver of Liens

(i) If any part of the Work shall become subject to any vendor's, mechanic's, laborer's, materialman's or other lien or encumbrance (collectively, "Liens")

based upon the delivery of the Work, the QESP shall cause any or all of the Liens to be discharged of record at its sole cost and expense prior to the Commencement Date or, if not of record at that time, then within one hundred twenty (120) calendar days after it receives notice of the Liens.

- (ii) Lien waiver certificates, in a form and substance satisfactory to the Owner, shall be submitted by the QESP with all payment requests certifying that the Work is free and clear of all Liens and any other encumbrance for any part of the Work completed. QESP shall also provide Lien waivers at the time of the Commencement Date in a form and substance satisfactory to the Owner that. upon completion and acceptance of the Work, the Work is free and clear of all Liens. If any person or entity refuses to furnish a release or waiver, the QESP shall, at the request of the Owner, furnish a bond satisfactory to the Owner to indemnify the Owner against any potential Lien. If a Lien remains unsatisfied after payments are made, then the QESP shall refund to the Owner all moneys that they may be compelled to pay in discharging the Lien, including all costs and reasonable attorney's fees, no later than thirty (30) days after receiving a written refund request from the Owner. The Owner may withhold amounts due to the QESP as it deems to be necessary or appropriate to protect the Owner against any losses arising out of the outstanding Liens or claims of former Lien holders and to reimburse the Owner for any costs and expenses incurred in the satisfaction and discharge of the Liens and, in required, the procuring of similar Work.
- (iii) Notwithstanding the provisions of this Liens and Waiver of Liens Section, a Municipality may execute and deliver financing documents and instruments in connection with a Municipality's SOW that allow the filing of Liens for purposes of securing the interests of the financing institution involved in that Municipal transaction. If so, then this Section shall be read and interpreted to allow the filing of Liens in accordance with the provisions of the financingrelated documents and instruments, but only as applicable to and for purposes of the Municipality's SOW.

ARTICLE 22. TERMINATION - NOT USED

ARTICLE 23. COMPLETE SOW

This SOW together with all Schedules attached or to be attached hereto, as provided for by this SOW, shall constitute the entire SOW between both parties and this SOW may not be amended, modified, or terminated except by a duly authorized amendment to the Contract.

ATTACHMENT 1. Schedules

Attachments on pages that follow.

SCHEDULE A

Energy Savings Guarantee

This Schedule A sets forth provisions and conditions of the QESP's Energy Savings Guarantee (the "Guarantee"). The "Annual Reporting Requirements" for the "Performance by QESP" section of the SOW will begin on the First Guarantee Period and continue for the Guarantee Term. Should the SOW be terminated (including, as applicable, the maintenance or measurement & verification services) in whole or in part for any reason prior to the end of the Guarantee Term, the Guaranteed Savings for the Guarantee Period in which such termination becomes effective will be prorated as of the effective date of such termination, with a reasonable adjustment for seasonal fluctuations, if any, in Energy and Operational Costs, and the Guaranteed Savings for all subsequent Guarantee Periods will be null and void. The Guarantee shall be defined in units of energy to be saved for the term of the SOW and specify unit costs to determine the anticipated cost savings on an annual basis for each Energy Savings Measure (ESM).

Definitions

When used in the SOW, the following capitalized words will have the meaning ascribed to them below:

"Annual Verification Report" is defined as the process and report for determining the Verified Savings in each Guarantee Period and reconciling it to the Guaranteed Savings in the same Guarantee Period.

"Baseline Period" is the period of time that defines the Baseline Usage and is representative of the Project Sites operations, consumption, and usage that is used as the benchmark for determining cost avoidance.

"Baseline Energy Use" is the energy usage of the Facilities prior to the implementation of the ESMs, as defined in Schedule B.

"Commencement Date" is the first day of the month following the date of execution of Exhibit A1, the Certificate of Acceptance of All Installed Equipment.

"Energy Costs" include the cost of electricity and fuels to operate HVAC equipment, mechanical and lighting systems, and energy management systems, and the cost of water and sewer usage, as applicable.

"ESM" is the Energy Saving Measure (ESM), which is the installation of equipment or systems, or modification of equipment or systems as described in Section C of the IGEA.

"Excess Verified Savings" is the amount of Verified Savings minus Guaranteed Savings in a Guarantee Period.

"Expected Savings" are the savings calculated based on the equipment installed during the Interim Period.

"Facilities" will mean those described in Section A of the IGEA.

- "First Guarantee Period" is defined as the period beginning on the Commencement Date and ending on the day prior to the first (1st) twelve-month anniversary thereof.
- "Guarantee Period" is defined as the First Guarantee Period and each of the successive twelve (12) month periods commencing on the anniversary of the commencement of the First Guarantee Period for the Guarantee Term.
- "Guaranteed Savings" is defined as the amount of avoided energy unit savings guaranteed to the City in each Guarantee Period. The Guaranteed Savings are set forth in Table A-2 and subject to adjustment in accordance with the terms of Schedule C.
- "IPMVP" will mean the International Performance Measurement and Verification Protocol 2012 and its Measurement and Verification Guidelines for energy savings performance contract projects. The IPMVP guidelines classify measurement & verification approaches as Option A, Option B, Option C, and Option D.
- "Measurement and Verification Plan" (M&V Plan) is defined as the plan providing details on how the Guaranteed Savings will be verified.
- "Operational Costs" will include the cost of operating and maintaining the Facilities, such as, but not limited to, the cost of inside and outside labor to repair and maintain Covered Systems and Equipment, the cost of custodial supplies, the cost of replacement parts, the cost of deferred maintenance, the cost of lamp and ballast disposal, and the cost of new capital equipment as defined for each ESM.
- "Post-Installation Report (PIR)" is defined as the process and report for determining the expected savings for the First Guarantee Period. QESP will submit the report to the City within 90 days following the execution of the Delivery and Acceptance Certificate.
- "Guarantee Term" will be 5 (five) years from the Commencement Date.
- "Verified Savings" is defined as the summation of avoided energy units for each Guarantee Period. These are determined by the Measurement & Verification Plan for the Project Sites in each Guarantee Period as a result of the ESMs.
- "Verified Energy Cost Savings" is the summation of avoided energy cost savings for each Guarantee Period as determined by the Measurement and Verification plan.

Table A-1 lists the Guarantee Period 1 ("Year 1") energy and cost savings that are expected to result from the ESMs to be installed by QESP.

Table A-1: Guarantee Annual Energy Unit Savings and Year 1 Anticipated Cost Savings

Total Year 1 Anticipated Cost Savings	\$344,408	\$127,455	\$43,149	\$29,038	\$621,167	\$47,528	\$79,239	\$93,420	\$27,543	\$13,115	\$69,948	\$153,827	\$27,863	0\$	\$1,677,700
Year 1 Anticipated O&M & Other Costs Savings	\$15,818	\$9,113	\$21,794	\$0	\$88,270	\$0	\$0	\$10,072	80	\$0	\$38,536	\$38,168	\$7,486	\$0	\$229,257
Year 1 Anticipated Energy Costs Savings	\$328,590	\$118,342	\$21,355	\$29,038	\$532,897	\$47,528	\$79,239	\$83,348	\$27,543	\$13,115	\$31,412	\$115,659	\$20,377	\$0	\$1,448,443
Guaranteed Annual Natural Gas (CCF) Savings	(17,522)	0	0	0	215,990	40,828	76,824	77,878	0	0	29,645	127,380	0	0	551,022
Guaranteed Annual Electric (kWh) Savings	1,632,263	881,676	116,829	153,414	2,603,237	13,417	0	0	201,247	97,771	0	0	136,116	0	5,835,970
Guaranteed Annual Electric (kVA) Savings	5,769	0	404	265	0	0	0	0	0	0	0	0	0	0	6,770
Guaranteed Annual Electric (kW) Savings	3,723	421	0	0	0	0	0	0	0	0	0	0	0	0	4, 144
Energy Savings Measures	Interior Lighting Improvements & Controls	Exterior Lighting Improvements	Variable Speed Chillers & Pumps	Air Handling Unit Damper Refurbishments	Energy Management System Upgrades & Expansion	Building Weatherization	Pipe & Fitting Insulation	Steam Traps & Thermostatic Radiator Valves	Plug Load Controls	Walk-In Cooler Controls	Steam Boilers	Hot Water Boilers & Pool Heating Systems	Solar Photovoltaics	New Electric Switchgear & Backup Power Generation	Siejo

Table A-2 lists the Guarantee Period anticipated cost savings that are expected to result from the ESMs to be installed by QESP.

Table A-2: Anticipated Cost Savings

Guarantee Period	Anticipated Total Savings
1	\$1,677,700
2	\$1,735,049
3	\$1,794,371
4	\$1,855,736
5	\$1,919,213

The Guaranteed Savings are subject to the terms included in Schedule C, including those described in the Savings Shortfalls and Guarantee Adjustment sections.

SCHEDULE B

Baseline Energy Consumption

This Schedule B describes the baseline from which the ESMs will be measured and the methodology for adjusting that baseline during the Guaranteed Period.

Baseline Energy Consumption

The QESP has established the baseline energy use for the purpose of measurement and verification of Verified Savings using following information:

- (1) The 36 months of baseline electric energy and natural gas utility bills for the baseline period beginning in January 2013 and ending in December of 2015; and
- (2) The heating and cooling degree days calculated from daily NOAA weather data collected at Hartford, CT for the same baseline period.

Energy consumption across the three years baseline period showed little variance, so, therefore, the three-year data set was averaged to determine baseline energy consumption.

Adjustments to the baseline energy use may be required throughout the Guarantee Period to account both for factors that change routinely, such as weather, and factors that did not vary significantly during baseline period, such as operating hours, building use, occupancy, and issues related to ongoing operation and maintenance of the ESMs and systems affected by the ESMs. If the baseline is adjusted during the Guarantee Term, the adjusted baseline will be used for calculating Verified Savings.

In developing the baseline, the QESP reviewed the baseline energy use against historical weather data. The review found that 30-year historical heating degree days were within 1% of the heating degree days associated with the baseline period. Therefore, no adjustment for weather has been included in the development of the baseline energy use. Adjustments to the baseline energy use have been made to three buildings, Crosby-Wallace Complex, Wilby-North End Complex, and West Side Middle School. These adjustments account for operational deficiencies associated with the HVAC systems in these buildings that will be corrected as part of the project. A description of these adjustments can be found later in this Schedule B, and the calculations can be found in IGEA *Appendix* 2.

Table B-1 provides the baseline energy use and adjustments for each facility.

Table B-1: Baseline and Adjusted Energy Use and Costs for the Baseline Period

Building	Annual Electrical Consumptio n (KWh)	Adjusted Annual Electrical Consumption (KWh)	Annual Gas Consumption (CCF)	Adjusted Annual Gas Consumptio n (CCF)	Annual Electrical Cost	Adjusted Annual Electrical Cost	Annual Gas Cost	Adjusted Annual Gas Cost	Total Baseline Energy Cost	Total Adjusted Baseline Energy Cost
Barnard School ¹	160,280	160,280	29,150	29,150	\$24,839	\$24,839	\$28,027	\$28,027	\$52,865	\$52,865
Bucks Hill School	281,600	281,600	95,399	95,399	\$47,047	\$47,047	\$89,704	\$89,704	\$136,751	\$136,751
Bunker Hill School	157,440	157,440	35,906	35,906	\$25,848	\$25,848	\$36,435	\$36,435	\$62,284	\$62,284
Carrington School ²	636,288	636,288	45,340	45,340	\$118,865	\$118,865	\$43,525	\$43,525	\$162,390	\$162,390
Chase Building	601,779	601,779	46,270	46,270	\$94,248	\$94,248	\$53,253	\$53,253	\$147,501	\$147,501
Chase School ³	251,040	251,040	40,127	40,127	\$43,766	\$43,766	\$39,812	\$39,812	\$83,578	\$83,578
City Hall⁴	1,042,944	1,042,944	42,225	42,225	\$175,174	\$175,174	\$36,143	\$36,143	\$211,317	\$211,317
Crosby-Wallace Complex ^{5.7}	4,275,838	4,329,296	303,653	393,584	\$689,016	\$695,246	\$253,540	\$328,629	\$942,556	\$1,023,87 5
Dept. Public Health	1,063,888	1,063,888	29,397	29,397	\$175,871	\$175,871	\$31,021	\$31,021	\$206,893	\$206,893
Driggs School	213,293	213,293	31,362	31,362	\$35,021	\$35,021	\$32,968	\$32,968	\$67,988	\$67,988
Duggan School	895,488	895,488	38,510	38,510	\$158,929	\$158,929	\$39,051	\$39,051	\$197,981	\$197,981
Enlightenment School	320,920	320,920	14,231	14,231	\$53,784	\$53,784	\$17,658	\$17,658	\$71,442	\$71,442
Generali School	296,960	296,960	32,054	32,054	\$48,755	\$48,755	\$31,512	\$31,512	\$80,267	\$80,267
Gilmartin School	605,423	605,423	28,693	28,693	\$114,098	\$114,098	\$28,618	\$28,618	\$142,716	\$142,716
Hopeville School	148,547	148,547	26,187	26,187	\$24,388	\$24,388	\$30,927	\$30,927	\$55,315	\$55,315
Kennedy School	948,864	948,864	159,055	159,055	\$158,695	\$158,695	\$137,090	\$137,090	\$295,785	\$295,785
Kingsbury School	143,400	143,400	25,184	25,184	\$23,545	\$23,545	\$28,939	\$28,939	\$52,484	\$52,484
Maloney School	792,192	792,192	43,857	43,857	\$137,516	\$137,516	\$39,553	\$39,553	\$177,069	\$177,069
Police Headquarters	1,118,208	1,118,208	47,177	47,177	\$183,469	\$183,469	\$54,567	\$54,567	\$238,036	\$238,036
Reed School	681,385	681,385	30,443	30,443	\$124,665	\$124,665	\$67,856	\$67,856	\$192,522	\$192,522
Regan School	233,280	233,280	11,872	11,872	\$37,991	\$37,991	\$12,668	\$12,668	\$50,659	\$50,659
Rotella School	964,800	964,800	73,098	73,098	\$167,595	\$167,595	\$65,634	\$65,634	\$233,229	\$233,229

Total Adjusted Baseline Energy Cost	\$89,802	\$71,686	\$61,214	\$63,896	\$32,564	\$447,320	\$274,580	\$47,854	\$356,300	\$738,406	\$60,490	\$36,319	\$36,319	\$6,259,697
Total Baseline Energy Cost	\$89,802	\$71,686	\$61,214	\$63,896	\$32,564	\$447,320	\$274,580	\$47,854	\$322,654	\$712,941	\$60,490	\$36,319	\$36,319	\$6,119,26 7
Adjusted Annual Gas Cost	\$16,824	\$40,797	\$32,745	\$31,605	\$15,780	\$127,909	\$4,523	\$24,900	\$80,305	\$198,733	\$32,888	N/A	N/A	31,880,699
Annual Gas Cost	\$16,824	\$40,797	\$32,745	\$31,605	\$15,780	\$127,909	\$4,523	\$24,900	\$49,603	\$176,311	\$32,888	N/A	N/A	\$1,752,38 6
Adjusted Annual Electrical Cost	\$72,978	\$30,890	\$28,469	\$32,291	\$16,784	\$319,411	\$270,057	\$22,955	\$275,995	\$539,673	\$27,602	\$36,319	\$36,319	\$4,375,098
Annual Electrical Cost	\$72,978	\$30,890	\$28,469	\$32,291	\$16,784	\$319,411	\$270,057	\$22,955	\$273,051	\$536,630	\$27,602	\$36,319	\$36,319	\$4,366,881
Adjusted Annual Gas Consumptio n (CCF)	12,478	43,580	25,993	29,290	14,214	181,467	3,480	23,277	87,833	236,865	36,573	NA	N/A	2,014,171
Annual Gas Consumption (CCF)	12,478	43,580	25,993	29,290	14,214	181,467	3,480	23,277	54,253	210,140	36,573	N/A	N/A	1,863,936
Adjusted Annual Electrical Consumption (KWh)	484,587	188,133	173,400	196,680	102,227	1,996,800	1,712,160	139,813	1,625,994	3,214,566	168,120	372,960	372,960	26,636,7715
Annual Electrical Consumptio n (kWh)	484,587	188,133	173,400	196,680	102,227	1,996,800	1,712,160	139,813	1,600,800	3,188,528	168,120	372,960	372,960	26,534,025
Building	Silas Bronson Library	Sprague School	Tinker School	Walsh School	Washington School	Waterbury Arts Magnet School	Waterbury Career Academy ⁶	Wendell Cross School	West Side School ⁷	Wilby-North Complex ⁷	Wilson School	Buckingham Garage	Scovill Garage	Totals

1: Barnard School was closed in 2013 and most of 2014, and then reopened in the September 2014. Any utility consumption prior to September 2014 is not consistent with the current building operations; therefore, we are using January 2015 to December 2015 as the baseline. Notes:

2: Carrington School completed a building extension in 2013, which increased the building square footage from 45,916 to 127,391. Therefore, we are using January 2014 to December 2015 as the baseline to account for the consumption for the current square footage of the building.

3. Chase School has two electric meters with different rate structures, therefore, this electric baseline represents the combined average kWh consumption for both meters.

4: City Hall was recently renovated and reliable historic data was available for March 2015 to February 2016, therefore, we used this as the baseline.

5. Crosby-Wallace Complex historic electrical data was available for January 2014 to December 2015; therefore, we used this as the baseline.

6. Waterbury Career Academy opened in 2013; therefore, we are using January 2014 to December 2015 as the baseline.

7: During the course of our audit, NORESCO evaluated the existing conditions of the air handling equipment and its ability to operate properly, specifically to introduce the proper amount of ventilation required. In three schools, we noticed that many of the outside air damper assemblies were inoperable, which minimizes the resulting utility consumption and costs. Per the RFP, and based on our design due diligence, we recommend improvements to these schools to correct these existing system deficiencies. This requires an adjusted average project baseline energy consumption and associated cost to account for the increase in ventilation to meet Code requirements.

Table B-2 lists the heating and cooling degree days calculated from daily NOAA weather data collected at Hartford, CT for the baseline period.

Table B-2: Weather Data for the Baseline Period

Baseline Period	HDD	CDD
January	1,212	0
February	1,144	0
March	962	0
April	484	8
May	183	101
June	68	177
July	13	326
August	30	229
September	126	138
October	369	20
November	671	2
December	875	0
Totals	6,137	1,001

Baseline Adjustment

NORESCO's data gathering process takes advantage of a very "hands-on" approach. During the energy audit of the facilities, our engineers and technicians spent a great deal of time examining building systems from top to bottom -- from studying the existing controls and sequences, to checking operations of pneumatic dampers and valve actuators, to collecting name plate data from motors and other pieces of equipment. Observations were made of actual operating conditions and the existing control systems in an effort to confirm the current operating sequences and schedules. The available facility blue prints were studied in great detail in order to fill in the gaps in our evaluation and achieve the most effective solution.

NORESCO made selective use of existing controls systems trending data and metering devices to establish the existing operating hours.

NORESCO interviewed facility staff to understand building operations. Extensive information was also gathered through numerous interviews with various building personnel. These included discussions with the facility operators and staff members on site. The accumulated data from these different sources allowed us to develop a very accurate picture of how the facility currently operates.

Based on this operational data gathering process, we observed some existing system deficiencies that reduce the baseline energy consumption and costs below what would be expected if the system was operating properly. Specifically, in Crosby-Wallace Complex, Wilby-North End Complex, and West Side Middle School, the outside air damper assemblies on air handling units were not operable, and therefore, minimized the mechanical ventilation to the

occupied spaces. As part of our baseline analysis, we modeled this in our savings calculations, as well as the resulting baseline adjustment associated with the heating and cooling energy consumption and costs to increase the amount of outside air required to meet Code requirements.

Table B-3 summarizes the baseline adjustment included at Crosby-Wallace Complex, Wilby-North End Complex, and West Side Middle School.

Table B-3: Baseline Adjustments

Total Adjusted Baseline Energy Cost	\$1,023,87 5	\$356,300	\$738,406	\$2,118,58
Total Baseline Energy Cost	\$942,556	\$322,654	\$712,941	\$1,978,15 1
Adjusted Annual Gas Cost	\$328,629	\$80,305	\$198,733	3607,667
Annual Gas Cost	\$253,540	\$49,603	\$176,311	\$479,454
Adjusted Annual Electrical Cost	\$695,246	\$275,995	\$539,673	\$1,510,914
Annual Electrical Cost	\$689,016	\$273,051	\$536,630	\$1,498,697
Adjusted Annual Gas Consumptio n (CCF)	393,584	87,833	236,865	718,282
Annual Gas Consumption (CCF)	303,653	54,253	210,140	568,046
Adjusted Annual Electrical Consumptio n (KWM)	4,329,296	1,625,994	3,214,566	9,169,856
Annual Electrical Consumptio n (kWh)	4,275,838	1,600,800	3,188,528	9,065,166
Building	Crosby-Wallace Complex	West Side School	Wilby-North Complex	Totals

equipment deficiencies which accounts for the lack of outside air. The deficiencies consisted of rusted closed dampers, disconnected At each site, NORESCO personnel conducted a detailed inspection of the AHUs, specifically, the dampers. We documented various damper linkages, and disconnected damper actuators and controls. In addition to the physical inspections, we observed the EMS graphical screens which confirmed our site observations.

The adjusted outside air percentage was determined by a review of the original building mechanical design drawings and equipment schedules. Below are the AHU equipment schedules with a summary of the air flow CFMs, which were used to determine the baseline adjustments due to increased ventilation.

Crosby-Wallace Complex

AHU Equipment Identification	Área Served	Supply Air CFM	Maximum Outdoor Air CFM	Minimum Outdoor Air CFM
1	Classrooms	30,600	24,000	6,600
2	Classrooms	31,350	25,000	6,350
3	Classrooms	35,165	26,000	9,165
4	Classrooms	31,950	25,000	6,950
5	Classrooms	32,210	26,000	6,210
6	Classrooms	32,020	26,000	6,020
7	Classrooms	28,945	24,000	4,945
8	Classrooms	27,350	23,000	4,350
9	Classrooms	30,700	24,000	6,700
10	Multipurpose Room	12,000	10,000	2,000
12	Middle School Music Area	6,700	5,400	1,300
13	Auditorium	18,000	15,000	3,000
14	High School Music Area	14,000	11,000	3,000
21	Locker Rooms	8,000	7,000	1,000
22	Locker Rooms	8,000	7,000	1,000
		435,990	367,400	68,590
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Wilby-North End Complex

AHU Equipment Identification	Area Served	Supply Air CFM	Maximum Outdoor Air CFM	Minimum Outdoor Air CFM
H-1	North Perimeter	14,400	14,100	300
H-3	3rd Floor Core Area	35,600	28,100	7,500
H-4	2nd Floor Core Area	35,900	30,000	5,900
M-2	East Perimeter	13,200	14,000	-800
M-3	2nd Floor Core Area	22,600	18,800	3,800
M-4	3rd Floor Core Area	23,500	18,200	5,300
M-5	West Perimeter	13,300	13,800	-500
C-1	Theater Arts	6,000	5,400	600
C-3	Middle School Cafeteria	12,400	10,400	2,000
C-5	Lobby & Faculty	9,800	6,500	3,300
C-7	High School Cafeteria	13,100	12,000	1,100
C-8	Stage	7,500	7,000	500
C-9	Gymnasium West	19,500	17,000	2,500
C-13	Gymnasium Center	17,400	17,000	400
C-14	Auxilliary Gym West	3,600	3,200	400

AHU Equipment Idenification	Area Served	Supply Ar CFM	Maximum Outcom Air GFM	Minimum Outdoor Air OFM
C-17	Gymnasium East	19,500	17,000	2,500
C-18	Watatorium	20,500	20,000	500
		413,500	378,200	35,300
		and control person species in the measures in decompanies on other members of the first of the f		9%

West Side Middle School

AHU Equipment Identification	Area Served	Supply Air CFM	Maximum Outdoor Air CFM	Minimum Outdoor Air CFM
1	Classrooms	34,500	30,000	4,500
2	Classrooms	29,100	20,000	9,100
3	Classrooms	31,300	26,000	5,300
4	Classrooms	16,000	13,000	3,000
5	Classrooms	22,600	20,000	2,600
7	Administration	15,000	13,000	2,000
8	Arts	6,000	4,260	1,740
9	Auxilliary Gym	6,500	3,000	3,500
10	Lobby	7,200	5,000	2,200
		233,200	199,260	33,940
Annews Carlotte State Carlotte		karkaran sanina matanda ari ini dalah kara ina aka ili pagigi dalah galandagan dalah gara penging da anggi da da		15%

SCHEDULE C

Measurement & Verification Plan

This Schedule C describes the process for measuring and verifying Guaranteed Savings and the associated Verified Energy Cost Savings as well as information that the QESP will provide for the post-installation and annual M&V reporting. The methodology uses the 2012 revision of the International Performance Monitoring and Verification Protocol (IPMVP) as the basis of the savings calculation and verification methodology.

Savings Measurement and Verification Plan

QESP's M&V Plan provides proof of performance for each ESM and overall facility savings. Table C-1 includes the M&V summary plan for this project.

Table C-1: Measurement and Verification Plan Summary for Energy Savings Measures

Contractually Agreed Upon Variables	Fixture power, operating schedule, and HVAC system efficiency	Fixture kW and operating schedule	Weather data, building cooling loads, occupancy schedule, temperature set points, and cooling system efficiency	Weather data, building heating and cooling loads, occupancy schedule, temperature set points, and HVAC system efficiency
Performance Period M&V	For five years, visually inspect a sample of fixtures during the annual inspection to verify that proper replacements are being used and that the fixtures are operating as intended for duration of the contract. Survey maintenance stock and maintenance records to confirm that proper materials are being inventoried.	For five years, visually inspect a sample of the installed fixtures annually to verify that they are operating as intended. Survey maintenance stock and maintenance records to confirm that proper materials are being inventoried.	Inspect annually for five years to verify that chillers and pumps are operating as intended and capable of achieving expected energy savings.	Inspect annually for five years to verify that ESM is operating as intended and capable of achieving expected energy savings.
Post-Installation M&V	Measure fixture wattage of a statistically representative sample of each selected lampballast combination. Verified electric energy savings will reflect final as-built quantities and pre- and post- retrofit fixture wattage measurements. Post-retrofit operating hours will be based on agreed-upon occupancy hours.	Post-installation lighting kW will be based on manufacturer's specifications, and hours of operation consistent with baseline hours.	Post-Installation energy use based on manufacturer's specifications. Savings calculations based on baseline heating and cooling loads.	Post-Installation energy use based on manufacturer's specifications, and hours of operation consistent with baseline hours.
Baseline M&V	Establish facility lighting kW utilizing instantaneous kW measurements of a statistically representative sample of common lamp-ballast combinations, and established hours of operation through deployment of data loggers and via interviews with facility personnel.	Establish baseline based on manufacturer's specifications, and establish hours of operation through based on site observations and discussions with facility personnel.	Baseline energy use established based on manufacturer's specifications. Hours of operation established through review of trended control system data and interviews with facility personnel.	Baseline energy use established based on manufacturer's specifications. Hours of operation established through trend data and interviews with facility personnel
Energy Savings Units	kWh, kW, kVA, ccf	kwh kw kw	kWh, kVA	K. K. A. J.
M&V Option	∢	Α	⋖	Ч
ESM Description	Interior Lighting Improvements & Controls	Exterior Lighting Improvements	Variable Speed Chillers & Pumps	Air Handling Unit Damper Refurbishments
SE		2		4

Performance Period M&V	Perform annual onsite Weather data, inspection for five years to building heating verify that EMS is operating as intended and is properly cocupancy flect maintained. Review trend reports and issue quarterly reports that identify operational changes that may impact system efficiency energy savings.	Inspect annually for five years to verify that envelope to verify that envelope ted improvements are in good condition and capable of occupancy and achieving expected energy schedules, space temperature setpoints	Inspect annually for five years Weather data, for verify that insulation is in loads, hours of achieving expected energy operation, system savings. Savings. temperature, and pipe and insulation thermal conductivity	w Visually inspect sample of Weather data, traps annually for five years steam system ate and discuss maintenance and loads, hours of ig operation with city personnel. operation, steam operating	inspect annually for five years Equipment electric to verify controls remain in place, in good condition and capable of achieving expected energy savings.
Post-Installation M&V	Verify proper installation and configuration during commissioning period. Postretrofit consumption based on baseline model updated to reflect agreed upon EMS schedules and set-points.	Verify proper installation of weatherization materials during commissioning period. Expected energy savings will be determined using design specifications and manufacturers' performance data.	Verify proper installation of new insulation during commissioning period. Expected energy savings will be based on design specifications and manufacturer's information.	Verify proper installation of new steam traps during commissioning period. Calculate expected energy savings using design specifications and manufacturer's information.	Verify proper installation during commissioning period. Expected energy savings using design specifications and manufacturer's information.
Baseline M&V	Measure a representative sample of baseline motor kW to establish motor power. Baseline occupancy schedule based on equipment runtime trend data and interviews with facility personnel. Existing space temperatures and schedules based on current set points.	Determine baseline energy consumption using information obtained from building drawings, manufacturers' data, interviews with facility staff, and site audits to determine current condition of existing weatherization.	Determine baseline energy use through a facility-wide audit of heating system insulation in the scope of this measure. The audit will be used to characterize the insulation condition and losses.	Baseline calculated based on audit inventory, trap failure rates, and hours of operation.	Baseline calculated based on inventory of equipment, manufacturers' ratings. and agreed-upon hours of operation established through interviews with facility personnel
Energy Savings Units	kWh, ccf	KWh, cof	OG of	- 60	ΚWh
M&V Option	<u> </u>	Α	4	Y	4
ES ESM Description	Energy Management System Upgrades & Expansion	Bullding Weatherization	7. Pipe & Fitting Insulation	Steam Traps & Thermostatic Radiator Valves	9: Plug Load Controls

S≅	ESM Description	M&V Option	Energy Savings Units	Baseline M&V	Post-Installation M&V	Performance Period M&V	Contractually Agreed Upon Variables
0)	Walk-in Cooler Controls	Y	kWh	Determine baseline energy use using manufacturers' data, onsite observations, and interviews with facility personnel.	Verified energy savings for controls will be determined using design specifications and manufacturers' performance data.	Perform onsite inspections annually for five years to verify that equipment is in good condition and capable of achieving expected energy savings.	Equipment efficiency, system design, and temperature setpoints
E ₩	Steam Boilers	В	Çef	Baseline calculated based on pre-retrofit combustion efficiency measurements and operating hours based on calculated baseline heating load.	Post-installation consumption based on post-retrofit combustion efficiency measurements and operating hours based on post-retrofit heating load.	For five years, inspect annually to verify boilers remain in place, in good condition and capable of achieving expected energy savings. In addition, perform combustion efficiency measurements.	Weather data, building heating loads, occupancy schedule, temperature set points
12	Hot Water Boilers & Pool Heating Systems	B	ु ज	Baseline calculated based on pre-retrofit combustion efficiency measurements and operating hours based on calculated baseline heating load.	Post-installation consumption based on post-retrofit combustion efficiency measurements and operating hours based on post-retrofit heating load.	For five years, inspect annually to verify boilers remain in place, in good condition and capable of achieving expected energy savings. In addition, perform combustion efficiency measurements.	Weather data, heating loads, occupancy schedule, temperature set points, and boiler combustion efficiency
<u>0</u>	Solar Photovoltaics	Ф.	ĸWh	Baseline energy is the amount of electric use to be offset by the PV system.	Post-installation output based on measurements of PV system for two weeks, normalized for standard test conditions.	Verified savings will be based on ongoing metering of electric production normalized to typical year irradiance and temperature data.	N/A
<u>4</u>	New Electrical Switchgear & Backup Power Generation	N/A		There are no er	There are no energy savings associated with this measure and therefore no M&V. Plan.	neasure and therefore no M&V Pla	Ü

ESM 1: Interior Lighting Improvements & Controls

Savings Calculation Methodology

This ESM replaces existing lighting system components with new high-efficiency light emitting diode (LED) units. This ESM also installs controls to minimize lighting operating hours in selected areas where additional controls were determined to be effective.

QESP created a spreadsheet model using baseline fixture power measurements, measured operating and occupancy hours, and other pertinent information to determine the energy consumed by existing lighting systems in use at the various City premises. This spreadsheet model establishes baseline energy consumption for this ESM.

To calculate the proposed direct energy savings, fixtures were grouped by baseline lamp and ballast combination (LBC), post-installation LBC, and hours of operation. Energy savings calculations for this ESM used data from the following sources:

An on-site audit

Measured electric demand (kW) of a sample of the existing fixtures Industry standard lighting wattage tables showing standard consumption of the major Lighting-Ballast Combinations (LBCs)

Data loggers to determine operating and occupancy hours

Data provided by facility personnel (facility schedules)

Key parameters that affect baseline energy use include fixture energy use and operating hours. Building operating and occupant data was provided by City staff. If any of these parameters could not be determined from these sources, QESP estimated the parameter based on standard engineering practices and experience.

For each line item in the inventory, the verified electric demand and energy savings will be calculated using the following equations:

$$ES_{LIGHTING} = (P_{base} * N_{base} - P_{post} * N_{post}) * H_{base}$$

Where:

 $\mathsf{ES}_{\mathsf{lighting}} \quad = \quad \mathsf{Energy} \; \mathsf{savings}, \; \mathsf{in} \; \mathsf{kWh}, \; \mathsf{for} \; \mathsf{the} \; \mathsf{lighting} \; \mathsf{retrofits}.$

P_{base} = Electrical power, in kW, per luminaire for appropriate baseline LBC group.
P_{post} = Electrical power, in kW, per luminaire for appropriate post-installation LBC group.

H_{base} = Existing annual operating hours defined by luminaire's pre hours group.

N_{base} = Number of luminaires in representative baseline LBC group.

N_{post} = Number of luminaires in representative post-installation LBC group.

For each group of luminaires, we calculated the monthly demand savings as follows:

$$DS_{LIGHTING} \, = \, \left(P_{base} \, * \, N_{base} \, - \, P_{post} \, * \, N_{post} \right) * \, DF_{lighting}$$

Where:

DSighting = Monthly demand savings, in kW, for the lighting retrofits.

P_{base} = Electrical power, in kW, per luminaire for appropriate baseline LBC group.
 P_{post} = Electrical power, in kW, per luminaire for appropriate post-installation LBC group.
 DF_{lighting} = Hours group diversity factor, as a percentage in IGEA Appendix 1: Savings Calculations.

 N_{base} = Number of luminaires in representative baseline LBC group.

The results of these LBC calculations are summed for total kW and kWh savings. Cost savings are determined by multiplying the expected demand and energy savings by the approved incremental energy costs listed in Table 1-12. This calculation can be found in IGEA *Appendix 1: Savings Calculations*. Project savings by building are also included in IGEA *Appendix 1: Savings Calculations*.

Lighting Controls

To calculate the proposed lighting control savings, luminaires have been grouped with other luminaires sharing the same baseline LBC group, post-installation LBC group, and hours of operation. The baseline and post-installation operating hours by building for all lighting equipment is detailed in IGEA *Appendix 1: Savings Calculations*.

QESP based projected energy savings on the actual installed quantities of luminaires. For each group of luminaires, QESP calculated the energy savings during each time of use period as follows:

$$ES_{controls} = \{(P_{post} * H_{base}) - (P_{post} * H_{post})\} * N_{post}$$

Where:

 $ES_{controls}$ = Energy savings, in kWh, for the on/off controls.

P_{post} = Electrical power, in kW, per luminaire for appropriate post-installation LBC group

 H_{base} = Baseline annual operating hours defined by luminaire's pre-hours group

H_{post} = Post-Installation annual operating hours defined by luminaire's post hours group

 N_{post} = Number of luminaires in representative post-installation LBC group

The post-installation operating hours are based on reductions to the baseline operating hours determined via measurements, direction and input from the City, staff interviews, and on-site observations. For each group of luminaires in this ESM, QESP calculated the monthly demand savings for the lighting controls as follows:

Where:

DS_{controls} = Monthly demand savings, in kW for the lighting controls

P_{post} = Electrical power, in kW, per luminaire for appropriate post LBC group
DF_{controls} = Diversity factor; as a percentage in IGEA Appendix 1: Savings Calculations

 N_{post} = Number of luminaires in representative post-installation LBC group

Heating and Cooling Interaction

The proposed lighting upgrade reduces the wattage and hours of operation for lighting, which in turn produces less heat in the lighted areas. Since cooling systems have less heat to remove, less air conditioning energy is required.

The actual heat contributed to the cooling load varies by luminaire type (recessed, surface-mounted, suspended, open, or enclosed), air return (open plenum or ducted return), and the amount of exhausted air. To represent various lighting and ventilation systems, QESP assumes that, in conditioned spaces, electrically produced mechanical cooling removes an average of 90

percent of light-generated heat. Luminaires in unconditioned spaces, such as outdoor areas, stairways, mechanical rooms, and high-bay areas, have no effect on the mechanical cooling systems. Therefore, cooling savings calculations do not include these luminaires.

For each group of luminaires in conditioned spaces, QESP calculated the heating ventilating and air conditioning (HVAC) cooling energy savings during each time of use (TOU) period as follows:

$$ES_{Cooling} = \frac{ES_{lighting}*C_{energy}*(1-\%_{BHO})}{C_{capacity}} * EFF * UTIL_{Cooling}:$$
 Where:
$$ES_{cooling} = \text{Energy Savings, in kWh, for the HVAC cooling interaction} \\ ES_{lighting} = \text{Energy Savings, in kWh, for the lighting retrofits (from conditioned spaces only)} \\ \text{includes controls savings} \\ C_{energy} = \text{Conversion factor} = 3,413 \text{ Btu/kWh} \\ \%_{BHO} = \text{Percentage of the Building that is heating only} \\ C_{capacity} = \text{Conversion factor} = 12,000 \text{ Btu/ton-hr, cooling capacity} \\ EFF = \text{Mechanical cooling efficiency, in kW/ton, from IGEA } 1: Savings$$

$$UTIL_{Cooliing} = \text{Cooling Utilization, is the cooling season length in fractions of a year multiplied} \\ \text{90\%, from IGEA } Appendix 1: Savings Calculations}$$

QESP determined the contribution to peak demand savings by applying a diversity factor to the gross kW load. The LBC's hours group determines the demand diversity factor already applied to the demand savings for direct lighting and lighting controls. For each group of luminaires in conditioned spaces, QESP calculated the HVAC monthly demand savings as follows:

$$DS_{cooling} = \frac{\left(DS_{lighting} + DS_{controls}\right) * C_{energy} * HC}{C_{energy}} * EFF$$

```
Where:  DS_{cooling} = \\ DS_{cooling} = \\ DS_{iighting} = \\ DS_{controls} = \\ DS_{
```

In heating season, the reduction in heat from the lighting upgrades results in the need for increased mechanical heating. For each group of luminaires in conditioned spaces, QESP calculated the HVAC heating energy penalty during each TOU period as follows:

$$HP_{Cooling} = \frac{ES_{lighting} * C_{energy} * HC}{C_{MMBtu} * EFF * SEA_{heating}}$$
 Where:
$$HP_{cooling} = Heating penalty, in MMBtu, for the HVAC interaction Energy savings, in kWh, for the lighting retrofits (in conditioned spaces only) controls savings
$$C_{energy} = C_{onversion} factor = 3,413 \; Btu/kWh$$

$$C_{MMBtu} = C_{onversion} factor = 1,000,000 \; MMBtu/Btu$$

$$EFF = Mechanical heating efficiency, as a percentage, in IGEA Appendix 1: Savings$$

$$Calculations$$$$

SEA_{heating} = Heating season, in percent of year

To determine cost savings, QESP multiplied the energy and demand savings of all luminaire groups (minus the heating penalty) by the approved incremental energy costs.

M&V Activities During IGEA

QESP has performed fixture power measurements for a statistical sample of the baseline fixture types that represent approximately 76% of the total connected baseline lighting load. Measurements were performed at the fixture or circuit level. QESP used these measurements to determine the averaged fixture power for the existing lighting system. The measured average was applied to the specific LBCs in the line-by-line lighting audit in IGEA *Appendix 1: Savings Calculations*.

The baseline Measurement & Verification Sampling Plan and field notes are included in IGEA Appendix 4: Audit Data.

QESP also measured lighting operating hours for representative areas. We placed data loggers in representative spaces and used the data to determine the run hours for these spaces.

Post-Installation Period

Post-installation lighting fixture electrical use will be based on spot fixture wattage measurements taken on a statistically significant sample of different lighting-ballast combinations or lighting fixture types. Post-installation energy use will be based on the measurement results, the calculations described above, and the as-built conditions.

M&V Activities during the Performance Period

QESP will perform a visual inspection of a sample of fixtures on an annual basis for the Guarantee Term. QESP will also survey maintenance stock and maintenance records to confirm that the proper replacement equipment is being inventoried. All noted discrepancies and improper maintenance practices will be reported. Resolution of these deficiencies and the savings implications of such will be the responsibility of the City. No measurements will be performed in the performance phase. Verified Savings throughout the performance period will be based on the calculations described above and the results documented in the Post-Installation Report (PIR).

ESM 2: Exterior Lighting Improvements

Savings Calculation Methodology

This ESM optimizes the existing lighting systems by upgrading the current lighting with lower wattage LED fixtures. QESP proposes to achieve this by replacing exterior high intensity discharge (HID) recessed down-lights, as well as building-mounted and parking lot fixtures with new high-efficiency LED fixtures.

QESP created a spreadsheet model of the lighting system's baseline electrical use based on manufacturer's specifications, operating hours, and other pertinent information.

Energy savings calculations for this ESM used data from the following sources:

An on-site audit

Manufacturers' performance data

Operating hours based on site observations and interviews with facility personnel Key parameters that affect baseline energy use include fixture energy use and operating hours.

M&V Activities During IGEA

Pre-installation audits and site observations were used for establishing the baseline energy consumption in conjunction with manufacturer's specifications of the existing exterior fixtures. The hours of operation were determined from site observations and interviews with facility personnel.

Post-Installation Period

Post-installation energy use will be based on the commissioning of the new fixtures, as well as the calculations described above. The agreed-upon fixture wattages will be based on the manufacturer's specifications. QESP will inspect the fixtures to verify that they have been installed properly and are functioning as intended. If the equipment installed differs materially from the proposed strategies, then the models will be revised to reflect the equipment and strategies that were actually implemented. If the modification is directed by the City, it may also require changes to the Guaranteed Savings.

M&V Activities During the Performance Period

QESP will perform a visual inspection of a sample of fixtures on an annual basis for the Guarantee Term. QESP will also survey maintenance stock and maintenance records to confirm that the proper replacement materials are being inventoried. All noted discrepancies and improper maintenance practices will be reported. Resolution of these deficiencies and the savings implications of such will be the responsibility of the City. Verified Savings throughout the performance period will be based on the calculations described above and the results documented in the PIR.

ESM 3: Variable Speed Chillers & Pumps

Savings Calculation Methodology

QESP will replace the two existing water-cooled chillers at Crosby-Wallace complex with two new 250-ton units. The new integrated variable speed, water cooled, screw chillers will make use of the environmentally friendly refrigerant R-134A to reliably and efficiently cool the High School and Middle School buildings.

Installing new variable speed chillers will eliminate two aging chillers that use ozone-depleting refrigerant R-22, which is no longer produced. The new chillers will also reduce the complex's electrical consumption and utility costs while improving reliability and comfort. The City of Waterbury will also benefit from reduced labor requirements, lower maintenance costs, and reduced future equipment replacement costs.

QESP created a model to determine the building cooling load profiles. This model was used in conjunction with electric usage history, trended data, and usage times based on logger data and estimations, to calibrate the baseline models.

The spreadsheet cooling end use model used data from the following sources:

Building drawings (building areas, construction, and HVAC equipment capacities and other data)

Weather data from Hartford, CT.

Electric usage data from billing records

Equipment runtimes based on EMS trend data

Estimated existing equipment parameters and efficiency based on manufacturer's performance data.

Discussions with facility personnel (occupancy hours, setpoints, number of occupants, operating hours of equipment)

If any of these parameters could not be determined from these sources, QESP determined the most likely parameter based on standard engineering practices and experience.

Key parameters that affect baseline energy use include cooling system efficiency, weather, cooling loads, operating hours, and building material and insulation performance characteristics. Building operating and occupant data was provided by the City. Building construction and insulating values of components such as walls, roofs, and windows were obtained from construction drawing data.

M&V Activities During IGEA

Pre-installation audits and site observations were used for establishing the baseline cooling energy use in conjunction with manufacturer's specifications and nameplate data. Characteristics of baseline chiller equipment were utilized for the assumptions that went into the spreadsheet models with regards to cooling loads and operating hours.

Post-Installation Period

Post-installation energy consumption will be based on the commissioning of the equipment as well as the calculations described above. The post-retrofit energy usage will be taken from the manufacturer's specifications and nameplate data. QESP will inspect the chillers to verify that they have been installed properly and are functioning as intended. If the equipment installed differs materially from the proposed strategies, then the models will be revised to reflect the equipment and strategies that were actually implemented. If the modification is directed by the City, it may also require changes to the Guaranteed Savings.

M&V Activities During the Performance Period

The chillers, and associated equipment installed as a part of this ESM will be inspected annually for the Guarantee Term to verify that they are in place and operating as intended. No measurements will be performed. Any modification of the equipment, or changes from its intended function are the responsibility of the City. Deficiencies in the chillers' ability to perform will be noted by QESP in the Annual Verification Report (AVR) and corrective actions will be discussed with the City. Verified Savings will be based on the results documented in the PIR.

ESM 4: Air Handling Unit Damper Refurbishments

Savings Calculation Methodology

QESP proposes to refurbish seventy-six (76) air handling units (AHUs) in various City buildings. The scope of work will include installing thirty-four (34) new outdoor/return/exhaust air dampers

and refurbishing/rebuilding one hundred and forty-six (146) existing-to-remain outdoor/return/exhaust air dampers.

Refurbishing the AHUs at the City schools will reduce the ongoing maintenance burden on the City HVAC shop and improve temperature control and air quality of the schools while reducing energy costs. Through improved system technologies and efficiencies, the AHUs will provide more reliable and consistent comfort levels, improve indoor air quality, improve system performance under varying conditions, and reduce current maintenance and service costs.

QESP proposes to perform a thorough servicing of key components and install new replacement parts where selected on the existing AHU equipment to bring the units back to their original heating, cooling, and ventilating capacities and efficiencies. Extending the useful life of the equipment will avoid the need for a considerable capital investment in the AHUs and allows the City flexibility in prioritizing where to use scarce capital funds elsewhere.

QESP created a model to determine the building heating and cooling load profiles. This model was used in conjunction with electric and fuel usage history, and estimated equipment usage times, to calibrate the baseline models.

The spreadsheet heating and cooling use model used data from the following sources:

Building drawings (building areas, construction, and HVAC equipment capacities and other data)

Weather data from Hartford, CT

Electric usage data from billing records

Fuel usage from billing records.

Equipment runtimes based on trend logs and loggers installed on pre-retrofit units

Estimated existing equipment parameters and efficiency

Discussions with facility personnel (occupancy hours, setpoints, number of occupants, operating hours of equipment)

If any of these parameters could not be determined from these sources, QESP determined the most likely parameter based on standard engineering practices and experience.

Key parameters that affect baseline energy use include heating and cooling system efficiency, heating and cooling loads, weather, operating hours, and building material and insulation performance characteristics. Building operating and occupant data was provided by City staff. Building construction and insulating values of components such as walls, roofs, and windows were obtained from construction drawing data.

M&V Activities During IGEA

Pre-installation audits and site observations were used for establishing the baseline heating and cooling energy use in conjunction with manufacturer's specifications and nameplate data. Characteristics of baseline HVAC equipment were utilized for the assumptions that went into the spreadsheet models with regards to heating and cooling loads and operating hours.

Post-Installation Period

Post-installation energy consumption will be based on the commissioning of the AHU refurbishments as well as the calculations described above. If the equipment installed differs materially from the proposed strategies, then the models will be revised to reflect the equipment

and strategies that were actually implemented. If the modification is directed by the City, it may also require changes to the Guaranteed Savings.

M&V Activities During the Performance Period

QESP will conduct annual inspections during the Guarantee Term to confirm that the refurbished equipment is installed and operating as intended, and capable of achieving the expected savings. No measurements will be performed. Any modification of the equipment, or changes from its intended function are the responsibility of the City. Noted deficiencies in the AHUs ability to perform will be reported in the AVR and corrective actions will be discussed with the City. Verified Savings will be based on the results documented in the PIR.

ESM 5: Energy Management System Upgrades & Expansion

Savings Calculation Methodology

QESP proposes to install new, comprehensive web-accessible direct digital control (DDC) energy management systems and/or retro-commission the existing-to-remain control systems. The new electronic controls will automatically enable HVAC systems and modulate heating, cooling, and ventilation to maintain space temperature set points. Schedules will be set up in accordance with occupancy to reduce energy use during off hours. For retro-commissioning, QESP will evaluate the HVAC and controls systems and identify and correct existing deficiencies with the controls and sequences of operation.

New energy management systems (EMSs) in the Waterbury facilities will improve building occupant comfort, reduce energy costs, reduce maintenance costs, and provide increased monitoring, control, and trouble-shooting of building HVAC systems.

To form the strategies for the included facilities, computer models were developed for each city facility and the operation of the various HVAC systems was analyzed. These models were used to identify opportunities for controls improvements and to calculate energy savings. Several tables in the Investment Grade Energy Audit (IGEA) Report show a simplified version of the analysis for each of the affected systems at each building. These tables are the basis for determining the energy savings that will result from installing the energy management systems and the associated control strategies.

The savings from the EMS are not dependent upon the improved efficiency of new equipment; instead, the savings depend entirely on the software control strategies, the programmed setpoints and schedules, and the hardware that implements the control strategies. After the installation of the EMS, QESP will verify that the energy saving control sequences are operational and functioning as specified in the IGEA Report. Energy savings calculations are documented in the IGEA Appendix 1: Savings Calculations.

The parameters used to determine the baseline and post energy usage are:

Engineering weather data from Hartford, Connecticut

Occupied and unoccupied space temperature settings

Outside air lockout temperature for heating and cooling systems

Occupancy schedules for the equipment

Size of the buildings and the heating, ventilation, and cooling requirements

Equipment runtimes based on trend logs and loggers installed on pre-retrofit units Efficiency of heating and cooling equipment, including fan and pump motors Baseline motor power measurements

Capacity of the heating, ventilation, air distribution systems

M&V Activities During IGEA

Pre-installation audits, site observations, and logger data were used for establishing the baseline equipment runtimes. The pre-retrofit space temperatures and setpoints were based on the current EMS setpoints. Characteristics of baseline HVAC equipment, including equipment efficiency, were taken from nameplate data, in conjunction with motor power measurements, to confirm the assumptions that went into the spreadsheet models with regards to heating and cooling loads.

Post-Installation Period

Post-installation energy consumption will be based on the model described above updated to reflect the agreed-upon set points, schedules, and sequences located in the IGEA Report, Section C, ESM 5. During the commissioning phase, QESP will verify occupied and unoccupied schedule settings and temperature setpoints. EMS hardware and associated controls will be commissioned and the software will be programmed to insure proper operation. If the equipment installed or strategies implemented differ materially from the proposed strategies, then the models will be revised to reflect the equipment and strategies that were actually implemented. If the modification is directed by the City, it may also require changes to the Guaranteed Savings.

M&V Activities During the Performance Period

During the Guarantee Term, QESP will analyze trended data from the upgraded EMSs at several of the City schools to evaluate the performance of the implemented schedules, setpoints, and control strategies at those facilities. QESP's trend reviews will focus primarily on units and strategies that represent the majority of the EMS-related cost savings. QESP will also review the units with smaller amounts of savings, but will do so on a rotating basis given their smaller impact on overall project performance.

For the Guarantee Term, QESP will perform quarterly reviews of EMS trends and will submit a quarterly report to the City. During these trend reviews, QESP will verify that the installed strategies and setpoints remain in place. Noted changes to building schedules, occupancy hours, or setback and setup temperatures are the responsibility of the City. QESP will note these changes when found and inform the City. On-site inspection of a sample of the installed EMS components will also be performed annually for the Guarantee Term.

The AVR will include information on the results of the trend reviews and site inspection. If changes to the energy strategies have been made that have the potential to negatively impact savings, corrective actions will be discussed with the City. Since any changes are outside of QESP's control, these modifications will not result in adjustments to the post-installation energy consumption model. Energy savings shown in the AVR will be based on results documented in the PIR.

Some of the key parameters that will be trended include:

Boiler status

- Temperature setpoints during occupied and unoccupied hours
- Fan runtimes
- Fan speed
- Outside air damper positions
- Space CO₂ concentrations
- Supply air temperatures
- Mixed air temperatures
- Return air temperatures
- Outside air temperatures

The list of parameters shown is not meant to be all-inclusive. Additional trending will be performed as appropriate to document savings. Monitoring of these systems will require QESP to access these systems both on-site and remotely. Maintenance of the trends and the agreed-upon communications pathway are the responsibilities of the City for the term of the contract. The ability to perform the trend review will be contingent on the City maintaining the trend logs that QESP will set up during the implementation phase of the project, and allowing QESP access to the data from the EMS. If the City fails to maintain the trends or to allow NORESCO's access thereto, the performance period M&V will be limited to the annual inspections.

ESM 6: Building Weatherization

Savings Calculation Methodology

QESP will reduce infiltration by sealing cracks with foam or beads of caulk as needed, improving door seals, replacing worn sweeps and weatherization strips on doors, making roof-to-wall joint gaps airtight and sealing exterior shell penetrations. Where cost-effective, QESP proposes to install blown-in cellulose in building attic spaces. Sealing these penetrations will improve thermal performance and reduce infiltration of outside air into the buildings, which will improve occupant comfort and reduce energy consumption. Baseline energy consumption for existing insulation and weather stripping components were calculated using a spreadsheet model based on engineering values of the materials and standard heat transfer formulas.

The overall savings for this ESM are the difference between the pre-installation and post-installation energy losses. These savings calculations are further detailed in the IGEA Appendix 1: Savings Calculations.

M&V Activities During IGEA

During the IGEA, room space temperatures, occupancy schedules and set points were obtained from EMS trend logs and interviews with facility staff. Site observations provided additional information for use in a calculation spreadsheet. Building construction materials and weather data were also used to determine how much energy was being lost through the inefficient building construction materials in the pre-retrofit condition.

Post-Installation Period

The post-retrofit energy use for the upgraded area will be calculated based upon the baseline spreadsheet model updated to reflect the installation of the upgraded weatherization materials.

QESP will perform an inspection of the weatherization materials to confirm that it is installed where proposed.

M&V Activities During the Performance Period

The materials installed as part of this measure will be inspected annually for the Guarantee Term to verify that they are in good condition and capable of achieving the expected savings. No other measurements will be performed. Any noted deficiencies or deviations from the intended function of the equipment discovered during the inspection will be reported to the City in the AVR. Verified Savings will be based on the results documented in the PIR.

ESM 7: Pipe & Fitting Insulation

Savings Calculation Methodology

QESP will insulate exposed steam and hot water heating system piping in the boiler rooms of the City's buildings with new fiberglass blanket insulation. Associated ancillaries such as valves, flanges, fittings, and other equipment will be insulated with removable jacket insulation. The new insulation will greatly reduce the thermal losses associated with the steam and hot water piping systems. A reduction in thermal losses will lower the demand on the heating systems in the associated buildings, reducing fuel consumption and utility costs. Insulating bare steam equipment will also make these buildings safer for students and staff.

QESP used a publicly available software application (3EPlus) model to calculate pipe equipment heating load profiles. The model was used in conjunction with fuel usage history, weather data, size and surface area of equipment, fittings, and pipe, and construction materials to calculate the baseline and post-retrofit energy losses.

M&V Activities During IGEA

QESP examined building drawings, performed visual inspections, to determine the baseline heating and cooling system use, surface area fittings and equipment, and measured length of pipe to be used in the spreadsheet model.

Post-Installation Period

QESP will review insulation specifications to confirm that the insulation R-Value meets the proposed value. QESP will perform an inspection of the insulation to confirm insulation is installed where proposed.

M&V Activities During the Performance Period

The insulation installed as part of this measure will be inspected annually for the Guarantee Term to verify that it remains in place and is capable of achieving the expected savings. No other measurements will be performed. Any deficiencies discovered during the inspection will be reported to the City in the AVR. Verified Savings will be based on the results documented in the PIR.

ESM 8: Steam Traps & Thermostatic Radiator Valves

Savings Calculation Methodology

A comprehensive steam trap audit was performed which identified failed and misapplied traps. This ESM will replace or repair approximately 262 traps to generate energy savings and prolong the service life of equipment served by the steam system. Traps that leak result in thermal losses, and can cause water hammer, corrosion, and damage to heat transfer equipment. By repairing or replacing faulty steam traps with new, properly functioning traps comfort conditions in these buildings will be improved and thermal energy savings will be achieved.

QESP utilized a spreadsheet calculation based on Grashof's formula for steam flow through an orifice to calculate the baseline and post-installation energy consumption for the steam trap portion of this ESM. This spreadsheet uses key parameters such as steam pressure, orifice size, and annual hours of operation to determine the amount of steam lost through a steam trap that is failed in the open position. Summing the losses from each of the failed traps included in this ESM yields the baseline energy consumption for this ESM.

Pre- and post-retrofit steam, or thermal, losses are calculated using the formula as its basis:

$$q = h \times I \times g$$

Where:

Thermal Heat Loss (lb steam)

= Operating Hours (hrs) = Failure Rate (%) h

Grashof Number (dimensionless)

Major assumptions for the use of this formula are that the orifices have well-rounded edges and the backpressure is less than the critical flow pressure. The overall annual flow is determined by multiplying the calculated hourly mass flow rate by the annual trap operating hours.

The post-installation energy consumption is calculated in the same manner, but this calculation assumes that only a small fraction of the traps fail between inspections. The difference between the baseline and post-installation steam trap losses equals the steam trap savings.

A comprehensive steam radiator/convector control valve audit was performed which identified their existing control configurations. This ESM will install approximately 812 thermostatic radiator valves (TRVs) to automatically control the steam equipment's heat output to generate energy savings as well as significantly improve the comfort conditions in the spaces served. The installation of these temperature control valves will also include the removal of existing obsolete and problematic pneumatic valves and thermostats, resulting in additional maintenance cost savings as well as the energy savings associated with running the building air compressors.

For energy savings associated with the thermostatic radiator valves, NORESCO uses site specific parameters and the following formula to calculate steam energy loss through the existing failed control valves.

```
• q = A \times P \times H \times I \times FR \times h / (103,000 \text{ Btu/CCF} \times \text{System efficiency})
```

Where:

q = Thermal Heat Loss (lb steam)

A = Average radiator area (sq. in.)

P = Steam Rate (lbs/hr)H = Annual Heating Hours

I = Idle Time (estimated new radiator valves let steam into radiators and convectors XX% of the time)

FR = Failure Rate (estimated existing radiator valve failure rate)

h = Energy Content (Btu) in 1 lb of steam

M&V Activities During IGEA

QESP performed a pre-installation audit to identify failed and misapplied traps, and control valve configurations. Key parameters that affect baseline energy use is the number of traps failed open, the sizes, pressures, and annual operating hours of these traps. For the TRVs, key parameters are the number of valves failed open, sizes, pressures, and annual operating hours for the valves.

Post-Installation Period

QESP will inspect the new traps and TRVs after installation is complete to verify that the equipment are in place and operating as intended. The results of the inspection will be documented and provided to the City.

M&V Activities During the Performance Period

A sample of steam traps and thermostatic radiator valves installed as part of this measure will be visually inspected annually during the Guarantee Term and maintenance and operations will be discussed with City personnel. No measurements will be performed. Any deficiencies discovered during the inspection will be reported to the City in the AVR. Verified Savings will be based on the results documented in the PIR.

ESM 9: Plug Load Controls

Savings Calculation Methodology

QESP will install plug load management technology to provide energy savings during unoccupied hours and weekends. The installation includes controllable electrical receptacles, building controllers, and web-based application and software suite for programming, analytics, reporting, with a visual dashboard.

QESP will implement smart power receptacles that remove the need to unplug from the wall when office equipment is not in use. The system uses a cloud-based software application to control whether the new smart receptacles will allow electrical power to be provided to the plugged in device, as well as measure the power being used. The web-based software will communicate with the smart receptacles via building controllers and either the existing LAN infrastructure and Wifi or Power Line modem in the buildings. The deployment of the equipment will be dependent upon the function, use, and occupant base of the buildings.

QESP created a spreadsheet model to determine the energy consumption of printers, copiers, vending machines, and other electrical equipment. This model was used in conjunction with manufacturer's ratings, and pre/post-retrofit hours of operation to calibrate the baseline model.

M&V Activities During IGEA

Pre-installation audits and site observations were used to establish the baseline energy consumption in conjunction with manufacturer's ratings of the existing electrical equipment and agreed-upon pre-retrofit hours of operation.

Post-Installation Period

Post-installation energy consumption will be based on the commissioning of the power management software installation as well as the calculations described above. QESP will inspect the head end software to verify that the software has been installed properly and is functioning as intended. If the equipment installed differs materially from the proposed strategies, then the models will be revised to reflect the equipment and strategies that were actually implemented. If the modification is directed by the City, it may also require adjustments to the Guaranteed Savings.

M&V Activities During the Performance Period

QESP will conduct annual inspections on a sample of the installed equipment during the Guarantee Term to confirm that the smart power receptacles and new software remain installed and operate as intended. No measurements will be performed. Any modification of the equipment, or changes from its intended function are the responsibility of the City. Deficiencies in the software's ability to perform will be noted by QESP in the AVR and corrective actions will be discussed with the City. Verified Savings will be based on the results documented in the PIR.

ESM 10: Walk-in Cooler Controls

Savings Calculation Methodology

QESP will install new controls on the cooling systems of existing walk-in refrigeration and freezer units in the City's kitchens. The controls and equipment will optimize evaporator fan, door heater, compressor, and condensing unit operation. Improving the efficiency of the walk-in coolers and freezers will decrease energy consumption and increase reliability through reduced equipment runtime.

The controls will monitor the load in the walk-ins and regulate the operation of the evaporator fans and condensing units to match the load. Evaporator fans will no longer operate continuously, nor will the door heaters, which will be controlled, based on the dew point temperatures in the surrounding storerooms. The controls also incorporate improved strategies for defrost cycles that will further reduce the energy consumption associated with the walk-in units.

QESP will also replace the fractional horsepower evaporator and condenser fan motors with high efficient electronically commutated motors. These new motors have a more efficient design that results in less energy consumption to operate, as well as emitting less waste heat to the space while they are running which also reduces cooling energy.

The savings from the walk-in refrigeration controls are dependent upon the improved efficiency of new equipment, software control strategies, the various setpoints, and the hardware that implements the control strategies. After the installation of the controls, QESP will verify that the energy saving control sequences are operational and functioning as specified in the IGEA

Report. As long as these implemented control sequences are maintained and not altered, the calculated savings will occur. Energy savings calculations are documented in the IGEA Appendix 1: Savings Calculations.

The parameters used to determine the baseline and post energy usage are:

Walk-in refrigerator temperature settings

Occupancy / kitchen schedule for seven days

Nameplate power ratings and efficiencies of refrigeration equipment, including fan motors M&V Activities During IGEA

Baseline audits and site observations were used for establishing the baseline cooling system energy use. Characteristics of baseline cooler equipment including physical condition of existing equipment and manufacturer's performance ratings were taken to confirm the assumptions that went into the spreadsheet models with regards to cooling loads.

Post-Installation Period

Post-installation energy consumption will be based on the model described above updated for the post-implementation design conditions. If the equipment installed differs materially from the proposed equipment, then the models may be revised to reflect the equipment that was actually implemented. If the modification is directed by the City, it may also require an adjustment to the Guaranteed Savings. During the commissioning phase, QESP will verify control settings and temperature setpoints and walk-in refrigeration system controls hardware will be commissioned to ensure proper operation.

M&V Activities During the Performance Period

The equipment installed as part of this measure will be inspected annually for the Guarantee Term to verify that it is in good condition and capable of achieving the expected savings. No measurements will be performed. Any noted deficiencies or deviations from the intended function of the equipment discovered during the inspection will be reported to the City in the AVR. Verified Savings will be based on the results documented in the PIR.

ESM 11: Steam Boilers

Savings Calculation Methodology

QESP proposes to install new steam boilers and ancillary heating system equipment. QESP will modernize the boiler systems in multiple Waterbury buildings. In the elementary schools heated by steam boilers that are past their useful life, the boilers will be replaced with new steam boilers that will improve the heating reliability and reduce the maintenance costs to the City. Control of the new boilers will be handled through the EMS and provide visibility of the buildings' heating plants to the City HVAC shop. The new heating systems will significantly reduce natural gas consumption due to higher seasonal operating efficiencies.

QESP created a model to determine the building heating load profiles. This model was used in conjunction with electric and fuel usage history, and estimated equipment usage times, to calibrate the baseline models.

The spreadsheet heating use model used data from the following sources:

- Building drawings (building areas, construction, and HVAC equipment capacities and other data)
- Weather data from Hartford, Connecticut
- Fuel usage from billing records
- Equipment runtimes, setpoints, and schedules from EMS trendlogs
- As-built equipment schedules
- Measured combustion efficiency
- Discussions with facility personnel (occupancy hours, setpoints, number of occupants, operating hours of equipment)

If any of these parameters could not be determined from these sources, QESP determined the most likely parameter based on standard engineering practices and experience.

Key parameters that affect baseline energy use include heating system efficiency, weather, heating loads, operating hours, and building construction and insulating values. Building operating and occupant data was provided by the City. Building construction and insulating values of components such as walls, roofs, and windows were obtained from construction drawing data.

M&V Activities During IGEA

Pre-installation audits and site observations were used for establishing the baseline heating energy use in conjunction with measured combustion efficiency, manufacturer's specifications and nameplate data. Characteristics of pre-retrofit equipment were utilized for the assumptions that went into the spreadsheet models with regards to heating loads and operating hours.

Post-Installation Period

Post-installation energy consumption will be based on the commissioning of the equipment as well as the calculations described above. The post-retrofit boiler combustion efficiency will be taken from stack gas testing at full load as part of commissioning. If the stack gas test results are within 2% of expected efficiency, allowing for variability from radiation and convection losses not captured during stack testing, the savings for the ESM will be verified so that no adjustment will be required. If the stack test results fall outside of plus or minus 2% of the expected efficiency, adjustments will be made to the savings.

QESP will inspect the boilers to verify that they have been installed properly and are functioning as intended. If the equipment installed differs materially from the proposed strategies, then the models will be revised to reflect the equipment and strategies that were actually implemented. If the modification is directed by the City, it may also require adjustment to the Guaranteed Savings and associated anticipated cost savings.

M&V Activities During the Performance Period

The equipment installed as part of this measure will be inspected annually for the Guarantee Term to verify that they are in good condition and capable of achieving the expected savings. Also during the Guarantee Term, QESP will perform stack gas tests on an annual basis to confirm the proper operation of the boilers. The results of the stack gas test will be used to verify that the boilers are operating as intended, and will not be used to calculate the Verified Savings.

Verified Savings will be based on the results documented in the PIR. Any deficiencies or deviations from the intended function of the equipment discovered during the inspection will be reported to the City in the AVR.

ESM 12: Hot Water Boilers & Pool Heating Systems

Savings Calculation Methodology

QESP proposes to install new natural-gas fired hot water boilers and ancillary heating system equipment. QESP will modernize the boiler systems in multiple Waterbury buildings. Heating systems in the middle/high school complexes will be redesigned to allow high-efficiency condensing boilers to be incorporated with new steam boilers to provide equipment redundancy. The boilers will be a combination of high-efficiency condensing hot water boilers and steam boilers with high-efficiency natural gas burners and combustion controls. This new equipment will serve the building space, domestic, and pool heating loads. Control of the new boilers will be handled through the EMS and provide visibility of the buildings' heating plants to the City HVAC shop.

New boilers will increase the heating system reliability by replacing equipment that is past its useful life and provide redundancy in cases where the backup boiler has failed. New boilers have a smaller footprint than the existing boilers and will increase space in the mechanical rooms for more efficient equipment servicing. The new heating systems will significantly reduce natural gas consumption due to higher seasonal operating efficiencies. At the middle/high school complexes, the steam boilers will no longer need to operate year round, thus extending their operating life as well as creating extended periods to perform routine preventative maintenance.

QESP created a model to determine the building heating load profiles. This model was used in conjunction with electric and fuel usage history, and estimated equipment usage times, to calibrate the baseline models.

The spreadsheet heating use model used data from the following sources:

- Building drawings (building areas, construction, and HVAC equipment capacities and other data)
- Weather data from Hartford, Connecticut
- Fuel usage from billing records
- Equipment runtimes, setpoints, and schedules from EMS trend logs
- As-built equipment schedules
- Measured combustion efficiency
- Discussions with facility personnel (occupancy hours, setpoints, number of occupants, operating hours of equipment)

If any of these parameters could not be determined from these sources, QESP determined the most likely parameter based on standard engineering practices and experience.

Key parameters that affect baseline energy use include heating system efficiency, heating loads, weather, operating hours, and building construction and insulating values. Building operating and occupant data was provided by the City. Building construction and insulating

values of components such as walls, roofs, and windows were obtained from construction drawing data.

M&V Activities During IGEA

Pre-installation audits and site observations were used for establishing the baseline heating energy use in conjunction with measured combustion efficiency, manufacturer's specifications and nameplate data. Characteristics of pre-retrofit equipment were utilized for the assumptions that went into the spreadsheet models with regards to heating loads and operating hours.

Post-Installation Period

Post-installation energy consumption will be based on the commissioning of the equipment as well as the calculations described above. The post-retrofit boiler combustion efficiency will be taken from stack gas testing at full load as part of commissioning. If the stack gas test results are within 2% of expected efficiency, allowing for variability from radiation and convection losses not captured during stack testing, the savings for the ESM will be verified so that no adjustment will be required. If the stack test results fall outside of plus or minus 2% of the expected efficiency, adjustments will be made to the savings.

QESP will inspect the boilers to verify that they have been installed properly and are functioning as intended. If the equipment installed differs materially from the proposed strategies, then the models will be revised to reflect the equipment and strategies that were actually implemented. If the modification is directed by the City, it may also require adjustment to the Guaranteed Savings.

M&V Activities During the Performance Period

The equipment installed as part of this measure will be inspected annually for the f Guarantee Term to verify that they are in good condition and capable of achieving the expected savings. Also during the Guarantee Term, QESP will perform stack gas tests on an annual basis to confirm the proper operation of the boilers. The results of the stack gas test will be used to verify that the boilers are operating as intended, and will not be used to calculate the Verified Savings. Verified Savings will be based on the results documented in the PIR. Any deficiencies or deviations from the intended function of the equipment discovered during the inspection will be reported to the City in the AVR.

ESM 13: Solar Photovoltaics

Savings Calculation Methodology

QESP proposes to install new solar photovoltaic systems at two City-owned buildings, the Duggan school and the Waterbury Police Department Headquarters. The PV systems include solar panels, racks, mounts, inverters, disconnects, and cabling, wiring, and controls. PV will generate electricity from a renewable resource and offset a portion of the purchased electric consumption and peak demand.

The energy savings associated with this ESM is based on the normalized results of ongoing metered system output. QESP calculated the expected output of the array, net of the array and inverter losses, using PVWatts, a software tool developed by the National Renewable Energy Laboratory (NREL). PVWatts calculates the monthly and annual expected output of the PV

system based on parameters such as location, azimuth, tilt angle, and long-term historical weather data. It also accounts for PV array losses, inverter losses, and other miscellaneous power conditioning losses.

The key assumptions used in the calculations, along with their sources, are listed below.

- PV module performance and inverter efficiencies are based on typical manufacturer's data
- The energy savings calculations use long-term solar irradiance and weather data interpolated from nearby weather stations in PVWatts

The equation used to determine the net output of the array is as follows:

```
E_{AC} = (H_t) (A_P) (h_P) (1 - L_P) (1 - L_C) (h_{inv})
Where:
E_{AC} = Net \ electric \ power \ produced \ (W-AC)
H_t = Solar \ irradiance \ in \ the \ plane \ of \ the \ PV \ array \ (W/m^2)
A_P = Area \ of \ the \ PV \ array \ (m^2)
h_p = Average \ efficiency \ of \ PV \ array \ (%)
L_P = Miscellaneous \ PV \ array \ losses \ (%)
L_C = Other \ power \ conditioning \ losses \ (%)
Inverter \ efficiency \ (%)
```

Measurements will be taken for power output at the array, along with ambient temperature and solar irradiance. This data will be used to normalize the post-acceptance system performance to standard test conditions (STC) to calculate the Verified Savings.

M&V Activities During IGEA

At present, the PV array is not installed and therefore the baseline is the current amount of electricity used by the facility.

The baseline development for this ESM included two key analyses: documentation that the facility's annual electricity baseline demand was consistently greater than the rated PV system output, and analysis of the electrical utility rates. The baseline is equal to the amount of purchased electricity before the installation of the new PV array.

Post-Installation Period

The variables affecting the post-installation energy use include the solar insolation on the PV array, PV cell temperature, the PV array efficiency, and the DC to AC conversion efficiency. The key system performance factor is the amount of electricity generated by the PV array.

QESP will inspect the PV system and power distribution equipment to verify that they have been installed properly and are functioning as intended. If the equipment installed differs materially from the proposed strategies, then the models will be revised to reflect the equipment and strategies that were actually implemented. If the modification is directed by the City, it may also require adjustments to the Guaranteed Savings.

The PV system AC output, solar insolation, cell temperature and ambient temperature will be measured for a minimum of two weeks. The measured data will be used to normalize the system performance to STC: 1,000 W/m² plane-of-array irradiance and 25°C cell temperature. The results will then be used in the PVWatts program to verify the proposed savings. The measured data will be normalized with the following equation:

$$P_{ACSTC} = P_{AC} \cdot \left(\frac{Irr_{STC}}{Irr}\right) / \left(1 - \left(T_{Cell} - 25\right) \cdot T_{co-eff}\right)$$

Where:

PACSTC = Power Output at STC (W-AC)
PAC = Power Output Measured (W-AC)
IrrsTC = Solar Irradiance at STC (1,000 W/m2)
Irr = Solar Irradiance Measured (W/m²)

T_{cell} = Cell Temperature, Measured or Calculated (°C)

T_{co-eff} = Temperature co-efficient of cell (approximately 0.45% / °C)

If measured cell temperatures are not available, the nominal operating cell temperature (NOCT) can be used with the following equation. NOCT is defined as the cell temperature under 800 W/m² plane-of-array irradiance, an ambient temperature of 20°C, and a wind speed of <1 m/s.

$$T_{Cell} = T_{Ambient} \times \frac{NOCT - 20}{0.8} \times Irr$$

Where:

 $T_{Ambient} = Ambient temperature measured (°C)$

NOCT = Nominal Operating Cell Temperature (approximately 45°C)

Only those measurements associated with irradiance greater than or equal to 800 W/m² will be used for the normalization and erroneous data will be discarded.

If the post-installation P_{ACSTC} is equal to or greater than the proposed P_{ACSTC} , the post-installation performance will be verified and the installed PV system would have the potential to meet or exceed the Guaranteed Savings. If the post-installation P_{ACSTC} is less than the proposed P_{ACSTC} , QESP will investigate the cause, and attempt to remedy the condition. The expected savings will be recalculated based on the post-installation P_{ACSTC} . The expected savings will be documented in the PIR.

M&V Activities During the Performance Period

During the first five (5) years of the Guarantee Term, Verified Savings will be based on the metered electric output (kWh) of the PV systems, normalized to STC, to account for typical annual fluctuations in ambient temperature and solar irradiance. A true RMS power meter will record system electric output throughout the performance phase. Permanently installed instrumentation will record ambient temperature and plane-of-array irradiance. The metered system kWh production will be normalized to STC based on the measured temperature and irradiance data.

QESP will perform periodic system inspections and will review the systems' output on a quarterly basis to verify that they continue to operate as intended and to evaluate the City's ongoing maintenance of the systems. The City is responsible for all ongoing tasks related to system operation, maintenance, repair, and replacement (OMR&R) including, but not limited to, cleaning of the PV panels, resetting tripped inverters, replacing failed inverters, and repair of damaged or failed systems components. If the City's failure to perform the manufacturers' suggested OMR&R results in system failure or degraded system performance, QESP will

exclude from its analysis the data from such periods and will instead use the post-installation data to calculate the Verified Savings until such time that proper system operation is restored. QESP will notify of noted deficiencies so that the City may promptly return the system's to their proper working order.

ESM 14: New Electrical Switchgear & Backup Power Generation

There are no energy savings associated with this measure and therefore no M&V Plan.

Table C-2: Risk Responsibility and Performance Matrix

CLARIFICATION OF KEY M&V VARIABLES	QESP's APPROAGH
1. Financial	
a. Interest Rates: The timing of the SOW signing may impact the available interest rate and project cost. Describe all of the particulars concerning the interest rate and specify time period for which the interest rate is valid.	A project cash flow using representative interest rates at the time of SOW execution is in Schedule H, Final Project Cost and Project Cash Flow Analysis. QESP makes no representations or guarantees with regard to the interest rate or repayment terms that the City will have with their source of financing.
b. Construction Costs: The QESP is responsible for determining construction costs and defining a budget for cost-effective ESMs, which may change during project development. Clarify design standards and the design approval process (including changes) and how costs will be reviewed.	The SOW Sum is based on sufficient design detail and Interim Period planning to mitigate risk of cost overruns. Design standards used are in accordance with the Connecticut state building codes. Following signature of the Notice to Proceed in Schedule S, final designs will be developed and provided to the City for review and approval at the start of the Interim Period. This is a firm fixed price contract and, provided there are no changes in scope, there will be no change in SOW Sum after execution of the SOW. The SOW Sum is based on the City providing Project Site access based on City approved contractor security badging for unescorted access to all work areas for QESP work as outlined in Article 6 of the SOW. If access is not provided as outlined, additional costs will be required and will be the responsibility of the City. The SOW Sum in Schedule H, Final Project Cost and Project Cash Flow Analysis, will be valid for 90 days from the submission of the Schedule. If SOW signature is delayed beyond this time, QESP reserves the right to reevaluate the price or withdraw the SOW, as the firm quotes for materials and services may expire before QESP purchase orders can be generated. QESP has included a Hazardous Materials Abatement Allowance as described in Schedule I. The City is responsible for any hazardous materials testing and abatement that exceeds the amount of the allowance.
c. M&V Verification: The City will determine the degree of verification required for the M&V program and energy savings determinations prior to QESP's submission of final SOW. Clarify how energy savings will be verified (e.g., Equipment performance, operational factors, energy use) and the impact on M&V costs.	Refer to material above in this Schedule for M&V details.
d. Operation and Maintenance Cost Savings: The project may include savings from recurring costs (based on actual spending reductions) and/or one-time future replacement expenditures (e.g., capital expenditures that were appropriated for future replacement of Equipment but will no longer be necessary). Clarify sources of operation and maintenance cost savings and how they will be verified.	Refer to Section C of the IGEA.

CLARIFICATION OF KEY M&V VARIABLES	QESP's APPROACH
e. Delays: Clarify schedule and how the cost of delays will be addressed.	A detailed project schedule will be created and agreed upon with the City prior to the Interim Period. City delays and associated costs from this schedule are the responsibility of the City. QESP will work in collaboration with the City and make best efforts to mitigate any City delays to the greatest extent possible. However, no cost or time has been included in our QESP's SOW Sum to account for delays caused by the City, their subcontractors or other parties or conditions or events not under the control of QESP. To avoid potential delays, careful implementation planning will begin after execution of the SOW Award and will be finalized before the construction notice to proceed is issued.
f. Major Changes in Facility: Clarify the City's and QESP's responsibilities in the event of a premature facility closure, loss of funding, or other major change in facility use and the impact on M&V.	QESP has no control over major changes at the City Project Sites or future closure plans. Therefore, the City has responsibility for changes in the use of the Project Sites, including reduction and/or closure. The SOW provides for early termination should it become necessary or desirable. In the unlikely event that changes are so significant that they impact project economics, the City can exercise its option to terminate. Alternatively, and at the request of the City, QESP can review alternative contractual modification options. Any major changes will require analysis of adjustments that will impact future consumption and verified savings. The City must provide written notice of planned changes to the QESP at least 120 days in advance of any major changes to the facility, and provide QESP with the opportunity to implement additional data collection required to quantify the impact of the major changes on the ESMs and make the necessary adjustments to the energy use and savings. The City will be responsible for the cost of additional analysis required to quantify the impact of major changes in the facility.
2. Operational	
a. Operating Hours: Clarify whether operating hours are to be measured or stipulated and what the impact will be if they change. If the operating hours are stipulated, the baseline should be carefully documented and agreed to by both parties.	Baseline operating hours were determined from input from City staff, IGEA inspections, and IGEA pre-measurement of equipment using data loggers to determine normal operating patterns. Since the Project Sites operate on a routine schedule, these agreed upon operating hours are used to establish the baseline. Because QESP cannot control the City mission, any changes reported will be reviewed for impact on consumption and may be applied as adjustments when calculating annual verified savings.
b. Load: Clarify whether Equipment loads are to be measured or stipulated and what the impact will be if they change. If the Equipment loads are stipulated, the baseline should be carefully documented and agreed to by both parties.	Baseline loads have been developed for the savings analysis using data provided by City as well as detailed site data collected. QESP has analyzed loads and system operating patterns to determine the optimum operating profile for baseline conditions. Since QESP cannot control City mission, the City will provide, in writing a summary of changes in the loads in buildings. These changes include, but are not limited to, the following: • Addition, renovation or demolition of buildings served by these meters • Significant changes in functional use of the buildings, • Adding or removing equipment in the buildings

CLARIFICATION OF KEY M&V VARIABLES	QESP's APPROAGH
c. Weather: Clearly specify how weather fluctuations will be addressed in M&V.	Any changes reported will be reviewed for impact on consumption and may be applied as an adjustment when calculating annual verified savings. Weather affected savings calculations are based on long-term 30 year weather data, and the baseline data reflects the long-term historical average. Savings may be normalized to long term average weather conditions if the actual weather conditions, as measured by heating and cooling degree days, deviate by more than 5% from the long term averages and the deviation results in a savings shortfall.
d. User Participation: Clarify what degree of user participation (e.g., control settings) is needed to generate savings and use monitoring and training to mitigate risk. If performance is stipulated, document and review assumptions carefully and consider M&V to confirm the capacity to save (e.g., confirm that the controls are functioning properly).	User participation is anticipated to operate and maintain the Equipment and produce the projected savings. QESP will provide training to the operating staff to ensure that they understand the system requirements and can quickly identify any problems that impact proper performance. Because QESP cannot control the City mission, any changes reported will be reviewed for impact on consumption and may be applied as adjustments when calculating annual verified savings.
3. Performance	
a. Equipment Performance: Clarify the QESP's and City's responsibilities for initial and long- term performance of Equipment, how it will be verified, and what will be done if performance does not meet expectations.	ESM implementation responsibility of the QESP includes properly completing final designs and installation of systems and equipment. During commissioning, the initial performance of the Equipment will be verified as described in the M&V Plan. In the event of performance of the Equipment will be verified as described in the M&V Plan. In the event of performance deficiency during commissioning, QESP will make needed corrections. QESP has included pre and post-installation onsite measurements for the ESMs, along with a regular detailed review of Energy Management System (EMS) trend data and electric and natural gas data. This will allow QESP to monitor operations of the ESMs during the Guarantee Tem, and help identify any discrepancies to City in a timely manner to help ensure the persistence of savings. In the event QESP identifies an ESM that is not meeting the expected level of service or performance due to factors under the City's control, the City will report back to QESP with a plan to bring the ESM back into compliance. If the expected level of service or performance is not met due to design or equipment selection, QESP will report back to the City with a plan to bring the ESM back into compliance. This process will ensure that both standards of service and performance are maintained throughout the Guarantee Term.
b. Operations: Clarify which party will perform Equipment operations, the implications of Equipment control, how changes in operating procedures will be handled, and how proper operations will be assured.	The City will operate the installed Equipment. During the Interim Period, QESP will provide training to City staff members who will be operating the equipment. Periodic site visits by QESP staff during the Guarantee Term will be used to identify any areas where operational improvements are needed. The City will provide, in writing a monthly operations report documenting the their operation of equipment and systems associated with the ESMs, as well as changes in the operation of other systems that affect the energy use of the facility. Because QESP cannot control the City mission,

QESP's APPROACH	any changes reported will be reviewed for impact on consumption and may be applied as adjustments when calculating annual verified savings.	ain Responsibilities and Schedule CC, City's Maintenance Responsibilities. Responsibilities and Schedule CC, City's Maintenance Responsibilities. The City will provide, in writing a monthly operations report documenting the their operation of equipment and systems associated with the ESMs, as well as changes in the operation of other systems that affect the energy use of the facility. Because QESP cannot control the City mission, any changes reported will be reviewed for impact on consumption and may be applied as adjustments when calculating annual verified savings.	After the initial warranty period, the City will retain responsibility for long-term repair and replacement of the installed Equipment with the exception of QESP repair and replacement responsibilities outlined in Schedule BB, QESP's Maintenance Responsibilities. Training for proper equipment replacement of ESPC-installed equipment will be provided as specified by QESP. The City will provide, in writing a monthly operations report documenting the their operation of equipment and systems associated with the ESMs, as well as changes in the operation of other systems that affect the energy use of the facility. Because QESP cannot control the City mission, any changes reported will be reviewed for impact on consumption and may be applied as adjustments when calculating annual verified savings.
CLARIFICATION OF KEY M&V VARIABLES		c. Preventive Maintenance: Clarify who is responsible for performing long-term preventive maintenance to maintain operational performance throughout the term of the SOW. Clarify how long term preventive maintenance will be assured, especially if the party responsible for long-term performance is not responsible for maintenance (e.g., QESP provides maintenance checklist and reporting frequency). Clarify what will be done if inadequate preventive maintenance impacts performance.	d. Equipment Repair and Replacement: Clarify who is responsible for performing replacement of failed components or Equipment replacement throughout the Guarantee Term. Specifically address potential impacts on performance due to Equipment failure. Specify expected Equipment life and warranties for all installed Equipment. Discuss replacement responsibility when Equipment life is shorter than the Guarantee Term.

Determination of Verified Energy Cost Savings

The Verified Energy Cost Savings during the Guarantee Term will be determined by multiplying the Verified Savings as detailed in *M&V Plan* multiplied by the applicable utility rate for each Guarantee Period. The total Verified Energy Cost Savings for each year will be compared against the total of the Guaranteed Savings multiplied by applicable utility rates to determine the amount of any shortfall or excess savings in any Guarantee Period. The section below contains a detailed description of how the Utility Rates have been determined. The following sections illustrate the utility rates that will be used.

Annual Energy Savings Guarantee Overview Table

The annual energy savings guarantee overview table is provided in *Schedule A: Energy Savings Guarantee*.

Utility Rates

Baseline Utility Rates

The baseline energy utility rates are shown below in Table C-3 and Table C-4. These rates were used to calculate projected savings.

Table C-3: Baseline Utility Rates

	Rate Code	\$/kVV	\$/KVA	\$/kWh	Natural Gas Rate (\$/CCF)
Barnard School	30	\$19.49	-	\$0.0974	\$0.961
Bucks Hill School	30	\$19.49	-	\$0.0974	\$0.940
Bunker Hill School	40	-	-	\$0.1642	\$1.015
Carrington School	37	\$11.69	-	\$0.1391	\$0.960
Chase Building	30	\$19.49	_	\$0.0974	\$1.151
Chase School	40	\$6.34		\$0.1461	\$0.992
City Hall	37	\$11.69	-	\$0.1391	\$0.856
Crosby-Wallace Complex	58	-	\$15.64	\$0.1166	\$0.835
Department of Public Health	37	\$11.69	e kilono vermelikili kili mekrali arkera miliera e kilali mili ekil	\$0.1381	\$1.055
Driggs School	40	-	-	\$0.1642	\$1.051
Duggan School	37	\$11.69	-	\$0.1391	\$1.014
Enlightenment School	30	\$19.49	-	\$0.0974	\$1.241
Generali School	40	-	-	\$0.1642	\$0.983
Gilmartin School	58	\$11.69	-1	\$0.1391	\$0.997
Hopeville School	40		-	\$0.1642	\$1.181
Kennedy School	56	-	\$15.38	\$0.1169	\$0.862
Kingsbury School	40		•	\$0.1642	\$1.149
Maloney School	56	-	\$15.38	\$0.1169	\$0.902
Police Headquarters	37	\$11.69	-	\$0.1409	\$1.157
Reed School	37	\$11,69		\$0.1391	\$0.9394

	Rate Code	\$/kW	\$/KVA	\$/kWh	Natural Gas Rate (\$/CCF)
Regan School	30	\$19.49	-	\$0.0974	\$1.067
Rotella School	56	-	\$15.38	\$0.1169	\$0.898
Silas Bronson Library	40	\$19.49	-	\$0.0974	\$1.348
Sprague School	40	-	- 12 Sept. 1914	\$0.1642	\$0.936
Tinker School	40	-	-	\$0.1642	\$1.260
Walsh School	40	-	- C	\$0.1642	\$1.079
Washington School	40	-	-	\$Ő.1642	\$1.110
Waterbury Arts Magnet School	56	-	\$15.38	\$0.1169	\$0.705
Waterbury Career Academy	56	-	\$15.38	\$0.1169	\$1.300
Wendall Cross School	40	-	_	\$0.1642	\$1.070
West Side School	56	-	\$15.38	\$0.1169	\$0.914
Wilby-North End Complex	56	-	\$15.18	\$0.1169	\$0.839
Wilson School	40	-	-	\$0.1642	\$0.899
Buckingham Parking Garage	30	\$19.49	-	\$0.0974	
Scovill Parking Garage	30	\$19.49	-	\$0.0974	

Post-Installation and Performance Phase Utility Rates

Upon project completion the energy rates will be escalated for each successive Guarantee Period of the contract by the percentages shown in Table C-4. Guarantee Period 1 cost savings will be calculated using either the escalated Guarantee Period 1 rates shown below in table C.1.1.5-3 or the actual utility rates paid by the City, whichever is higher.

Table C-4: Escalation Rates of Baseline Utility Rates

Guarantee Period	Electricity	Natural Gas
1	107.1%	107.1%
2	103.5%	103.5%
3	103.5%	103.5%
4	103.5%	103.5%
5	103.5%	103.5%

Verified Energy Cost Savings Calculation

Verified Energy Cost Savings = ∑ Energy Unit Savings x Applicable Escalated Utility Rate

Additional Savings: Additional energy and/or operational cost avoidance that can be demonstrated as a result of QESP's efforts that result in no additional costs to the City beyond the costs identified in this SOW will be included in Verified Savings reported in the AVR for the applicable Guarantee Period(s).

Savings Prior to Final Acceptance: All energy and operational cost avoidance realized by the City, and as calculated through the Measurement & Verification Plan, that results from activities undertaken by QESP prior to the Date of Commencement may be applied to the Verified Savings for the First Guarantee Period.

Savings Shortfalls: In the event that the total Verified Energy Cost Savings in any Guarantee Period is less than the total of the Guaranteed Savings multiplied by the applicable utility rates, as described in this section, for that Guarantee Period, QESP will, upon receipt of written demand from the City, compensate the City the amount of any such shortfall, limited by the value of the guarantee, within thirty (30) calendar days. Resulting compensation will be QESP's sole liability for any shortfall in the Guaranteed Savings.

Savings Reconciliation Documentation: QESP will provide the City with an Annual Verification Report ("AVR") within 60 days of the end of the Guarantee Period. City will provide QESP access to all energy billing information, maintenance records, drawings, or other data deemed necessary by QESP to generate the AVR.

The City will also provide in writing a summary of changes to facilities each month including, but not limited to:

- Addition, renovation or demolition of buildings served by these meters
- Significant changes in functional use of the buildings or portions of buildings.
- Changes in operating hours, temperature set points, and other control strategies,
- Adding or removing equipment in the buildings, including plug loads.
- Improper maintenance or operation of the heating systems

Data and calculations used by QESP in the preparation of its AVR will be made available to the City, along with such explanations and clarifications as City may reasonably request.

Acceptance of Annual Verification Report: At the end of each Guarantee Period, the City will have 30 days after receipt of the AVR to review it and provide written notice to QESP of acceptance or non-acceptance of the AVR for that Guarantee Period. Failure to provide written notice within 30 days of the receipt of the AVR will constitute the deemed acceptance of the Report and its findings by the City.

Annual Verification: Verified Savings will be determined in accordance with the methodologies, operating parameters, formulas, and constants as described in this Measurement & Verification Plan. Actual savings reduction in utility bills may vary from the Verified Savings for reasons outside of QESP's control, including but not limited to: changes in energy and other utility rates and tariffs, changes in City operating schedules and usage patterns, changes in City loads due to addition or reductions in energy and water consuming devices, changes in weather, impacts due to the operations of ESMs, impacts due to the maintenance of ESMs maintained by the City, and additions to and/or reduction in Project Sites space usage. For the purposes of

calculating any shortfalls or excesses of Verified Savings versus Guaranteed Savings, the Measurement & Verification Plan will be used.

Verified Energy Cost Savings will be determined by multiplying the energy unit savings by the agreed-upon escalated utility rates. While Guaranteed savings have been provided for each unit of energy savings, no shortfall will be recognized unless the overall Verified Energy Cost Savings in a given Guarantee Period falls short of the total of the Guaranteed Savings for that year multiplied by the applicable utility rates.

Activities and Events Adversely Impacting Savings: The City must promptly notify QESP of any activities known to the City, which adversely impacts QESP's ability to realize the Guaranteed Savings; and, QESP will be entitled to reduce the Guaranteed Savings by the amount of any such adverse impact, to the extent that such adverse impact is beyond QESP's reasonable control.

Guarantee Adjustment: QESP's Guaranteed Savings obligations under this SOW are contingent upon:

- (1) the City following the operations and maintenance requirements for the ESMs in accordance with the SOW;
- (2) no alterations or additions being made by the City without prior notice and written agreement of the Parties;
- (3) the City sending all current utility bills to QESP within two (2) weeks after receipt; and
- (4) QESP's ability to render services not being impaired by circumstances beyond its control.

To the extent that the City defaults or fails to perform fully any of its obligations under this the SOW, QESP may, in its sole discretion, make a corresponding adjustment to the Guaranteed Savings obligation equal to the impact to savings from the City's default or failure to perform; provided, however, that no adjustment hereunder will be effective unless QESP has first provided the City with written notice of the City's default(s) or failure(s) to perform and the City has failed to cure its default(s) and failure(s) to perform within thirty (30) days after receipt of such notice.

SCHEDULE D

Warranties

This Schedule D describes the warranties.

NORESCO will provide a standard parts and labor warranty on all equipment installed under this contract, as well as, an extended manufacturer's parts and labor warranty on the new chillers and new energy management systems. These warranties cover issues such as improper equipment installation, faulty wiring, and systemic product failure and are subject to limitations in the specific warranties which will be provided to the City.

The warranties will begin upon Substantial Completion of each ESM. Any defect or failure in the manufacturer's product can be remedied by the manufacturer during the manufacturer's warranty period. NORESCO will also provide manufacturer's warranty information to the City in as-built O & M manuals delivered to the City at the end of the construction period and before receiving the Certificate of Acceptance of all ESMs upon Final Completion from the City. Table D-1 shows the major equipment and associated manufacturer warranty periods that will run from the date specified at Substantial Completion of the ESM. NORESCO will manage manufacturer warranty claims during the warranty period only, with the exception of the chillers and new energy management system equipment where NORESCO will manage warranty claims during the extended parts and labor warranty periods. Owner shall be responsible for managing all other manufacturer warranties after NORESCO's warranty period.

Final equipment and manufacturer selection will be completed during the material submission process post award. The table below provides estimated warranty periods for the equipment used to develop the IGEA price. In the event that equipment selections changes during the post execution design process, associated warranty periods may change and will be documented as part of the design submittal process.

Table D-1: Manufacturer Warranties for Equipment to Be Installed

ES	M Equipment	Warranty			
1	Lamps	Manufacturer 3-year limited warranty on parts			
	Ballasts	Manufacturer 5-year limited warranty on parts			
	Controls	Manufacturer 5-year limited warranty on parts			
	LED Interior High/Low Bay Fixtures	Manufacturer 5- to 10-year limited warranty on parts			
2	LED Exterior Fixtures	Manufacturer 5-year limited warranty on parts			
3	Chiller	Manufacturer 5-year extended warranty on parts and labor			
	Pumps	Manufacturer 1-year limited warranty on parts			
4	Dampers	Manufacturer 1-year limited warranty on parts			
5	Direct Digital Controls	Manufacturer 2-year extended warranty on parts and labor			
6	Weatherstripping	Manufacturer 1-year limited warranty on parts			
	Batt Insulation	Manufacturer 1-year limited warranty on parts			
	Rigid Insulation	Manufacturer 1-year limited warranty on parts			
7	Piping Insulation	Manufacturer 1-year limited warranty on parts			

ESM	Equipment	Warranty			
8	Thermostatic Radiator Valves	Manufacturer 1-year limited warranty on parts			
9	Plug Load Controls	Manufacturer 1-year limited warranty on parts			
10	Cooler Controls	Manufacturer 1-year limited warranty on parts			
11	HB Smith Steam Boilers – Cast Iron Sections	Manufacturer 10-year limited warranty on parts			
	PowerFlame Burners	Manufacturer 15-month limited warranty on parts)			
12	Cleaver Brooks Steam Boilers – Pressure Vessels & Burners	Manufacturer 5-year extended warranty on parts and labor			
	HB Smith Steam Boilers – Cast Iron Sections	Manufacturer 10-year limited warranty on parts			
	Aerco Hot Water Boilers – Pressure Vessel/Heat Exchanger	Manufacturer 10-year limited warranty on parts			
	Aerco C-More Control Panel	Manufacturer 2-year limited warranty on parts			
	Aerco Hot Water Boilers – Other Components	Manufacturer 18-month limited warranty on parts			
	Aerco Smart Plate Heat Exchangers	Manufacturer 5-year limited warranty on parts			
	Lochinvar Pool Heaters – Pressure Vessel/Heat Exchanger	Manufacturer 3-year limited warranty on parts			
13	Trina Solar Photovoltaic Panels	Manufacturer 25-year limited warranty on parts			
	Solectria Inverters	Manufacturer 10-year limited warranty on parts			
	Solar Mounting System	Manufacturer 1-year limited warranty on parts			
14	Electrical Switchgear	Manufacturer 1-year limited warranty on parts			
	Emergency Generator	Manufacturer 1-year limited warranty on parts			

Average Useful Life

Table D-2 below contains the average useful life of the major equipment to be installed as part of the ESMs. Equipment useful lives are based on 2011 ASHRAE: HVAC Application Handbook, Chapter 37.3.

Table D-2: Average Useful Life of Major Equipment

ESM Name	ESM Equipment	Useful Service Life (Median Years)
Interior Lighting Improvements	Interior lighting and controls	15 and 15
Exterior Lighting Improvements	Exterior lighting	15
Variable Speed Chillers and Pumps	Chillers and pumps	20 and 20
Air Handler Unit Damper Refurbishments	Dampers	20
EMS Upgrades and Expansion	Direct digital controls and motors	15 and 18

ESM Name	ESM Equipment	Useful Service Life (Median Years)
Building Weatherization	Weatherstripping, sealants	24
Pipe & Fitting Insulation	Blanket and removable jackets	24
Steam Traps & Thermostatic Radiator Valves	Traps	15
Plug Load Controls	Plug Load Controls	15
Walk-In Cooler Controls	Controls & motors	15 and 18
Steam Boilers	Cast Iron Sectionals	30
Hot Water Boilers & Pool Heating Systems	Firetube (steam and hot water) boilers	25
Solar Photovoltaics	PV arrays	20
New Electrical Switchgear & Backup Power Generation	Panel boards and gas-fired engine	30 and 20

SCHEDULE H

Final Project Cost & Project Cash Flow Analysis

Table H-1 illustrates the costs and pricing for the work being installed as defined in the SOW. Table H-2 provides the project cash flow analysis.

Table H-1: Summary of Energy Savings Measures

	Energy Savings Measures	Implementation Price (Note 1)	Estimated Incentives	Anticipated Annual Cost Savings	Simple Payback Net of Incentives
1	Interior Lighting Improvements & Controls	\$2,099,167	\$489,680	\$344,408	4.7
2	Exterior Lighting Improvements	\$986,487	\$264,504	\$127,455	5.7
3	Variable Speed Chillers & Pumps	\$1,205,847	\$35,049	\$43,149	27.1
4	Air Handling Unit Damper Refurbishments	\$321,805	\$46,024	\$29,038	9.5
5	Energy Management System Upgrades & Expansion	\$5,345,037	\$1,536,934	\$621,167	6.1
6	Building Weatherization	\$584,590	\$146,921	\$47,528	9.2
7	Pipe & Fitting Insulation	\$804,356	\$268,882	\$79,239	6.8
8	Steam Traps & Thermostatic Radiator Valves	\$784,163	\$272,573	\$93,420	5.5
9	Plug Load Controls	\$176,810	\$60,372	\$27,543	4.2
10	Walk-In Cooler Controls	\$147,423	\$29,329	\$13,115	9.0
11	Steam Boilers	\$5,984,134	\$103,757	\$69,948	84.1
12	Hot Water Boilers & Pool Heating Systems	\$7,407,670	\$445,829	\$153,827	45.3
13	Solar Photovoltaics	\$305,388	\$0	\$27,863	11.0
14	New Electrical Switchgear & Backup Power Generation	\$1,255,855	\$0	\$0	N/A
	Project Totals	\$27,415,059	\$3,699,854	\$1,677,700	14.1

Note 1: This Implementation Price includes a \$225,738 total credit to the City consisting of a reduction of ECG's Consulting Services fee, as well as, a reduction of NORESCO's overhead and profit. The original Implementation Price before this credit was applied was \$27,640,797. The ECG Consulting Fee has been included, and proportionally allocate d to the ESM Implementation prices illustrated.

Illustrative Cash Flow for the City of Waterbury Project

NORESCO recognizes that the City has finance and term options to select the most advantageous method to fund the project scope. The cash flow on the following page illustrates a potential Tax-Exempt Municipal Lease (TELP) funding option. Table H-2 provides a cash flow

positive net of the anticipated savings, payments, and utility incentives over a 15-year term, after project implementation. Cash flow assumptions are provided below.

Table H-2: Illustrative Cash Flow Based on the Following Page Assumptions

Net Cash Flow	\$0	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$1,238,286
Total Cost	\$1,353,600	\$1,595,148	\$1,652,497	\$1,711,819	\$1,773,184	\$1,836,661	\$1,821,517	\$1,887,016	\$1,954,781	\$2,024,891	\$2,097,426	\$2,172,471	\$2,250,113	\$2,330,442	\$2,413,550	\$2,499,536	\$31,374,646
O&M Service	\$0	\$193,848	\$199,663	\$205,653	\$211,823	\$218,177	0\$	0\$	\$0	\$0	0\$	80	80	\$0	0\$	\$0	\$1,029,164
M&V Service	\$0	\$35,697	\$36,767	\$37,870	\$39,007	\$40,177	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$189,51
Financing Payments	\$1,353,600	\$1,365,603	\$1,416,067	\$1,468,296	\$1,522,354	\$1,578,307	\$1,821,517	\$1,887,016	\$1,954,781	\$2,024,891	\$2,097,426	\$2,172,471	\$2,250,113	\$2,330,442	\$2,413,550	\$2,499,536	\$30,155,970
Anticipated Total Savings	\$1,353,600	\$1,677,700	\$1,735,049	\$1,794,371	\$1,855,736	\$1,919,213	\$1,904,069	\$1,969,568	\$2,037,333	\$2,107,443	\$2,179,978	\$2,255,023	\$2,332,665	\$2,412,994	\$2,496,102	\$2,582,088	\$32,612,932
Anticipated SREC Savings	0\$	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$112,290
Anticipated O&M Cost Savings	0\$	\$221,771	\$228,424	\$235,277	\$242,335	\$249,605	\$176,287	\$181,576	\$187,023	\$192,634	\$198,413	\$204,365	\$210,496	\$216,811	\$223,315	\$230,015	\$3,198,347
Anticipated Utility Cost Savings	\$1,353,600	\$1,448,443	\$1,499,139	\$1,551,608	\$1,605,915	\$1,662,122	\$1,720,296	\$1,780,506	\$1,842,824	\$1,907,323	\$1,974,079	\$2,043,172	\$2,114,683	\$2,188,697	\$2,265,301	\$2,344,587	\$29,302,294
Year	0	T	2	છે.	Þ	9	9	7	••)	6	10	Ţ	12	(13)	14	15	Totals

\$27,415,059	\$1,353,600	\$3,699,854	\$1,145,281	
Project Implementation Price:	Anticipated Savings During Construction Amount (-)	Estimated Utility Incentives & Rebates (-)	Estimated Capitalized Construction Interest (+)	

Total Financing Balance when Repayment Commences: \$23,506,887

Finance Rate: 2.50%

Cash Flow Assumptions:

- A 24-month construction and commissioning period prior to commencing the repayment term.
- First-year savings based on 3-year average utility rates for each specific building from 2013-2015, and an annual energy escalation rate of 3.50%.
 - Year 0 represents the cumulative estimated savings that will be achieved during the construction period as ESMs are completed.
- Net of utility incentives based on Eversource Project Caps and Incentive Levels effective January 2016
- Operating lease with stepped payments with level net cash flow to match savings at 2.50% for 15-year term.
- Project Implementation Price includes ECG consulting service fee.

SCHEDULE I

Payment Schedule

This Schedule I includes the payment schedule and the progress payment disbursement schedule that will be used to pay the QESP during the Interim Period (construction and installation) for the agreed-upon percentages of Work completed.

The City shall pay to QESP the amount equal to the SOW Sum \$27,415,059, in accordance with the terms described herein. During the Interim Period, the City will make monthly progress payments to QESP based upon the portion of the Work completed and material stored on-site at the end of each month. The estimated monthly amounts for the duration of the Interim period are identified in Table I-1.

Table I-1: Projected Progress Payments During the Interim Period

	Projected Progress
Construction Month	Payment
1	\$655,142
2	\$729,799
3	\$1,017,503
4	\$1,432,528
5	\$1,861,316
6	\$1,453,948
7	\$1,884,112
8	\$1,830,385
9	\$1,830,385
10	\$1,830,385
11	\$1,705,433
12	\$856,917
13	\$560,042
14	\$460,679
15	\$460,679
16	\$460,679
17	\$690,119
18	\$1,463,429
19	\$1,463,429
20	\$1,420,683
21	\$605,963
22	\$0
23	\$2,622,756
24	\$118,750
Total	\$27,415,059

The projected progress payments above include the Consulting Services fee for ECG of \$1,187,500. NORESCO shall remit payment directly to ECG based on the payment schedule below. Payment shall be due within 30 days from achieving each milestone. The City may withhold payment to NORESCO in the event timely payments are not made to ECG.

ECG Payment Schedule

- 20% upon City signing contract with QESP;
- 35% upon approval of applicable plans and specifications by applicable local, state and federal agencies;
- 25% upon fifty percent (50%) completion of QESP construction contract;
- 10% upon certified substantial completion of QESP construction contract; and
- 10% upon certified final completion of QESP construction contract.

Within thirty (30) days after the date of an invoice on account of work completed by QESP, the City shall pay QESP the invoiced amount. Retainage defined in Section 2.1 of the SOW shall be held as additional security for the faithful performance by QESP of all the work required under SOW and shall be paid to QESP within thirty (30) days from the Commencement Date.

Amounts not paid to QESP on or before the due dates specified above will accrue interest at the rate of the prime interest rate for the number of days following the due date until such time as such amount due has been paid in full.

Pursuant to Section 3.2 of Exhibit A, NORESCO has provided an annual guarantee sufficient to cover any and all annual payments as shown in Schedule H, Table H-2 for the 5 year Guarantee Term. NORESCO has include anticipated savings for the 15 year financing term in Schedule H despite the City requesting the guarantee only extend 5 years. The project cost including financing was calculated using financing assumptions provided by the City. The City must advise QESP of any changes to the financing assumptions prior to execution of Exhibit A. In no event shall QESP be responsible for savings in excess of the Guaranteed Savings for the Guarantee Term.

Hazardous Materials Abatement Allowance

The SOW Sum includes an allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered on the project, including the abatement of lead and asbestos that may be encountered. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Completion of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.

ECM 14 Design Allowance

The SOW Sum includes a design allowance in the amount of \$50,000 for ECM 13 that may be used to add additional scope to that measure after execution of the Contract at the request of

the City. Use of this allowance will be authorized by execution of a change order by both Parties. Any funds remaining in the allowance may also be allocated to additional work at the City's request through execution of a change order or remitted to the City at the end of the Interim Period.

SCHEDULE J

Compensation to QESP for Annual Services

This Schedule J shows the amount and frequency of payments to be made to the QESP for Annual Services. Table J-1 provides the annual total of the quarterly services payments that are to be made to the QESP. The services payments are for the maintenance, monitoring, and verifications services in Schedule C. Services fees are calculated using the QESP costs and margins applied in accordance with Schedule H.

QESP shall invoice the City monthly beginning in the first month of each Guarantee Period for Annual Services. The City shall pay for Annual Services in twelve (12) equal monthly installments. Amounts not paid to QESP on or before the invoice due dates will accrue interest at the rate of the prime interest rate for the number of days following the invoice due date until such time as such amount due has been paid in full.

At any time during the Term of this Contract, the City may cancel the O&M services upon ninety (90) days' written notice to NORESCO that the services are no longer required. NORESCO shall terminate all remaining services upon expiration of the ninety (90) day notice period and shall pro-rate and return any unused O&M Fee payments for the Guarantee Year in which the termination becomes effect. Upon termination the City shall be responsible for performing the annual services provided by NORESCO as described in Schedule V and Schedule BB.

At any time during the Term of the Contract, the City may terminate Measurement and Verification (M&V) services for convenience upon thirty (30) days' written notice to NORESCO. In the event the M&V services are terminated prior to the end of the Guarantee Term, the Guaranteed Savings for the Guarantee Period in which such termination becomes effective will be prorated as of the effective date of such termination, with a reasonable adjustment for seasonal fluctuations, if any, in Energy and Operational Costs, and the Guaranteed Savings for all subsequent Guarantee Periods will be null and void.

Table J-1: Guarantee Term Fees

Guarantee Period	O&M Fees	M&V Fee	Annual Service Payments
1	\$193,848	\$35,697	\$229,545
2	\$199,663	\$36,767	\$236,430
3	\$205,653	\$37,870	\$243,523
4	\$211,823	\$39,007	\$250,830
5	\$218,177	\$40,177	\$258,354
Total	\$1,029,164	\$189,518	\$1,218,682

SCHEDULE K

Rebates, Incentives, and Grants

This Schedule K identifies and describes dollar amounts for any rebates, incentives, or grants related to the Work.

QESP will apply for rebates, incentives, and grants in a timely manner. Incentives will be paid directly to the City unless the City directs the utility otherwise. Any incentive amounts projected by QESP are estimates and are subject to pre-approval and post-approval by the awarding authority. Actual amounts paid may vary from the estimated incentives.

All incentive monies will be credited to the City. QESP has conducted a preliminary evaluation of the electric and gas incentives offered by Eversource. Incentives are currently available for several of the technologies under their Comprehensive Project Initiative for Existing Building Retrofit. The Comprehensive Project Initiative incentive levels require that multiple buildings are included in the project and the savings are generated from both electricity and natural gas. This project currently meets both of those criteria. In addition, the incentive levels are: Total Project Incentive is up to 50% of installed cost; neither electric nor gas can exceed 85% of the total project savings; and comprehensive "Project Cap" for all ESMs is \$0.40/kWh saved and \$3.50/CCF saved.

SCHEDULE Q

Description of Project Sites

This Schedule Q is a description of the condition of the Project Site(s) at the time of execution of the SOW, including facility square footage, building construction, and department of use. This information is outlined in Table Q-1. Additional Project site details are included in IGEA Section A: Facility Profiles.

Table Q-1: Description of Project Sites

Building	Address	Sq Ft.	Construction	Dept
Barnard School	11 Draher Street	48,600	1898	BOE
Bucks Hill School	330 Bucks Hill Road	77,194	1953	BOE
Bunker Hill School	170 Bunker Hill Avenue	54,156	1905	BOE
Carrington School	24 Kenmore Avenue	127,391	2013	BOE
Chase Building	236 Grand Street	56,624	1912	DPW
Chase School	40 Woodtick Road	80,572	1920	BOE
City Hall	235 Grand Street	90,000	1915	DPW
Crosby-Wallace Complex	300 Pierpont Road	397,604	1974	BOE
Dept. of Public Health	185 South Main Street	46,573	1969	DPW
Driggs School	77 Woodlawn Terrace	63,501	1889	BOE
Duggan School	38 West Porter Terrace	75,418	2010	BOE
Enlightenment School	30 Church Street	40,777	1955	BOE
Generali School	3196 East Main Street	59,091	1942	BOE
Gilmartin School	94 Spring Lake Avenue	75,000	2010	BOE
Hopeville School	2 Cypress Street	59,000	1917	BOE
Kennedy School	422 Highland Avenue	235,994	1964	BOE
Kingsbury School	220 Columbia Boulevard	46,842	1917	BOE
Maloney School	233 South Elm Street	92,000	1996	BOE
Police Headquarters	255 East Main Street	71,651	1978	DPW
Reed School	33 Griggs Street	79,858	2010	BOE
Regan School	2870 North Main Street	31,000	1966	BOE
Rotella School	380 Pierpont Road	106,000	2001	BOE
Silas Bronson Library	267 Grand Street	40,000	1963	DPW
Sprague School	1448 Thomaston Avenue	64,502	1913	вое
Tinker School	809 Highland Avenue	54,976	1925	BOE
Walsh School	55 Dikeman Street	61,500	1930s	BOE
Washington School	685 Baldwin Street	41,118	1882	BOE
Waterbury Arts Magnet School	16 South Elm Street	292,000	2004	BOE
Waterbury Career Academy	175 Birch Street	145,392	2013	BOE
Wendell Cross School	1255 Hamilton Avenue	41,098	1953	BOE

Building	Address	Sq. Ft.	Construction	'Dep
West Side School	483 Chase Parkway	172,676	1976	вое
Wilby-North Complex	534 Bucks Hill Road	434,416	1978	BOE
Wilson School	235 Birch Street	59,208	1928	вое
Buckingham Parking Garage	210 Bank Street		1970	DPW
Scovill Parking Garage	33 Scovill Street	▼ 1777 P1 17 17 17 17 17 17 17 17 17 17 17 17 17	1970	DPW

SCHEDULE R

Equipment to Be Installed by QESP

This Schedule R includes a summary of each ESM included in the final project scope. A detailed scope of work and list of the Equipment to be installed for the ECMS listed below, including manufacturer, quantity, and location, and sets forth any modifications that will be made to existing Goods can be found in IGEA Section C: Savings Opportunities Summary.

ESM 1: Interior Lighting Improvements & Controls

NORESCO will optimize the existing lighting systems by upgrading the existing T8 lighting with linear TLED lamps. NORESCO will achieve this by retrofitting existing 32-watt 4-ft and U-tube fluorescent luminaries with high-efficiency, 12.5- and 16.5-watt, TLED lamps compatible with existing electronic ballasts; retrofitting existing 2-ft and 3-ft fluorescent luminaries with high-efficiency, 8- and 10.5-watt, TLED lamps compatible with existing electronic ballasts; replacing incandescent lighting with new high-efficiency LED lamps or luminaries; and replacing high intensity discharge (HID) luminaries with new high-efficiency LED luminaries. NORESCO will also install wireless ceiling-mounted sensors in selected classroom and corner-mounted sensors in selected hallways in nine Waterbury schools.

ESM 2: Exterior Lighting Improvements

NORESCO will optimize the exterior lighting systems by upgrading existing High Intensity Discharge (HID) luminaries with new LED luminaries. NORESCO will achieve this by: replacing existing building-mounted and pole-mounted metal halide (MH) and High Pressure Sodium (HPS) luminaries with new high-efficiency LED luminaries. For exterior fluorescent luminaires in walkways and parking garages, NORESCO will upgrade them by retrofitting existing 32-watt 4-ft luminaries with high-efficiency, 12.5-watt, TLED lamps compatible with existing electronic ballasts.

ESM 3: Variable Speed Chillers & Pumps

NORESCO will replace the two (2) existing water-cooled chillers with two (2) new 250-ton high efficiency units. The new integrated variable speed, water cooled, screw chillers will make use of the environmentally friendly refrigerant R-134A to reliably and efficiently cool the high school and middle school buildings. The existing chilled and condenser water pumps will be replaced with properly sized equipment, including premium efficiency motors, and the piping will be modified to optimize operational efficiencies. The new equipment will include new direct digital controls (DDC) that will be integrated to the newly upgraded energy management system (EMS).

ESM 4: Air Handling Unit Damper Refurbishments

NORESCO will refurbish or replace the dampers for seventy-six (76) air handling units in the buildings listed above. The scope of work will include installing thirty-four (34) new outdoor/return/exhaust air dampers and refurbishing/rebuilding one hundred and forty-six (146) existing-to-remain outdoor/return/exhaust air dampers.

ESM 5: Energy Management System Upgrades & Expansion

NORESCO will install new, comprehensive web-accessible direct digital control (DDC) energy management systems and/or retro-commission (RCx) the existing-to-remain control systems in twenty-three (23) buildings. New electronic controls will automatically enable HVAC systems and modulate heating, cooling, and ventilation to maintain space temperature setpoints. Schedules will be set up in accordance with occupancy to reduce energy use during off hours. For retro-commissioning, we will evaluate the existing-to-remain HVAC controls systems at the appropriate facilities and identify and correct existing deficiencies with the controls and sequences of operation.

ESM 6: Building Weatherization

NORESCO will reduce infiltration by sealing cracks with foam or beads of caulk as needed, improving door seals, replacing worn sweeps and weatherization strips on doors, making roof-to-wall joint gaps airtight and sealing exterior envelope penetrations.

ESM 7: Pipe & Fitting Insulation

NORESCO will install new fiberglass pipe insulation with all service jackets, and removable insulating jackets on exposed metal steam and hot water pipe, fittings, valves, and associated equipment in twenty-three (23) City buildings and schools.

ESM 8: Steam Traps & Thermostatic Radiator Valves

NORESCO performed a comprehensive steam trap audit, identifying all traps as well as quantifying leaking and plugged traps. We will repair two hundred and sixty-two (262) traps to generate energy savings and prolong the service life of equipment served by the steam system. NORESCO also performed a comprehensive audit of all the standalone perimeter steam terminal devices such as radiators, convectors, and baseboard fin tube, cataloguing each piece of equipment and its control device. NORESCO will install eight hundred and twelve (812) thermostatic radiator valves (TRVs) to automatically control the steam equipment's heat output to generate energy savings as well as significantly improve the comfort conditions in the spaces served. The installation of these temperature control valves will also include the removal of existing obsolete and problematic pneumatic valves and thermostats, resulting in additional maintenance cost savings as well as the energy savings associated with running the building air compressors.

ESM 9: Plug Load Controls

NORESCO will install plug load management technology to provide additional energy savings during unoccupied hours and weekends. The installation includes controllable electrical receptacles, building controllers, and a web-based application and software suite for programming, analytics, reporting, and a user-interface dashboard.

ESM 10: Walk-in Cooler Controls

NORESCO will install advanced controls and equipment on the walk-in coolers and freezers in the City's kitchens. The controls and equipment will optimize evaporator fan, door heater, compressor, and condensing unit operation. NORESCO will also replace low-efficiency

fractional horsepower evaporator fan motors with high-efficiency electronically commutated motors.

ESM 11: Steam Boilers

NORESCO will install fourteen (14) new natural gas-fired steam boilers and ancillary heating system equipment in seven (7) buildings. The boilers will be equipped with high-efficiency natural gas burners and modulating controls. This new equipment will serve the buildings' current steam loads, as well provide a degree of redundancy if one of the boilers is down for service. Control of the new boilers will be integrated through the new energy management system (EMS) and provide web-accessible control and monitoring of the buildings' heating plants to facilities staff.

ESM 12: Hot Water Boilers & Pool Heating Systems

NORESCO will install a total of seven (7) gas steam boilers, seven (7) gas hot water boilers, two (2) gas pool heaters, one (1) pool heat exchanger, two (2) hot water heat exchangers, three (3) domestic hot water heat exchangers, pumps, feedwater tanks, and other ancillary heating system equipment in the four buildings listed. Heating systems will be redesigned and modernized to allow for high-efficiency condensing boilers and pool heaters to be incorporated with new steam boilers to provide optimized operations and efficiencies. The boilers will be a combination of high-efficiency condensing hot water boilers and steam boilers with high-efficiency natural gas burners and electronic combustion trim and O₂ controls. This new equipment will serve the building space, domestic, and pool heating loads. Control of the new boilers will be integrated with the upgraded and expanded EMS and provide web-accessible monitoring and control of the buildings' heating plants to facilities personnel.

ESM 13: Solar Photovoltaics

NORESCO will install solar PV array systems on the roofs of the Police HQ and Duggan ES. The PV systems will include solar panels, racks, mounts, inverters, disconnects, and all cabling, wiring, and controls. Roofs on all buildings were evaluated, and the buildings listed are included because the roofs are only a few years old or will be replaced by the time this project goes to construction.

ESM 14: New Electrical Switchgear & Backup Power Generation

NORESCO will install new electrical switchgear, backup emergency generator, and additional electrical infrastructure in the Chase Building to provide emergency power to the third floor IT data center and the fourth floor Emergency Operations Center.

The SOW Sum includes a design allowance in the amount of \$50,000 for ECM 14 that may be used to add additional scope to that measure after execution of the Contract at the request of the City. Use of this allowance will be authorized by execution of a change order by both Parties. Any funds remaining in the allowance may also be allocated to additional work at the City's request through execution of a change order or remitted to the City at the end of the Interim Period.

Hazardous Materials Abatement Allowance

The SOW Sum detailed in Schedule I includes an allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered on the project, including the abatement of lead and asbestos that may be encountered. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW.

SCHEDULE S

Construction and Installation Schedule

This Schedule S includes the dates and milestones for project construction and Equipment installation.

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SCHEDULE T

Systems Startup and Commissioning

This Schedule T describes the thorough and systematic commissioning process that the QESP shall undergo for each element and total system of the installed Equipment pursuant to the SOW. QESP shall provide systems commissioning services that meet the requirements detailed in this Schedule T. All commissioning services for the project shall be provided in accordance with the requirements of ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Guideline 0-2005.

COMMISSIONING PROCESS

The project's commissioning plan and specific commissioning requirements that the QESP will develop shall include at least the following:

- Qualifications and affiliation of the QESP commissioning team, including project staff licensed by the State of Connecticut as Professional Engineers in mechanical or electrical engineering and project staff certified in building commissioning by the Building Commissioning Association or the Association of Energy Engineers;
- Roles and responsibilities of commissioning team, including completion of the commissioning requirements, overseeing or performing the commissioning tests, and verifying the adequacy of the commissioning results;
- Roles and responsibilities of QESP, City, and City's commissioning representative, including witnessing of commissioning activities;
- Process that will be followed to document the design intent or City's project requirements for each ESM or system, including:
 - Operational parameters, such as temperature setback capabilities or operator interface features.
 - Requirements for design details or ancillary items, such as sensors, valves, access, electrical, existing Goods demolition, etc., and
 - Performance requirements, such as Equipment efficiencies;
- Schedule for developing and approving a commissioning plan, including expected content such as:
 - Pre-functional inspections,
 - Functional testing procedures, and
 - Required use of manufacturers' start-up procedures;
- Requirements for the documentation of the City's attendance at the various tests and the City's approval that the tests followed the specified procedures and meet or exceed the expected results;
- Plan for seasonal testing and conditional acceptance, if needed;
- Contents and timing of periodic project reports, Final Commissioning Report, and Systems Manual;
- Requirements for commissioning team oversight of O&M training; and
- Plan for warranty walk-though or other follow-up procedures.

PROJECT DESIGN

QESP shall be responsible for successful performance of commissioning activities by the commissioning team during the design phase, including:

- Meeting with City to review project design and Equipment submittals;
- Documenting the design intent for each ESM or system;
- Developing a commissioning plan, including the specifics of pre-functional inspections and functional performance tests;
- Developing commissioning specifications for project (if needed);
- Facilitating review and acceptance of commissioning documents by City and QESP;
- Issuing Commissioning Plan and specifications.

CONSTRUCTION

QESP shall be responsible for successful performance of commissioning activities by the commissioning team during the construction phase, including:

- Observation of construction by commissioning team and City's commissioning representative;
- Pre-construction and periodic commissioning meetings with the project team;
- Tracking of commissioning progress through regular reports or updates;
- Completion of pre-functional inspections by the QESP prior to Equipment start-up and functional testing;
- Completion of manufacturer's start-up procedures by the QESP or manufacturer's representative.

PROJECT ACCEPTANCE

QESP shall be responsible for successful performance of commissioning activities by the commissioning team during the project acceptance phase, including those listed below. Project acceptance shall occur upon execution by the City of the Certificate of Acceptance of All Installed Equipment.

- Development of test checklists and verification of completion forms for Equipment to be commissioned;
- Execution of the functional performance tests and documentation of the procedures;
- Documentation in a deficiency log of any items that did not pass;
- Correction and retesting of noncompliant items in the presence of the commissioning team to confirm that the items have been fixed, noting the date and corrective action taken in the deficiency log;
- Preparation of the Commissioning Report or a Systems Manual including, at minimum, the following:
 - Commissioning summary report, including how the project requirements or design intent prescribed for each system were met,
 - · QESP test forms and checklists,
 - Completed manufacturers start-up sheets,

- Results of functional testing and verification of system,
- Detailed operating procedures / sequences of operations,
- Closed out deficiency log, and
- Overview of training provided to O&M staff.

POST-ACCEPTANCE PHASE

QESP shall be responsible for successful performance of commissioning activities by the commissioning team during the post-acceptance phase, including:

- Scheduling and verification of deferred functional testing, as necessary, based on seasonal conditions required to evaluate certain systems; and
- If necessary, scheduling and performance of a warranty walk-though to review any problems with Equipment encountered during warranty periods.

APPROACH

The approach that QESP uses for commissioning is an extension of our site management approach. It is based on a project team organization that requires the input of all functional areas of the team. The commissioning team, led by the commissioning agent, will consist of QESP project implementation staff, the City project staff, and members of each relevant construction discipline. Manufacturer's representatives and subcontractors will also be included in the team to assist in performing certain specialized startup and testing procedures.

Key customer personnel, such as the City's technical representative, the City engineers and technical personnel, and the City operations & facilities staff will be an integral part of the commissioning team. QESP includes these customer personnel to coordinate activities with building operations, serve as resources in solving technical issues, review site-specific startup procedures, leverage commissioning efforts for training purposes, and witness tests. It is beneficial for supervisors and operational personnel to participate in commissioning activities, as they provide an ideal opportunity to become familiar with how the equipment included in the project should be operated to meet the design intent. As a result, facility personnel will be more likely to use the operational features of installed equipment to their fullest.

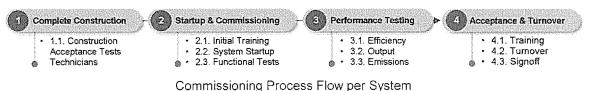
The following organizational chart is intended to serve as a preliminary guide to outline the parties who will be included in the City project commissioning team. Actual team members will be selected based on final design, equipment, and vendor selections.



Physical testing and documentation of commissioning tasks for the City project will be a joint effort between the commissioning team and the construction team. Subcontractors and equipment vendors are issued detailed specifications and are held accountable for the commissioning of equipment and systems included in their scopes. QESP construction and commissioning personnel will coordinate the activities of these supporting contractors and vendors. Testing and commissioning will be directly supervised and verified by QESP's professional staff.

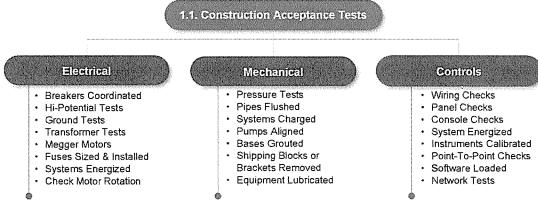
COMMISSIONING PROCESS

The following flowcharts are intended to serve as a guide to outline the type of commissioning process QESP will implement at the City project. Each of these charts is meant to be a simplified example of how most systems will be commissioned. Given the range of systems and ESMs involved at the City, as well as the preliminary nature of the design, it is expected that these may be revised during the final design stage.



Commissioning Freedom Few per Cystem

Systems will proceed through the commissioning process on individual schedules as they are ready for startup. Simple systems and ESMs will only require a subset of the tasks outlined above and will be brought on-line incrementally.



Construction Acceptance Tests

The construction acceptance tests outlined above are meant to be a representation of the majority of construction acceptance tests; this is not intended to be an all-inclusive list. Many systems and ESMs will only require a subset of these tests, while other systems and equipment (Controls, Chillers, Boilers, PV, Variable Frequency Drives, etc.) will require additional measures.



Startup and Commissioning Phase - Per System

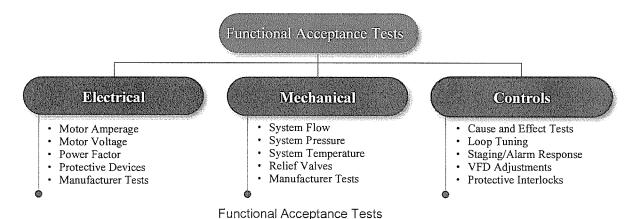
The startup and commissioning phase will require a great deal of coordination because ancillary systems will be required to operate larger integrated systems, and in many cases the ancillary systems cannot be fully tested until the integrated system is brought on-line. Coordination of



System Preparation and System Startup

these tasks will be outlined during daily communications between the QESP project staff and the City personnel.

Preparation and startup will vary greatly from system to system. This list is meant to convey examples of the tasks that will be performed at the City facilities during this phase. As site and equipment specific tasks are defined, they will be added to the project schedule and coordinated with the City facilities staff.



The tests outlined above are meant to be a representation of different types of functional acceptance tests that may be required at the City; this is not intended to be an all-inclusive list. Many systems will only require a subset of these tests.



Functional acceptance testing will vary greatly for each of the ESMs and each of the systems within the ESMs. Actual tasks for each of the ESMs and systems (chilled water systems, steam systems, energy management controls system, photovoltaic systems) will be included in functional acceptance test forms generated for that specific ESM or system.

COMMISSIONING PLAN

The primary objective of the commissioning plan is to define how QESP will ensure that the individual pieces of equipment and integrated systems will perform in conformance with the design intent of the project. Although there are different approaches to commissioning, the fundamental process provides quality assurance to confirm that each of the following standards are met for Equipment included in the project:

- The products and components selected and installed meet project design criteria.
- Products and components are installed in accordance with the engineer's and manufacturer's recommendations and design criteria.
- Products and components are capable of meeting their published performance criteria.
- If the project includes a system of several products and components, the integrated system is installed in accordance with the engineer's design criteria.
- If the project includes a system of several products and components, the integrated components are interacting in accordance with the engineer's design criteria.
- Foreseeable items necessary for the components and systems to continue to operate as designed have been identified for inclusion in the Operations and Maintenance (O&M) Manuals.
- The facility training plan includes items that need to be discussed and reviewed with facility personnel in order for the project to continue to perform.

Detailed commissioning tasks and requirements for the equipment to be installed as part of the City project will be identified in commissioning specifications. These specifications are developed by QESP using an approach customized to the complexity of each piece of equipment and the technology involved. The commissioning team will use the specifications to coordinate individual commissioning tasks and ensure that appropriate commissioning test forms are generated and completed to cover the items requested.

COMMISSIONING PROCEDURES

Specific commissioning procedures vary depending on component technologies, equipment types, and applications involved. As final design is completed, equipment selections are confirmed, and control sequences are finalized, QESP will generate a site-specific commissioning plan for the City project to outline these procedures. Procedures for each piece of equipment will draw from each individual manufacturer's recommendations.

The following representative sections provide examples of the range and types of commissioning procedures for a few of the components that will be listed in the commissioning plan when it is generated.

General Commissioning Items

 Verify that each piece of equipment was manufactured, shipped, and installed with the options and features specified (operator workstation, control system interface, ground fault protection, thermal overload, automatic bypass, safety devices).

- Provide a complete list of equipment nameplate data, component manufacturer's software and firmware versions, and serial number(s). (This should include data for individual available pressure vessels, coils, and motor data.)
- Document dates, times, durations, operating conditions, and names of parties involved with any tests performed.
- Document the procedures, forms, and submissions required to initiate and maintain the manufacturer's warranty.
- Provide written copies of applicable O&M instructions.
- Ensure that appropriate log books have been established using a factory recommended format to record critical operating parameters during equipment operation.
- Document that equipment manufacturer recommended startup and check-out procedures have been completed using manufacturer's forms.
- List rejected items, failed tests, abnormalities observed, or remedial action required by others that were not completely rectified during the construction punch list process.
- Document training provided with names and signatures of parties who received training.
- Verify that adequate clearances exist around components for cooling air and to provide access for routine service.
- Review component locations to ensure that they are not subject to temperatures beyond the manufacturer's published operating limits.
- Check that panels and enclosure locations are of the type specified and are not subject to excessive moisture, spray, or dirt.
- Confirm that fluid systems and system components (valves, sensors, radiators, coils, hoses, tanks, quick disconnects) are properly routed, supported, and free of leaks.
- Ensure that lubricants and fluids meet manufacturer requirements for the equipment installed and the anticipated operating conditions (arctic, tropical). Document that special additives or conditioners have been added to the specified concentrations.
- Provide copies of Safety Data Sheets (SDS) for materials.
- For exterior installations, confirm that enclosure penetrations are watertight and/or do not void weather rating.
- Confirm that equipment, component, and device labels, tags, or signs have been installed per specifications.

Lighting Retrofit Commissioning

- Confirm that post-retrofit group light levels meet the specified illumination requirements.
- Ensure that non-permanent or disposable batteries have been installed and tested and battery locations, types, and recommended replacement intervals have been documented.
- Test emergency egress and exit lights for proper sequencing from normal to emergency mode on battery and/or emergency power as applicable.

- Confirm that battery condition pilot lights and test switches are fully functional.
- Verify that new fixtures and/or existing fixture retrofit kits have been installed per specifications.
- For exterior installations, ensure that enclosure penetrations are watertight and/or do not void weather rating.
- Check operation of completed installation using available controls (wall switches, occupancy sensors, lighting panels) to confirm that they cycle on and off as intended.
- During operation, check that fixtures and ballasts are free of abnormal vibration or unusual noise.
- Confirm that required equipment, component, and device labels, tags, or signs have been installed per specifications.

Lighting Controls Commissioning

- Verify that lighting controls components match project specifications.
- Confirm non-permanent or disposable batteries have been installed and tested and battery locations, types, and recommended replacement intervals have been documented.
- Confirm wiring has been completed and protection devices, (fuses, breakers), have been installed per final design specifications.
- Verify disconnect and/or H-O-A switches have been installed and tested. Hand=On, Off=Off, Auto=EMCS state.
- Confirm pilot lights, control switches, touchpad's, and operating displays are fully functional.
- Verify placement, orientation, and field of view for occupancy sensors. Test and adjust sensitivity and time delay settings. Provide a list of final settings.
- Confirm location and adjustment of sensors and controls used for daylight harvesting or lumen maintenance provide the desired light levels at work surfaces and are free from unwanted interference.
- Adjust sequencing, start time, stop time, and override processing for Sweep-Off controllers.
- Set upper and lower limits of manual dimming controls as appropriate.
- Confirm schedules and interfaces with EMCS controls with the EMCS contractor.
- Provide copies of programming settings and schedules.
- Check that adequate clearances exist for fixture cooling air and routine service.
- Confirm components are not installed in locations subject to temperatures beyond manufacturer's published operating limits.

Electrical Equipment and Electrical System Commissioning

- Confirm that wiring has been completed and protection devices (fuses, circuit breakers, vacuum fault interrupters) have been installed to meet applicable codes and specifications for electrical components installed.
- Ensure that wire, cable, panel grounding, system grounding, insulation, and shielding has been checked, meets specifications, and has been tested per specifications.

- Where applicable, check overhead electrical lines to ensure that they were constructed using the specified materials and follow the approved routing.
- Provide convenience receptacle inside control panels per specifications.
- Verify that disconnect and/or H-O-A switches have been installed and tested (Hand=On, Off=Off, Auto=Control System state). If the H-O-A switch is to be wired in series with an end switch, verify that this interlock has been wired and is working correctly as well.
- Check motor rotation prior to connecting any couplings or belt drives. If applicable, verify that variable frequency drive (VFD) controlled equipment has been checked for proper rotation in both drive and bypass.
- Confirm that pilot lights, control switches, touch pads, warning buzzers, audible alarms, operating displays, are fully functional.
- Confirm that electrical insulation testing (hi-pot, motor megger) has been completed per code and test results have been documented.
- Verify that heaters (lube oil, gearbox, generator winding, enclosure) have been energized and tested. Document the settings of heaters and confirm that power supplies (breakers, panels) have been properly tagged so heaters will not be deenergized.
- Ensure that grounding and other safety systems are installed and properly tested per applicable specifications.
- Document the final voltages, taps, and selector switch settings on transformers.
- Confirm that oil level and type has been checked and recorded for oil-filled transformers.
- Functionally test any thermostatic controls or cooling fans on fan-cooled transformers.
- Confirm that non-permanent or disposable batteries have been installed and tested and battery locations, types, and recommended replacement intervals have been documented.
- For battery installations that include a battery tender or battery charger, verify that the tender or charger has been installed per specifications and is operating as intended.
- Ensure that specified electrical warning and safety labels and tags are in place.
- Ensure that wiring, panels, and equipment have proper tagging and have been checked against electrical schematics, drawings, and specifications.
- Ensure that internal compartment light fixtures have been installed as specified.
- Measure and document equipment no load and full load voltages and amperages to establish an operating baseline and ensure that they are within manufacturer's specifications.
- If applicable, confirm that switchgear and circuit breaker settings have been coordinated with new and existing electrical distribution system components.
 Document coordination study settings and approval prior to energizing equipment.

Mechanical Equipment and Mechanical System Commissioning

- Ensure that life safety systems (harnesses, climbing restraints, barriers, lockouts) have been installed, labeled, and reviewed with customer personnel.
- Verify that equipment has been installed (configuration, orientation, pitch) and supported (housekeeping pads, vibration isolators, seismic restraints) per specifications.
- Review equipment connections and accessories for installation issues that might prevent the equipment from operating properly (loose flex connectors, sharp inlet/outlet transitions, improper slope, pipe strain, inadequate space for thermal expansion).
- Confirm that shipping blocks or temporary supports have been removed prior to startup.
- Ensure that motor and drive components have been aligned and tensioned to specifications.
- Document that alignment procedures used, tolerances, adjustments, and final results for shaft-driven equipment meet or exceed manufacturer requirements and tolerances.
- If specified, ensure that baseline vibration measurements are taken for rotating equipment and that initial readings are within vibration severity guidelines.
- Check to ensure that enclosures, shrouds, guards, or access panels are securely in place.
- Review pressure gauge and temperature sensor locations to ensure that they can be read from floor level and are of proper scale or range for the medium being measured.
- Verify that thermal insulation and sound attenuation has been installed per specifications.
- Confirm that each motor, bearing, and gearbox has been lubricated, if necessary, and that remote grease lines, if specified, have been installed.
- Confirm that adequate clearances exist for routine service and replacement of motors, controls, dampers, valves, tube bundles, coils, gearboxes
- Review outside air intake openings to ensure that they are free of pollution sources, such as trash, cooling tower mists, building exhaust, vehicle exhaust, or other sources that could impact indoor air quality or deteriorate equipment.
- Ensure that equipment piping and accessories (strainers, valves, air vents, vacuum breakers, Pete's plugs) have been installed per specifications.
- Confirm that piping systems have been pressure tested per specifications.
- Verify that piping systems have been flushed, cleaned, and purged per specifications. Document that cleaning procedures were performed at specified velocities using appropriate media (air, steam).
- Where applicable, ensure that proper type and efficiency of filters or strainers have been installed, are clean, fit properly without leakage, and can be readily serviced.

Energy Management Control System Commissioning

- Provide a troubleshooting logbook by the operator workstation for use by facility operators and control technicians to document issues and contractor responses to ongoing fine-tuning.
- Confirm that sensor locations and inputs have been reviewed to ensure that readings are stable and accurately reflect the medium being measured (no stratification, excessive pulsations, system effects).
- Document that inputs, sensors, outputs, and transducers have been calibrated and that ranges match the medium being measured or devices to be controlled. Where applicable, ensure that current transformer magnetization and polarity tests have been completed per specifications.
- Document that flow control devices (valves, dampers) have been tested through full range of motion to ensure shutoff when closed, unrestricted flow when open, and smooth operation.
- If applicable, verify that interface and monitoring of any original equipment manufacturer equipment (VFD, chiller control panel, burner management system) operating parameters, faults, or alarms have been completed and tested.
- If applicable, document that remote monitoring of the control system through dial-up or internet connection has been completed and tested with lists of all phone numbers, modem settings, IP addresses, passwords
- Provide lists of user defined system variables, including default or initial values (set point, schedule, reset, alarm, gain) to facilitate future modifications and fine-tuning.
- Test control sequences and software logic by completing functional performance tests that confirm system responses through cause and effect methods.
- Collect and print trends for dynamic control loops to demonstrate proper control (timely and smooth response, lack of hunting, close to set point, minimal overshoot) over a range of system loads (weather, startup, shutdown) encountered during normal operation.
- If applicable, review graphic screens to ensure they accurately reflect equipment and systems controlled, include ranges for controlled devices, have transfers or links to quickly navigate through related subsystems, and include narrative explanation of any non-intuitive sequences.
- If applicable, enable password protection of control system programming and confirm that the password matrix of access levels and privileges has been approved and implemented per customer requirements.
- Confirm that control system and equipment failure modes (power failure, sensor failure, signal or communication loss) and alarm responses have been reviewed with a customer representative to ensure that they meet facility standard operating procedures.
- Confirm that devices with clocks or calendar functions have been checked for proper dates and times and coordinated with local daylight savings time practices.
- Confirm that equipment subject to automatic start/stop control by the control system has been reviewed with a customer representative to ensure that equipment is

properly labeled and life safety protection measures (horns, lights) are compatible with facility standard operating procedures.

Chiller and Chilled Water System Commissioning

- Confirm that wiring has been completed and protection devices (fuses, heaters, breakers) have been installed to meet specifications for the chiller installed.
- Confirm that sump or crankcase heaters are operating per manufacturer recommendations.
- Confirm proper operation of EMCS interfaces with the chiller (remote set point adjustment, remote start/stop, alarm monitoring, demand limiting).
- Test operation of safety or protection devices (pressure, flow, temperature, voltage, amperage, refrigerant) to ensure that they have been adjusted or programmed to meet specifications and are operating as intended.
- Document that chiller control panel has been programmed for the specific chiller purchased, as well as the actual chiller plant configuration (constant flow, variable flow).
- Confirm and document that minimum and maximum operating flows have been identified and adjusted within limits during test and balance.
- If applicable, document that remote monitoring or EMCS network interfaces with the chiller control panel operating parameters, faults, or alarms have been tested and calibrated.
- Verify proper operation of unique controls or features that were specified to have been provided with chiller control panel (lead/lag, load balance, hot gas bypass).
- Provide a list of chiller control panel programming parameters and settings.
- Confirm that control sequencing for ancillary equipment (chilled and condenser water pump start/stop, cooling tower interlock) meets specifications and desired control sequences.
- Verify that the chiller has been installed and supported (housekeeping pads, vibration isolators, seismic restraints) per specifications.
- Ensure that chiller piping and piping accessories (strainers, control valves, flow switches, balance valves, pete's plugs) have been installed per specifications and are free of leaks.
- Confirm that refrigerant purge unit, if applicable, is operating correctly. Verify that refrigerant relief piping is installed per manufacturer's requirements and vented outside.
- If possible, test the chiller under potential surge conditions to ensure that automatic surge protection devices (variable diffusers, load limiting algorithms) are functioning.
- Confirm that there is no abnormal noise or vibration during part- and full-load operation.
- Measure and document no load, normal load, and full load pressures, temperatures, and flows to establish an operating baseline and ensure they are within manufacturer's specifications.

Variable Frequency Drive and Variable Flow System Commissioning

• Check equipment operation through the full range of operating speeds to identify any harsh vibrations or critical frequencies.

- Document critical frequencies and ensure that they are blocked and labeled on the drive or device used to modulate speed.
- Confirm that minimum operating speeds have been reviewed for manufacturer requirements (motor cooling, gearbox oil distribution, pump stall, fan surge) and are documented and programmed into control equipment.
- If specified, verify that drive installation has been modeled using a harmonic analysis program or to ensure harmonics will not exceed specifications at the point of common coupling (PCC).
- Measure cable length between the drive output and motor terminal and confirm that it does not exceed specified maximum distance without approved compensating filtration.
- If a service disconnect is installed between a VFD and motor, confirm the disconnect has been provided with specified supervisory relays and that interlock wiring has been completed to prevent the drive from operating if the disconnect switch is opened.
- For scopes that include converting flow or capacity modulation to a new strategy (inlet guide vanes to VFDs, three-way valve to two-way valve), document that the original flow control devices have been removed and/or decommissioned as outlined in the specifications.
- Confirm that motors used are capable of operating with the VFD and cable arrangement to be used for the installation.
- If specified, ensure that motor shaft grounding rings have been installed on each motor.

Engine-Driven Generator Commissioning

- Verify that equipment has been installed (configuration, orientation, pitch) and supported (housekeeping pads, vibration isolators, seismic restraints) per specifications. Where applicable, ensure that units have been doweled and grouted after final alignment.
- Document that engine, generator, and drive components have been aligned to within specified tolerances. Use "cold check" and "hot check" methods. Confirm that generator gap has been inspected after the unit has been secured to the foundation and that manufacturer startup checklists and procedures have been followed.
- Ensure that inlet filters, silencers, and cooling systems have been installed per plans and specifications. Confirm that inlet passages have been thoroughly inspected for cleanliness and integrity and are free of items that could cause foreign object damage to engine.
- Check air inlet locations to verify that they will not expose unit to undesirable vapors, fumes, or mists during normal operation.
- Verify that exhaust systems and silencers have been installed as specified, will not
 impart undue backpressure on the unit at rated flow, and are oriented so that
 exhaust discharge will not impact adjacent structures or equipment. Confirm that any
 expansion bellows, condensate drains, and thermal or sound insulation have been
 installed per plans.
- Review fuel systems to confirm that they are capable of providing unit with specified quality and quantity of fuel under anticipated operating conditions. Confirm that fuel

- filters, driers, pumps, compressors, and regulators have been started per manufacturer recommendations.
- Confirm that post transportation tasks (shipping sleeves removed, bearings flushed, casings flushed) and pre-startup procedures (lube oil system flushing, temporary strainers, coupling lubrication) have been completed per manufacturer requirements.
- If applicable, confirm that system performance tests (at factory and/or in field) have been completed per specifications. Document that variables (fuel consumption, kWh, gal/kWh, Power Factor, pressures, temperatures) meet specifications for each test condition
- Review installation of totally enclosed water air cooled enclosures to ensure that they
 were manufactured and installed per specifications. Document that cooling systems
 (pumps, radiators, regulating valves) have been checked for proper flow and
 temperature control while generator is under load.
- Verify that applicable engine, gearbox, generator, and enclosure sensors (gas
 monitors, thermocouples, resistance temperature detectors, pressure transducers,
 vibration switches) have been field tested by completing a point-to-point checkout of
 each one.
- Provide lists of user defined system variables, including default or initial values
 (alarm settings, time delays, voltage regulator tuning parameters, governor settings, generator staging, grid power limits) to facilitate future modifications and fine-tuning.
- Ensure that governors and over-speed trip devices have been properly adjusted for application and that they have been tested using manufacturer's procedures.
 Document test results.
- Ensure that manufacturer specified sequences, strategies, and limits (pre-purge, slow roll, warm-up, acceleration, cool down, inlet air cooling, on-line wash) have been incorporated into control programming.
- Verify that critical frequencies have been clearly identified and that control programming includes blocking of these speeds as well as rapid acceleration through them.
- If applicable, ensure that emergency power has been provided to engine, generator, and ancillary equipment (programmable logic controller, telemetry, lube oil system, air compressor, water cooler, enclosure ventilation) required for the unit to operate as intended during emergency mode.
- Verify that heaters (lube oil, fuel oil, jacket coolant, generator winding, enclosure)
 have been energized and tested. Document the temperature settings of heaters and
 confirm that power supplies (breakers, panels) have been properly tagged so that
 heaters will not be inadvertently de-energized.
- If installation includes a sound or weatherproof enclosure, verify that enclosure includes specified ventilation systems, lights, monorails, or rigging systems necessary to maintain prime mover, generator, and ancillary components. Document testing of these systems.
- Check that safety and emergency support systems (combustible gas monitor, fire suppression system) for equipment and equipment enclosure have been started and tested in accordance with manufacturer recommendations and local codes.

- Verify that pressure gauges have been installed on main supply lines, at pressure reducing stations, at inlet to devices (starters, burners).
- Review normal operating adjustments (cooling water temperature, lubricating oil level, fuel pressure, inlet cooling system, drains) after startup is complete to ensure that they are within manufacturer recommended settings.
- Collect trends for dynamic control loops (combustion, governor, voltage regulator) to demonstrate proper control (timely and smooth response, lack of hunting, close to set point, minimal overshoot) over each range of system loads (startup, shutdown, light load, full load, sudden load change) encountered during normal operation.
- Confirm that cooling, fuel, lubrication, air, and hydraulic system components (valves, sensors, hoses, quick disconnects) are properly routed, supported, and free of leaks.
- Verify that filters and strainers (air, water, fuel, lube oil) have been installed and, where necessary, have been replaced after initial startup and system flush-out.
- Ensure that lubricants and fluids meet manufacturer requirements for the equipment installed and the anticipated operating conditions (arctic, tropical). Document that special additives or conditioners have been added to the specified concentrations.

Steam and Boiler System Commissioning

- Confirm that wiring has been completed and protection devices (burner management system, low limits, high limits, operating controls, draft sensors, smoke detectors, fusible links) have been installed to meet specifications for the boiler installed.
- If applicable, ensure that emergency power has been provided to the boiler and ancillary equipment and controls that are required for unit to operate as intended during power loss.
- Confirm proper operation of automated valves, operating controls, level controls, limit controls, feedwater pump controls, circulating pump controls, low water cutouts, automatic blowdown sensors, remote alarms, remote start/stop controls, remote pressure controls
- Test operation of protection and safety devices (pre-purge, over-temp, overpressure, low water, post-purge, power failure) and associated alarms to ensure that they have been adjusted per specifications and meet facility standard operating procedures.
- Document programming settings and test results for safety protection devices.
- If applicable, ensure that steam supply meets specified requirements for purity (inert or reactive components), quality (temperature and pressure), and flow (klb/hr).
- Check boiler modulating control through full operating range to verify that pressures and temperatures are maintained within acceptable tolerances, especially during load changes.
- Confirm that any continuous trim or closed loop burner controls have been calibrated and are maintaining desired set points. Document settings and programming values.
- Review boiler boil-out and first-fire procedures to confirm that they meet boiler manufacturer recommendations and are compatible with facility chemical treatment system.

- Where applicable, ensure that refractory curing procedures are followed during firstfire. If condensate drains are opened during curing, document results of curing process and installation of plugs after procedure is complete.
- Confirm that discharge header on steam boilers meets manufacturer recommendations to minimize any possibility of boiler water carryover.
- Ensure that burner motor, jackshafts, and operating cams, if applicable, have been lubricated, aligned, and/or tensioned to manufacturer specifications.
- Document size, setting, and capacity of pressure relief or combination temperature and pressure relief valves or devices. Ensure that devices are located and piped per specifications.
- Review location and sizing of combustion air dampers and louvers, if applicable, to
 ensure that they are adequately sized and do not pose a risk of dumping
 unconditioned air on unprotected piping. Confirm that dampers open and close by
 sequence of operations.
- Test boiler discharge isolation valves and check valves, if applicable, to ensure that they properly seal against normal system operating pressure.
- Document that burner nozzles and combustion air baffles, if applicable, meet manufacturer recommendations for fuel sources and boiler elevation above sea level.
- Confirm that there are no abnormal noises or pulsations during part- and full-load operation and that sight glasses are free of abnormal foaming or bouncing.
- Check that boiler blowdown systems (slow-acting, quick-acting, and continuous) have been tested under operating temperature and pressure.
- If a blowdown cooler or tempering device has been installed, ensure that it has been adjusted to maintain discharge temperatures within specified range. Document final settings.
- Verify that breeching and flue piping is installed and insulated per specifications and that discharge configuration meets manufacturer recommendations.
- Confirm that boiler and associated piping has been cleaned per specifications and chemical treatment program has been initiated per manufacturer recommendations.
- Measure and document operating temperatures and pressures, fuel pressure, fuel flow, stack temperatures, and boiler efficiency with available fuels to establish an operating baseline and ensure that they are within manufacturer's specifications.

Steam trap Commissioning

- Where applicable, (traps with leak detection sensors), confirm that non-permanent or disposable batteries have been installed and tested and battery locations, types, and recommended replacement intervals have been documented.
- Verify that typical operating temperatures at the installation location are not expected to exceed manufacturer's published limits.
- Ensure remote communications are operational and that expected signals (trap open, trap cold) can be collected using the specified supervisory equipment.
- Confirm that appropriate type trap (inverted bucket, float & thermostatic, orifice) was installed per final design drawings or specifications.

- Where applicable, document that the trap orifice or metering components match the sizes indicated in the specification for the particular piece of equipment or service.
- Inspect steam trap and adjacent piping from trapped device through to condensate return header to verify steam trap has been installed, oriented, and supported per specifications.
- Confirm piping to and from steam trap has been properly supported and pitched.
- Verify adequate clearances exist for routine service of renewable components.
- Check that piping accessories, (strainers, isolation valves, check valves), have been installed per specifications and that the completed system is free of leaks.
- Verify thermal insulation, if applicable, has been installed or replaced per specifications.
- Ensure steam trap has been primed and fill ports specified for continued preventive maintenance have been installed.
- Verify piping to and from the steam trap has been cleaned per specifications and chemical treatment program has been initiated per manufacturer recommendations.
- Check steam trap in operation to see if it is cycling as expected and, if possible, confirm the equipment served by the steam trap is operating, (heating, sterilizing), as designed.
- Confirm required steam trap labels, tags or signs have been installed per specifications.

Photovoltaic System Commissioning

- Verify that photovoltaic (PV) system was constructed, shipped, and installed with options specified (PV panels, panel mounting racks, inverters, inverter interfaces, disconnects, isolation transformers, safeties, meters, alarms, displays, wiring, conduit)
- Provide a complete list of nameplate data and serial number(s) for PV system components.
- Confirm wiring and protection devices, (fuses, heaters, breakers), have been installed to meet specifications for PV system components installed.
- Ensure pilot lights, control switches, touchpads and operating displays are fully functional.
- Check and document that PV system start-up, transfer to grid, transfer from grid, shutdown and failure modes have been tested.
- Document factory recommended start-up and check-out procedures have been completed.
- Measure and document both Direct Current (DC) open circuit voltage (Voc), short circuit current (Isc), and peak power (Pp), and Alternating Current (AC) voltage, frequency, amperage, and power factor at multiple sunlight and temperature conditions to establish an operating baseline and ensure they are within manufacturer's specifications. Ensure that factory performance test results of modules have been received and properly recorded.

- Confirm layout, orientation and slope/tilt of PV panel modules and grid system match specifications.
- Ensure PV system component locations are not subject to temperatures beyond manufacturer's published operating limits.
- Check that adequate clearances exist for cooling air and routine service of components.
- Verify locations of electronic enclosures are not subject to excessive moisture, spray, or dirt.
- Make sure exterior penetrations are watertight and/or do not void weather ratings.
- Ensure that mounting hardware does not subject modules to physical stress, i.e., check that structural elements are straight and not twisted.
- Perform visual inspection of modules to check for cracked cells.
- Check the location and orientation of sensors, (anemometers, air temperature, PV
 cell temp, pyranometer) to ensure they are installed per manufacturer's instructions
 and will not experience interference from adjacent surfaces or structures.

DOCUMENTATION

As mentioned above, QESP will prepare a detailed commissioning plan for the City project. This plan will be prepared as soon as final design, equipment selections, and control sequences are completed. The commissioning plan will be prepared with input from major subcontractors and vendors and will outline the design intent, objectives, organization, schedule, documentation requirements, and testing procedures to be used.

After the commissioning plan has been drafted, QESP will schedule meetings with appropriate commissioning team members to review the proposed plan and document relevant corrections and clarifications.

Commissioning activities and milestones will be identified in the QESP construction schedule to communicate how systems will be brought on-line. As the project transitions from construction to startup, a brief outline of ongoing commissioning activities will be included in the agendas for regular job meetings and will be documented in the meeting minutes. During startup, detailed look-ahead schedules will be generated to coordinate commissioning tasks so that appropriate commissioning team members can participate.

Actual commissioning test forms for the City project will include a mixture of QESP test forms, customized subcontractor test forms, and standard manufacturer installation and startup checklists. Since the commissioning process ranges from simple static tests performed during construction (such as piping pressure tests) to complex dynamic tests (such as control system functional testing), it is typically impractical to collect and submit each and every test form and checklist. The commissioning team will discuss each commissioning procedure and agree upon the forms and documents to be used to document it prior to the task being performed. Where requested, QESP will submit copies of the actual test forms that will be used to the City personnel for review and approval.

Where appropriate for the technologies involved, commissioning forms may also include specialized electrical, thermal, or vibration studies performed by consultants. Customized test

forms will be generated by QESP and subcontractors as needed to outline the procedures to be followed during testing of integrated systems or automated control sequences.

Upon completion of project commissioning, the QESP Commissioning agent will perform a final quality control check of commissioning documents and support the submission of project close out documents. The commissioning submittals will contain relevant commissioning documentation collected during the project, such as completed checklists, test forms, start-up sheets, balance reports, and acceptance forms. Descriptions of any abnormalities or unusual observations will also be included.

SCHEDULE U

Standards of Comfort

This Schedule U sets forth the acceptable standards of comfort that the QESP shall maintain for heating, cooling, lighting levels, hot water temperatures, humidity levels, and/or any special conditions for occupied and unoccupied areas in each building in the Project Site(s).

Table U-1 includes the standards of comfort for the project.

Table U-1: Standards of Comfort

Table U-1. Sta	ildards of Colffiort			
Type	Acceptance	Status and Setting		
Space Cooling	Occupied: 72°F to 76°F			
	Unoccupied: 78°F to 80°F	W - 1 (W		
Space Heating	Occupied: 68°F to 72°F			
	Unoccupied: 55°F			
Domestic Hot	Supply to Kitchens: 140°F			
Water Heating	Supply to Other Areas: 120°F			
Type		Standard		
Indoor Air Quality	ASHRAE 62.1-2007: Ventilation for	Acceptable Indoor Air Quality		
Energy Efficiency	ASHRAE 90.1-2007: Energy Stand 2009 International Energy Conserva	ard for Buildings Except Low-Rise Residential		
Chillers	ANSI/ASHRAE 15-2010: Safety Sta			
	t e e e e e e e e e e e e e e e e e e e	nce Rating of Water-Chilling and Heat Pump Water-		
Cooling Towers	NFPA 214-2011: Standard on Water-Cooling Towers			
	CTI STD-201 (2011): Standard for the Performance	the Certification of Water Cooling Tower Thermal		
NFPA	NFPA 90A-2012: Standard for the I	nstallation of Air-Conditioning and Ventilating Systems		
Lighting *Source: IESNA	Location	Recommended Light Levels (Footcandles)*		
Lighting Handbook, 10th	Office (General)	30–50		
Edition	Office (Task Lighting)	30–35		
	Conference Rooms	30		
	Auditorium	7.5		
	Gymnasium	30–50		
	Classrooms	40		
	Dining Areas	10		
	Kitchen	50		
	Restrooms	30		
	Entrances/Lobbies/Corridors	5		
	Stairwells/Elevators	5		
	Parking Areas	0.2		

SCHEDULE V

QESP's Training Responsibilities

This Schedule V includes the training program for Facilities personnel, including the duration and frequency of the specified training, any provisions for ongoing training, commitments to train newly hired Facilities personnel, and training with respect to possible future equipment or software upgrades.

QESP's training personnel will provide or arrange for instruction on the troubleshooting, maintenance, emergency, emergency shut-down procedures, technical functions, warranty provisions, and repair of equipment and systems modified or installed under each ESM. Training will be conducted on-site using actual ESM equipment wherever possible. QESP will coordinate training with the City, and will provide a minimum ten business days' notice in advance of such training. QESP will demonstrate that City has attended training. The City may record the training sessions at their own expense for future training needs.

Table V-1 summarizes the amount of training to be provided for each ESM.

Table V-1: Training Responsibilities

	ESM	Duration	Frequency	Description
1	Interior Lighting Improvements & Controls	1 hour	Annually during the 5 year Guarantee Period	QESP project manager and lighting vendor will review O&M manual and warranty procedures.
2	Exterior Lighting Improvements	1 hour	Annually during the 5 year Guarantee Period	QESP project manager and lighting vendor will review O&M manual and warranty procedures.
3	Variable Speed Chillers & Pumps	6 hours	Annually during the 5 year Guarantee Period	On-site training by QESP project manager and chiller vendor of chiller startup, shutdown, control panel, sequences and warranty procedures.
4	AHU Damper Refurbishment	1 hour	Annually during the 5 year Guarantee Period	On-site training by QESP project manager, sequences.
5	Energy Management System Upgrades & Expansion	16 hours	Annually during the 5 year Guarantee Period	Onsite training provided by QESP project manager and controls manufacturer's representative will be conducted at the affected buildings using the installed controls components and workstation.
6	Building Insulation	30 minutes	Annually during the 5 year Guarantee Period	QESP project manager will review as-built documentation and warranty procedures.
7	Pipe & Fitting Insulation	30 minutes	Annually during the 5 year Guarantee Period	QESP project manager will review as built documentation and warranty procedures.

	ESM	Duration	Frequency	Description
8	Steam Trap Repair & TRVs	1 hour	Annually during the 5 year Guarantee Period	QESP project manager will review as built documentation and warranty procedures.
9)	Plug Load Controls	1 hour	Annually during the 5 year Guarantee Period	QESP project manager will review as built documentation, system operation and warranty procedures.
1 0	Walk-in Cooler Controls	1 hour	Annually during the 5 year Guarantee Period	QESP project manager will review as built documentation, system operation and warranty procedures.
1	Steam Boilers	6 hours	Annually during the 5 year Guarantee Period	On-site training by QESP project manager and boiler vendor of boiler startup, shutdown, control panel, sequences and warranty procedures.
1 2	Hot Water Boilers & Pool Heating Systems	6 hours	Annually during the 5 year Guarantee Period	On-site training by QESP project manager and boiler vendor of boiler startup, shutdown, control panel, sequences and warranty procedures.
1 3	Solar Photovoltaics	2 hours	Annually during the 5 year Guarantee Period	On-site training by QESP project manager and solar vendor of photovoltaic system startup and warranty procedures.
1 4	New Electrical Switchgear & Backup Power Generation	2 hours	Annually during the 5 year Guarantee Period	On-site training by QESP project manager and generator vendor of generator startup, shutdown, control panel, sequences.
Tot	al Training Duration	45 hours	ermany thouse von seam (part againstinen militari) illi militaria (landidessa lahii 11 Your ing) (masimbanii la	recommendation of the second s

Educational Outreach

Addressing energy efficiency at the building level is a critical first step in achieving energy savings, but not addressing the energy use of the people inside these buildings leaves a piece of the savings pie on the table. Our Green Operations (GO) team works to ensure this piece is included, achieving quick, significant, and sustainable savings. Our behavior change program is unlike any other. It is tailored to each customer's specific energy conservation challenges and strengths. Our program is intrinsically motivated: when people understand the benefits and consequences of energy consumption, they change for the right reasons. This change is more effective, sustainable, and exponential compared to change based on external rewards.

NORESCO's Energy Conservation Through Behavior Change® (ECTBC) program is the creation of Dr. Scott Finlinson, an Industrial Organization psychologist whose doctoral dissertation became the foundation for the program today. With over fifteen years of experience in changing behavior, Dr. Scott Finlinson and his highly-skilled team create custom, comprehensive behavior change programs for a variety of organizations. NORESCO's proprietary Human Behavior Energy AuditSM (HBEA) is the first step to identifying and analyzing

opportunities for Energy Conservation Through Behavior Change®. This "people side" of performance contracting empowers organizations to augment energy savings by creating a culture of conservation.

Human Behavior Energy AuditSM

The HBEA is an exploratory research process that identifies and assesses current levels of behavior-related energy factors. Both intrinsic and extrinsic barriers, and facilitators, toward energy itself and energy consumption will be explored and assessed throughout the organization. Example factors include energy attitudes, knowledge, social norms, perceptions of control, as well as behaviors. Once identified, assessment of these factors establishes a baseline of current human behavior with regards to energy use. Various research methods are employed to collect this data, including one-on-one interviews, focus groups, and surveys. Next, using a combination of organizational archival data with HBEA interviews, focus group and survey results, specific behaviors are identified that have a significant impact on the environment and your energy costs. Considering that building occupants typically control 30% of a building's energy consumption, the HBEA is a powerful measurement tool that identifies the most impactful energy behaviors and allows your organization to achieve the greatest return on investment.

- Talk to People: Our specialists talk to people to better understand an organization's culture and needs.
- Data Collection: We collect data on levels of energy conservation attitudes, knowledge and behaviors of building occupants.
- Establish Baseline: By establishing an energy baseline, program effectiveness can be measured. Comparing post-program data to the baseline creates quantifiable results that can be used to modify the program for increased effectiveness.

Overview

- Meet on-site with organization stakeholders
- Conduct on-site interviews and focus groups with groups of similar energy users
- Design organization-specific, web-based survey for email distribution including items discovered during the interview/focus group stage
- Work with organization to distribute survey to building(s) occupants
- Analyze all HBEA data, including interviews, focus groups, and survey

Deliverables

- Web-based survey and announcement
- Provide survey incentives not to exceed \$1,000
- Comprehensive HBEA report detailing findings
- Digital copy of summary-level focus group and survey data
- You will be assigned a Green Operation representative who will guide you through the process and be available for questions and concerns.

SCHEDULE BB

QESP Maintenance Responsibilities

Performance period service responsibility begins with the development of O&M Manuals during the construction phase. NORESCO will compile these manuals and present them to the City's O&M team following execution of the Certificate of Substantial Completion of all ESMs. They will include performance specifications and information to set up a planned maintenance program for the service technicians and facility staff that will perform maintenance. These documents will be incorporated into the training programs for the project. Responsibility for maintenance and repair will be clearly delineated in these manuals.

The City is generally responsible for all operations, maintenance, repair, and replacement of NORESCO installed equipment to ensure a comfortable environment for students, staff, and visitors, and that optimal equipment performance and savings persist throughout the contract term. Our approach to meet this objective is to augment the City's facilities' staff with a Site Manager who will work with the City facility staff onsite for a maximum of 600 hours per year. The Site Manager will be responsible for the following:

- ▶ Coordinate subcontracted services and provide oversight of all maintenance, repair, and replacement activities for equipment for which NORESCO is responsible as outlined in Table BB-2.
- ▶ Provide annual refresher training on the installed ESMs, as well as training for new hires and newly assigned managers or supervisors when requested in accordance with the terms of Schedule V.
- ▶ Implement Educational Outreach through NORESCO's Energy Conservation Through Behavior Change® (ECTBC) program in accordance with the terms of Schedule V.

NORESCO proposes that the City retain assignment for all day-to-day operations of all new and existing equipment and serve as first responder to all service calls for all ESMs and equipment installed as part of this project as a continuation of current practice. Operations include starting, stopping, scheduling, adjusting, and monitoring equipment.

NORESCO will provide an onsite Site Manager to serve as an extension of the City facilities staff, and support the City's efforts in reporting utility savings. Table BB-1 lists our Performance Period Team members and their roles.

Table BB-1: QESP Performance Team

Mike Richardson	Þ	Leads NORESCO's team
Performance Period Manager	₽	Oversees and manages maintenance activities and quality control
John Feeney	Þ	Coordinates all on-site service efforts and subcontracts

Regional Manager	
Site Manager – TBD	Oversees maintenance activities for new controls systems, and
	onsite subcontracted maintenance effort
	Responds to warranty/non-warranty calls
Remote Monitoring Center	▶ NORESCO's 24/7 call center can receive calls, open service
	requests, and follow up on afterhours issues with onsite staff

Table BB-2 describes the QESP maintenance responsibility for each of the proposed ESMs. The overall strategy is to perform the maintenance for specific ESMs, as well as quarterly or annual inspections to ensure proper maintenance and operation of the other installed equipment.

During the contract term, NORESCO will monitor O&M functions for all ESMs on a quarterly basis. Monitoring will be performed by conducting onsite inspections on a sample of equipment, and reviewing the associated maintenance and repair records for each ESM. The total sample size for all equipment will be determined by the amount of equipment to which NORESCO can gain access and inspect within a 2-day timeframe for each inspection. The Regional Manager or Site Manager will complete O&M Inspection Reports on a quarterly basis. Any issues identified during the quarterly inspections that are likely to impact energy consumption will be reported to the customer at the time of discovery. The quarterly reports will be compiled for inclusion with the Annual Verification Report (AVR). The reports will include a summary of activities that occurred onsite during the visits, the status of the inspected equipment, and the status of any maintenance or repair activities. The reports will indicate if all O&M activities have been performed in accordance with the required specifications and will identify deficiencies and outline remedies.

Table BB-2: QESP Maintenance Responsibilities

ESM	Type of Function	Activity	NORESCO
ESM 1: Interior	Maintenance	Perform quarterly O&M site inspections	✓
Lighting Improvements & Controls	Training	Conduct annual training	✓
ESM 2: Exterior	Maintenance	Perform quarterly O&M site inspections	~
Lighting Improvements	Training	Conduct annual training	√
		Perform quarterly O&M site inspections	✓
		Sequence test all controls	✓
ESM 3: Variable Speed	Maintenance	Check setpoints of operating controls and safety limits	~
Chillers & Pumps	A Company of the Comp	Review operator log and alarm history	✓
•		Check overall operation.	✓
	Training	Conduct annual training	✓
ESM 4: AHU	Maintenance	Perform quarterly O&M site inspections	
Damper Refurbishments	Training	Conduct annual training	· ·

ESM	Type of Function	Activity	NORESCO
		Perform quarterly O&M site inspections	✓
		Perform lockout / tagout	~
		Check main control board	✓
	e que maio a de partir de la companya de la company	Check input and output wiring	√
	A consideration	Software review and monitoring	✓
	10()	Verify current occupancy schedules	~
		Verify current operating setpoints	~
ESM 5: EMS	Maintenance	Review alarm activity	✓
Upgrades & Expansion	01. p. 000000	Review customer provided complaint log	/
- Aparioro	and the second	Review customer provided operator logs	<i></i>
		Inspect server and field control panels	
		Check current temperature and record	~
		Identify temperature sensors that need to be calibrated and record	✓
	Spirite and the spirite and th	Identify CO ₂ sensors that need calibration (if equipped)	~
	Training	Conduct annual training	✓
ESM 6:	Maintenance	Perform quarterly O&M site inspections	✓
Building Weatherization	Training	Conduct annual training	V
ESM 7: Pipe &	Maintenance	Perform quarterly O&M site inspections	
Fitting Insulation	Training	Conduct annual training	✓
ESM 8: Steam	Maintenance	Perform quarterly O&M site inspections	✓
Traps & TRVs	Training	Conduct annual training	/
ESM 9: Plug	Maintenance	Perform quarterly O&M site inspections	
Load Controls	Training	Conduct annual training	✓
ESM 10: Walk-	Maintenance	Perform quarterly O&M site inspections	✓
in Cooler Controls	Training	Conduct annual training	~
		Perform quarterly O&M site inspections	
ESM 11: Steam Boilers	Maintenance	Perform lockout/tagout	✓
Dollers	Training	Conduct annual training	✓
ESM 12: Hot		Perform quarterly O&M site inspections	/
Water Boilers &	Maintenance	Perform lockout/tagout	
Pool Heating Systems	Training	Conduct annual training	· /
in describerados dos estradores de comercia en entre de comercia en entre en comercia de c		Perform quarterly O&M site inspections	
ESM 13: Solar	Maintenance	Perform lockout/tagout	✓
Photovoltaics	Training	Conduct annual training	✓
	Maintenance	Perform quarterly O&M site inspections	✓

ESM	Type of Function	Activity	NORESCO
ESM 14: New Electrical			
Switchgear &	Training	Conduct annual training	
Backup Power			
Generation			

SCHEDULE CC

City's Maintenance Responsibilities

This Schedule CC sets forth the City's operations and maintenance responsibilities for the installed equipment. The City shall, at its expense, maintain the Project Sites in good working order during the SOW term. Except for the limited activities that are to be performed by QESP as outlined in *Schedule BB: QESP's Maintenance Responsibilities*, the City shall be responsible for servicing and maintaining at its own cost (i) the ESMs and all other equipment that compose the ESMs and (ii) all other equipment that is attached thereto and/or is integral to the proper functioning of the ESMs. QESP shall provide to the City the operations and maintenance manuals that outline operations and maintenance duties for all Equipment. Department maintenance for the installed ESMs will begin after the Substantial Completion of each ESM.

In additional to the requirement below, the City will need to keep a log noting the hours of operation of the emergency generator installed as part of ESM 14. The emergency generator is designed to be used less than 300 hours in any consecutive twelve month period. In the event the City operates the generator in a manner that exceeds those limits, the City may need to obtain an individual air permit for the generator's operation at its expense.

Table CC-1: City's Maintenance Responsibilities

ESM	Type of Function	Activity	City
	Operations	Operate all equipment on a daily basis	✓
	Maintenance	Perform scheduled preventive maintenance on NORESCO-installed equipment	✓
ESM 1: Interior Lighting	Maintenance	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	✓
Improvements & Controls	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	✓
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	√
	Operations	Operate all equipment on a daily basis	✓
	Maintenance	Perform scheduled preventive maintenance on NORESCO-installed equipment	~
ESM 2: Exterior Lighting	Wantenance	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	· /
Improvements	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	✓
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	or bullet a 14 (One distribution and one of the original of th
	Operations	Operate all equipment on a daily basis	✓

ESM	Type of Function	Activity	City
	Maintenance	Perform scheduled preventive maintenance on NORESCO-installed equipment	✓
ESM 3: Variable Speed	Manitenance	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	✓
Chillers & Pumps	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	√
•	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	✓
	Operations	Operate all equipment on a daily basis	√ .
	Maintenance	Perform scheduled preventive maintenance on NORESCO-installed equipment	/
ESM 4: AHU Damper	Wallienance	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	✓
Refurbishments	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	~
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	<
	Operations	Operate all equipment on a daily basis	✓
	Maintenance	Perform scheduled preventive maintenance on NORESCO-installed equipment	✓
ESM 5: EMS Upgrades &		Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	✓
Expansion	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	~
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	✓
	Operations	Operate all equipment on a daily basis	✓
	Maintenance	Perform scheduled preventive maintenance on NORESCO-installed equipment	✓
ESM 6: Building	Wantenance	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	
Weatherization	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	\ \
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	✓
	Operations	Operate all equipment on a daily basis	✓
ESM 7: Pipe & Fitting	Maintenance	Perform scheduled preventive maintenance on NORESCO-installed equipment	✓
Insulation	iviaii iteliai ite	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	~

ESM	Type of Function	Activity	City
	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	✓
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	√
	Operations	Operate all equipment on a daily basis	✓
	Maintenance	Perform scheduled preventive maintenance on NORESCO-installed equipment	· /
ESM 8: Steam	Mannenance	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	1
Traps & TRVs	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	·
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	**************************************
	Operations	Operate all equipment on a daily basis	✓
	Maintanana	Perform scheduled preventive maintenance on NORESCO-installed equipment	✓
ESM 9: Plug	Maintenance	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	✓
Load Controls	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	✓
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	~
	Operations	Operate all equipment on a daily basis	√
		Perform scheduled preventive maintenance on NORESCO-installed equipment	✓
ESM 10: Walk- in Cooler	Maintenance	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	V
Controls	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	,
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	~
	Operations	Operate all equipment on a daily basis	✓
	Maintenance	Perform scheduled preventive maintenance on NORESCO-installed equipment	✓
ESM 11: Steam	Mannenance	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	~
Boilers	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	✓
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	~

ESM	Type of Function	Activity	City
	Operations	Operate all equipment on a daily basis	✓
	Maintenance	Perform scheduled preventive maintenance on NORESCO-installed equipment	✓
ESM 12: Hot Water Boilers &	Waittellance	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	✓
Pool Heating Systems	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	~
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	V
	Operations	Operate all equipment on a daily basis	✓
	Maintenance	Perform scheduled preventive maintenance on NORESCO-installed equipment	
ESM 13: Solar	Maintenance	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	✓
Photovoltaics	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	✓
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	✓
	Operations	Operate all equipment on a daily basis	~
	Maintenance	Perform scheduled preventive maintenance on NORESCO-installed equipment	V
ESM 14: New Electrical Switchgear &	Mantenance	Perform scheduled preventive maintenance on all non- NORESCO installed existing and supporting equipment	✓
Backup Power Generation	Repair	Repair NORESCO-installed equipment and non-NORESCO installed existing equipment as needed	✓
	Replacement	Replace NORESCO-installed equipment and non-NORESCO installed existing equipment when repair is no longer feasible or equipment becomes obsolete and parts are not available	~

SCHEDULE DD

Facility Maintenance Checklist

This Schedule DD is a checklist which the City shall maintain to record and track its compliance with operations and maintenance responsibilities of the Project Site(s) personnel. The checklist shall be available for inspection by the QESP upon request.

Below is a high level list of suggested maintenance tasks to be performed by the City for the installed Equipment. Where manufacturer specific tasks and intervals are provided as part of the operation and maintenance manuals delivered to the City at the completion of the Interim Period, those tasks and intervals take precedence over the table below. The intervals specified in Table DD-1 below are: (Q) Quarterly, (SA) Semi-Annual, (A) Annual, and (SP) Special Inspections.

Table DD-1: City Facility Maintenance Checklist

Item	Description	(Q)	(SA)	(A)	(SP)	Responsibility
SM 1	Interior Lighting Improvements & Controls					
1	Fixture cleaning (i.e., lamps, lenses, reflective surfaces).			√		City
2	Spot replacement of lamps and drivers.		THE REAL PROPERTY OF THE PROPE	٧	***************************************	City
3	Inspect for damages.			٧		City
4	Remove any obstacles that will block the function of the sensors.			√		City
5	Check on/off times - Adjust as required.			1		City
6	Check overall operation.	2 - 4 10000000000000000000000000000000000	Particular Control of	٧	. 40,000,000,000,000,000,000,000,000	City
SM 2	Exterior Lighting Improvements					
1	Fixture cleaning (ie: lamps, lenses and reflective surfaces.			٧		City
2	Spot replacement of lamps and drivers.			٧		City
SM 3	Variable Speed Chillers & Pumps					
	LOCKOUT/TAGOUT					
1	Perform lockout/tagout.			√	and the contraction of the contr	City/NORESC O
	CONTROL CENTER					
1	Sequence/test all controls.			٧		NORESCO
2	Calibrate and clean controls and safety devices.			V		Cîty
3	Inspect and clean electrical contacts.	NAME AND TO STATE OF THE PARTY OF		٧	ham and an in her owner	City
4	Check setpoints of operating controls and safety limits.			٧		NORESCO
5	Tighten all electrical connections.			7	instance in the second and to be	City
6	Test flow switch.			V		City
diamente en inside excesi culticansi in	MOTOR	· francisco con con con con con con con con con c	and the company of th	hanner vir en	vedskene vikuri-) ved regnesidnes oc	
1	Lubricate motor.			٦.		City
2	Check motor insulation.			٧		City
3	Check condition and alignment of drive section.			٧		City
4	Check motor mounts.			V	9 may 1 may 2 min and 2 mi	City

Item	Description	(Q)	(SA) (A)	(SP)	Responsibilit
4	MOTOR STARTER		-1		
1	Check operating current, voltage and heater size.		√ 		City
2	Inspect starter coils and contacts.		٧ - ا		City
3	Inspect overloads.		1		City
4	COMPRESSOR	in the second se	- I		
1	Check refrigerant charge.		√ 21		City
2	Check for refrigerant and oil leaks.		√ √		City
3	Test for proper operation.				City
4	Observe bearing temperatures. CONDENSER		V		City
1				1	
	Punch condenser tubes.		√	V	City
2	Replace gaskets. Check and record: Delta P and Delta T.		, \ √		City
GRACO COMPANION CONTRACTION OF	Check reliefs.			-	City
4	EVAPORATOR		\		City
1	Check and record Delta P and Delta T.		√		O:L.
2	Check freeze protection.		V		City
3	Check reliefs.				City
4	·		V		City
4	Every 10 yrs have Eddy current test. (*1) OIL	terre tundenda produktor terren eri erre i			City
1			- V		O:1
2	Check operation of oil pump. Replace oil and oil filters.	***************************************			City
3	Send oil sample out for analysis.		V		City
4	Check oil heaters.				City
4	PURGE UNIT		V		City
1	Lubricate motor.		√		O'L
2		Lawr (Siringbile)	\ \ \		City
3	Charge purge unit oil.				City
4	Check drive belt and adjust tension. Check operation of purge unit.		-1	10000000	City
4	REVIEW		Y		City
1	Review operator log and alarm history.	V	V		NODEGGG
2	Record run hours.	V			NORESCO
3	Check overall operation.	V	√ √		City
SWI5	Energy Management System Upgrades & Expansion	V	V		NORESCO
- 611/1 (B)	LOCKOUT / TAGOUT				
North Control of Contr				Name and Address of the Owner, where the Owner, which is the Owner, where the Owner, which is the Owner, where the Owner, which is the Owner, which i	City/NIODEO
1	Perform lockout / tagout.	√	√ √	1	City/NORES(O
	INSPECTION				
1	Clean control panels and compartments.		V		City/NORESO
	EQUIPMENT CONDITIONS				
1	Check main control board.	٧	V V		NORESCO
2	Check input and output wiring.	√	√		NORESCO

Item	Description	(Q)	(SA)	(A) (S	P) Responsibilit
4944birrasiblesvivi raveverse	PM TASKS				
1	Software review and monitoring.	1		- √	NORESCO
2	Verify current occupancy schedules.	٧	٧	٧	NORESCO
3	Verify current operating setpoints.			V	NORESCO
4	Review alarm activity.	٧	٧	٧	NORESCO
5	Review customer provided complaint log.	√	- 1	7	NORESCO
6	Review customer provided operator logs.	٧	√	٧	NORESCO
7	Inspect server and field control panels.	1	٧	√	NORESCO
8	Check current temperature: Record.		٧		NORESCO
9	Identify temperature sensors that need to be calibrated: Record.			V	NORESCO
10	Inspect control wiring for loose connections and tighten as required.			٧	City
11	Identify C0 ₂ sensors that need calibration (if equipped).			7	NORESCO
ESM 8	Steam Traps & Thermostatic Radiator Valves				
1	Verify condition of steam trap and piping.		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	√	City
2	Verify temperatures, inlet/outlet of trap; Record - deg F	***	************************	٧	City
3	Test steam flow with ultrasonic flow meter; Record			∀	City
4	Open strainer drain to blow out line sediment.			٧	City
ESM 9	Plug Load Controls				
1	Inspect for damages.	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		٧	City
2	Remove any obstacles that will block the function of the sensors.			٧	City
3	Check on/off times - Adjust as required.		***************	٧	City
4	Check overall operation.			7	City
ESM 13	Solar Photovoltaics				
	LOCKOUT / TAGOUT				
1	Perform lockout / tagout.	Productive Collection on Article States (as the states)		4	City/NORES
	INSPECTION	7			
1	Clean control panels and compartments.			٧	City
	EQUIPMENT CONDITION				
1	Check main control board.			√	City
2	Check input and output wiring.			٧	City
*;***;	PM TASKS		Dhaffing congressions are conserved		
.1	Panel cleaning			√	City
2	Test AC and DC electrical characteristics (grid voltage, open circuit voltage, short circuit current, etc)	100000000000000000000000000000000000000	9-01-1-2-00-1-2-00-00-00-0	V	City
3	Inspect modules for cracks and hot spots			٧	City
4	Inspect racking and mounting equipment			V	City
5	Inspect wire management and terminations			٧.	City

The intervals specified in Table DD-2 are: (Q) Quarterly, (SA) Semi-Annual, (A) Annual, and (SP) Special Inspections.

Table DD-2: City Facility Maintenance Checklist for ESMs 11 & 12

Task	Description	(D)	(W)	(M)	(SA)	(A)	Responsibility
	LOCKOUT/TAGOUT						0
1	Perform lockout/tagout.					✓	City/NORESCO
	BURNER						
1	Inspect and clean air intakes	✓					City
2	Visually inspect burner cycle from purge to main flame					**************************************	City
3	Check operation of all motors, check for noise and vibration		✓				City
4	Burner Mounting Inspection; Check seal between the burner flange and furnace front plate.						City
5	Electric Motor; Clean the motor to assure adequate cooling	line of the	~				City
6	Electric Motor; Lubricate in accordance with manufacturer's instructions		✓				City
7	Inspect the burner, diffuser, pilot tube			✓			City
8	Check for free movement of the air damper	***************************************		✓			City
9	Tighten all electrical connections.					✓	City
10	Inspect burner diffuser and replace if cracked, bent or showing signs of excessive wear			A		✓	City
11	Firing Rate Controls; Check all rods and linkages						City
	BURNER CONTROLS						
1	Flue Gas Recirculation Valve; Monitor O2 and CO levels and adjust as necessary					✓	City
2	Analyze combustion			✓	***************************************		City
	PRESSURE VESSEL						
1	Bottom Blowdown; Blowdown to prevent concentration of solids in the boiler		✓		Over-Personne i vend i vend uvena vend vend vend vend vend vend vend vend		City
2	Water Column Blowdown; Blowdown gauge glass until glass is clear		~				City
3	Low Water Controls; Check operation of Low water Controls	a para 10 a 1	✓		(Antigorial Secured Secure Commission Commis	neghavis serjadi in sepanja nag madeng	City
4	Inspect the condition of the gauge glass for wear and etching		✓				City
5	Cleaning waterside of vessel; Inspect for grease, sludge, and foreign materials		00000000000000000000000000000000000000		y gan nagy ng pinakanakini dikinipisakanini king	✓	City
6	Lubricate slow open valves			✓	Terrain		City
7	Check operation of steam traps				nanonenanen errorri eriotzai erio	ong penangi minanginah kerikani penangi dibah	City

Task	Description	(D)	(W)	(M)	(SA)	(A)	Responsibility
8	Boil out waterside of vessel; Remove grease, sludge, and foreign materials					✓	City
9	Fireside Cleaning; Clean Soot and other noncombustible deposits					✓	City
10	Upper Pass Cleaning; Clean Soot and other noncombustible deposits					✓ :	City
11	Relief Valve Inspection; Check operation of Relief Valve				Michigan (Inc.) (Michigan) (Michi		City
12	Open the fireside doors and remove gaskets			16.50		✓	City
13	Open the waterside by removing manholes/handholes and gaskets, flush the boiler					✓	City
14	Inspect the boiler bottom blow down valves					✓	City
15	Install new gauge cocks and glass				reconstruction in the second		City
16	Clean handholes/manholes and install new gaskets					/	City
17	Install new fireside, door and burner gaskets					✓	City
18	Pressure test the boiler waterside at one and 1/2 times the operating pressure					/	City
19	Inspect throat and liner tile					✓	City
20	Wash coat refractory and tile					✓	City
	ELECTRICAL CONTROLS						
1	Check safety and interlock controls, flame scanner, fuel proving switches		~	a. 4a			City
2	Check operating and limit controls		✓				City
3	Check indicating lights		✓				City
4	Inspect and clean the low water cutoff(s)	- Complete Control Control	and interviewing and an artists		✓		City
5	Examine the tightness of electrical connections and keep terminations clean					√ hada	City
6	Flame Safeguard Control- Check retaining screws holding the chassis to the mounting base are secure					✓	City
7	Check loss of Flame- shut off the main burner valve to interrupt fuel supply and test operation					un 🗸	City
8	Remove the low water cutout head and inspect the interior				and the state of t	an aminina di dina di d	City
9	Replace the electrode					✓	City
10	Test all boiler safeties					√	City
11	Test all boiler operational interlocks					~	City
	GAS BURNER MAINTENANCE						
1	Inspect gas train / fuel supply operation	✓					City
2	Keep the outer parts clean		✓				City

Task	Description	(D)	(W)	(M)	(SA)	(A)	Responsibility
3	Stem packing gland- check O ring for oil		✓				City
4	Solenoid Valves- Check for chattering noise		✓				City
5	Leak test the gas train					✓	City
	REFRACTORY						
1	Inspect refractory				✓		City
2	High Temperature refractory lines- check lines on rear, front, sides, roof section, bottom drum, and drum vent					✓	City
	CASING SEALS						
1	Check for discolored paint on casing for leaks		✓	9:20 40 4 7 40 40 40 70 70 70 70 70 70 70 70 70 70 70 70 70		1000 TO 1000 T	City
2	Burner Dry Oven- Check for discolored paint on burner dry oven for leaks		~	15.0			City
3	Drum Seals- Check for discolored paint on drum seals for leaks		✓	e in the second			City
4	Sight Port- Check for discolored paint on sight port for leaks		✓				City
5	Inspect the outside of the boiler for hot spots			✓			City
	WATER CHEMISTRY					100	
1	Check chemical tank levels and verify, leak check, supply to boiler water	✓		this to the second		66.000 Per	City
2	Insure proper water chemistry on system		✓			137	City
3	Review boiler water chemistry			✓	i denti i con contenenza di composizioni con al sicre al accidente		City
4	Inspect the feed water controls for proper operation			,			City
5	Inspect the chemical feed systems					✓	City

SCHEDULE EE

Certificate of Final Acceptance of All ESMs/Final Completion

Certificate of Final Acceptance of All Installed ESMs and Final Completion of the Project

Owner hereby acknowledges Final Acceptance of all ESMs, and Final Completion of the
project described in the Contract between the City and NORESCO dated
The date of Final Completion is the date certified by the Owner that
the Work has been installed, functionally tested and all punch-list items completed in
accordance with the Contract Documents, so that the Owner has possession of the
ESMs and can use the ESMs for their intended use. Owner hereby accepts the ESMs
listed hereto after full inspection thereof as complete for all purposes of the Contract.

The Commencement Date shall be the first day of the month after the month in which the Final Acceptance was certified by the Owner.

Owner agrees to make the required payment(s) to NORESCO as set forth in the Contract.

Date of Final Co	npletion:	
Accepted for:	Owner	
Accepted by:		
	Name:	
	Title:	

Note: ESMs to which this Certificate of Acceptance relates are attached hereto.

SCHEDULE FF

Certificate of Substantial Completion of all ESMs/Substantial Completion

Certificate of Substantial Completion of all ESMs and Substantial Completion of the Project

Substantial Completion, a and attached hereto. The inspection thereof as Sub	ges receipt of all ESMs described in this Certificate of s fully installed and in good working condition, which are listed City hereby accepts all the ESMs listed hereto after full stantially Complete for all purposes of the Contract and the project described in the contract between the City and
Date of Substantial Comp	letion:
Accepted for:	Owner
Accepted by:	
	Name:
	Title:

Note: ESM(s) to which this Delivery and Acceptance Certificate relates is/are attached hereto.

SCHEDULE GG

Notice of Substantial Completion of ESM

Certificate of Substantial Completion of ESM

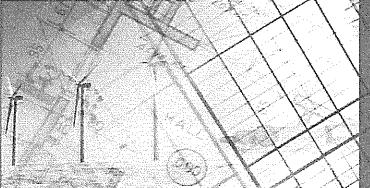
Owner hereby acknowledges receipt of ESM described in this Notice of Substantial Completion, as fully installed and in good working condition, which is listed and attached hereto. The City hereby accepts the ESM listed hereto after full inspection thereof as Substantially Complete for all purposes of the Contract.

ESM Substantial Completi	on Date:	
ESM(s):		
Date Accepted by Owner:		
Accepted for: Accepted by:	Owner	
	Name:	

Note: ESM(s) to which this Delivery and Acceptance Certificate relates is/are attached hereto.

Exhibit B

Investment-Grade Energy Audit and Project Development Proposal



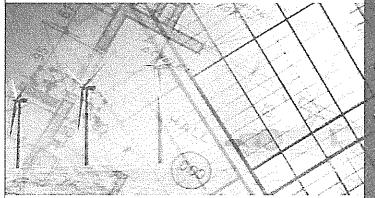
City of Waterbury

Investment
Grade Energy
Audit Report

May 13, 2015 **REVISED JUNE 14, 2016 REVISED JUNE 29, 2016**



NORESCO, LLC 5 Research Drive, 2nd Floor Shelton, CT 06484 508 • 614 • 1000 www.noresco.com



City of Waterbury

Investment
Grade Energy
Audit Report

May 13, 2015 **REVISED JUNE 14, 2016 REVISED JUNE 29, 2016**



NORESCO, LLC 5 Research Drive, 2nd Floor Shelton, CT 06484 508 • 614 • 1000 www.noresco.com

This IGEA report contains sensitive information which is confidential and proprietary to NORESCO, LLC (NORESCO). The reader is authorized to use this information solely for the purpose of evaluating a business relationship with NORESCO, acknowledges that release of this information to other parties could be damaging to NORESCO, and is not to divulge or distribute the information contained herein to any other party, except appropriate City of Waterbury personnel on a need-to-know basis, without the written permission of NORESCO.



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EXECUTIVE SUMMARY:

INVESTMENT GRADE ENERGY AUDIT REPORT



EXECUTIVE SUMMARY FOR THE CITY OF WATERBURY'S ENERGY-SAVINGS PERFORMANCE CONTRACT

The City of Waterbury (the City), facing challenges associated with aging buildings that have inefficient energy-related infrastructure, selected NORESCO as its Qualified Energy Service Provider (QESP) through a competitive solicitation process to complete an investment grade energy audit (IGEA) that would thoroughly investigate and define opportunities for the implementation of energy-saving projects. The IGEA maps out a balanced approach to prioritize and implement the most cost-beneficial and critically needed energy-related infrastructure upgrades that will be funded through a demonstrated reduction in annual expenses for its City and school buildings.

NORESCO is pleased to have been selected as the City's QESP partner to audit, engineer, and construct energy savings projects throughout its buildings. NORESCO, with local offices in Shelton and Wallingford, has a proven 32-year history of delivering high-quality performance-based projects to public entities in New England. The implementation of the recommended energy savings measures (ESMs) in the comprehensive IGEA will enable the City to become a leader in sustainability, create an optimum environment for working and learning, improve its economic viability by reducing energy use, and improve the quality of life of its residents, visitors, businesses and institutions by reducing greenhouse gas emissions. The City's investment of public funds toward this project will serve the dual win-win purpose of upgrading facilities with critically needed improvements while providing employment opportunities amongst residents, as envisioned by the "Good Jobs Ordinance."

City and school personnel have worked together with NORESCO in a collaborative, thorough, and detailed project development process to develop and review the ESMs included in the scope of work contained in this IGEA. We appreciate the City's commitment and support, as well as all the meetings, reviews, discussions, and guidance that were necessary to develop the rigorous engineering analysis and the resultant recommended comprehensive scope of work package contained in the report.

Some key building, operational and sustainability improvements outlined in the IGEA include:

- A fast-track mobilization plan to install 30 new boilers and associated equipment in 10 schools and the Chase Building that have aged heating systems in danger of failing.
- Extensive energy management system upgrades, including replacement of high maintenance pneumatic controls with electronic direct digital controls for more precise equipment operation and savings, including almost 4,800 control points across school and City buildings.
- New high-efficiency variable speed-drive chillers to replace existing chillers at the end of their useful service lives and contain old, environmentally unfriendly refrigerant.
- Retrofits and replacements of 31,119 interior lighting fixtures with 68,226 new LED lamps in City and school buildings.
- A commitment to cost-effective renewable energy at the Duggan School & Police Headquarters.



Table 1: Summary of Energy Savings Measures

	Energy Savings Measures	Implementation Price (Note 1)	Estimated Incentives	Anticipated Annual Cost Savings	Simple Payback Net of Incentives
1	Interior Lighting Improvements & Controls	\$2,099,167	\$489,680	\$344,408	4.7
2	Exterior Lighting Improvements	\$986,487	\$264,504	\$127,455	5.7
3	Variable Speed Chillers & Pumps	\$1,205,847	\$35,049	\$43,149	27.1
. 4	Air Handling Unit Damper Refurbishments	\$321,805	\$46,024	\$29,038	9.5
5	Energy Management System Upgrades & Expansion	\$5,345,037	\$1,536,934	\$621,167	6.1
6	Building Weatherization	\$584,590	\$146,921	\$47,528	9.2
7	Pipe & Fitting Insulation	\$804,356	\$268,882	\$79,239	6.8
8	Steam Traps & Thermostatic Radiator Valves	\$784,163	\$272,573	\$93,420	5.5
9	Plug Load Controls	\$176,810	\$60,372	\$27,543	4.2
10	Walk-In Cooler Controls	\$147,423	\$29,329	\$13,115	9.0
11	Steam Boilers	\$5,984,134	\$103,757	\$69,948	84.1
12	Hot Water Boilers & Pool Heating Systems	\$7,407,670	\$445,829	\$153,827	45.3
13	Solar Photovoltaics	\$305,388	\$0	\$27,863	11.0
14	New Electrical Switchgear & Backup Power Generation	\$1,255,855	\$0	\$0	N/A
	Project Totals	\$27,415,059	\$3,699,854	\$1,677,700	14.1

Note 1: This Implementation Price includes a \$225,738 total credit to the City consisting of a reduction of ECG's Consulting Services fee, as well as, a reduction of NORESCO's overhead and profit. The original Implementation Price before this credit was applied was \$27,640,797.



Table 2: Annual Energy and Cost Savings

Energy Savings Measures	Efectric (kW) Savings	Electric (kVA) Savings	Electric (KWh) Savings	Natural Gas (CCF) Savings	Anticipated Energy Costs Savings	Anticipated O&M Costs Savings	Anticipated Annual Cost Savings
Interior Lighting Improvements & Controls	3,723	5,769	1,632,263	(17,522)	\$328,590	\$15,818	\$344,408
Exterior Lighting Improvements	421	0	881,676	0	\$118,342	\$9,113	\$127,455
Variable Speed Chillers & Pumps	0	404	116,829	0	\$21,355	\$21,794	\$43,149
Air Handling Unit Damper Refurbishments	0	597	153,414	0	\$29,038	0\$	\$29,038
Energy Management System Upgrades & Expansion	O	0	2,603,237	215,990	\$532,897	\$88,270	\$621,167
Building Weatherization	0	0	13,417	40,828	\$47,528	0\$	\$47,528
Pipe & Fitting Insulation	0	0	0	76,824	\$79,239	\$0	\$79,239
Steam Traps & Thermostatic Radiator Valves	0	0	0	77,878	\$83,348	\$10,072	\$93,420
Plug Load Controls	0	0	201,247	0	\$27,543	\$0	\$27,543
Walk-In Cooler Controls	0	0	97,771	0	\$13,115	\$0	\$13,115
Steam Boilers	0	0	0	29,645	\$31,412	\$38,536	\$69,948
Hot Water Boilers & Pool Heating Systems	0	0	0	127,380	\$115,659	\$38,168	\$153,827
Solar Photovoltaics	0	0	136,116	0	\$20,377	\$7,486	\$27,863
New Electric Switchgear & Backup Power Generation	0	0	0	0	\$0	\$0	0\$
Totals	4,144	6,770	5,835,970	551,022	\$1,448,443	\$229,257	\$1,677,700

Executive Summary Page | 3



Illustrative Cash Flow for the City of Waterbury Project

NORESCO recognizes that the City has finance and term options to select the most advantageous method to fund the project scope. The cash flow on the following page illustrates the potential Tax-Exempt Municipal Lease (TELP) funding option. Table 3 provides a cash flow positive net of the anticipated savings, payments, and utility incentives over a relatively short 15-year term, after project implementation.

Table 3: Illustrative Cash Flow Based on the Following Page Assumptions

Net Cash Flow	0\$	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$82,552	\$1,238,286
Total Cost	\$1,353,600	\$1,595,148	\$1,652,497	\$1,711,819	\$1,773,184	\$1,836,661	\$1,821,517	\$1,887,016	\$1,954,781	\$2,024,891	\$2,097,426	\$2,172,471	\$2,250,113	\$2,330,442	\$2,413,550	\$2,499,536	\$31,374,646
O&M Service	0\$	\$193,848	\$199,663	\$205,653	\$211,823	\$218,177	\$0	0\$	\$0	\$0	\$\$	\$0	\$0	0\$	\$0	\$0	\$1,029,164
M&V Service	0\$	\$35,697	\$36,767	\$37,870	\$39,007	\$40,177	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$	3169,518
Efriancing Payments	\$1,353,600	\$1,365,603	\$1,416,067	\$1,468,296	\$1,522,354	\$1,578,307	\$1,821,517	\$1,887,016	\$1,954,781	\$2,024,891	\$2,097,426	\$2,172,471	\$2,250,113	\$2,330,442	\$2,413,550	\$2,499,536	0//6/991/06\$
Anticipated Total Savings	\$1,353,600	\$1,677,700	\$1,735,049	\$1,794,371	\$1,855,736	\$1,919,213	\$1,904,069	\$1,969,568	\$2,037,333	\$2,107,443	\$2,179,978	\$2,255,023	\$2,332,665	\$2,412,994	\$2,496,102	\$2,582,088	\$32,612,932
Anticipated SREC Savings	0\$	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$7,486	\$112,290
Anticipated O&M Cost Savings	0\$	\$221,771	\$228,424	\$235,277	\$242,335	\$249,605	\$176,287	\$181,576	\$187,023	\$192,634	\$198,413	\$204,365	\$210,496	\$216,811	\$223,315	\$230,015	\$3,198,347
Anticipated Utility Cost Savings	\$1,353,600	\$1,448,443	\$1,499,139	\$1,551,608	\$1,605,915	\$1,662,122	\$1,720,296	\$1,780,506	\$1,842,824	\$1,907,323	\$1,974,079	\$2,043,172	\$2,114,683	\$2,188,697	\$2,265,301	\$2,344,587	Totals \$29,302,294
Year	•	-	2	m	\hat{p}	ហ	9	7	E)	6	10	F	<u>ā</u>)	<u>S</u> I	<i>[</i> 4]	5	Trotells



\$997,183	NPV of Cash Flow:
2.50%	Finance Rate:
\$23,506,887	Total Financing Balance when Repayment Commences:
\$1,145,281	Estimated Capitalized Construction Interest (+)
\$3,699,854	Estimated Utility Incentives & Rebates (-)
\$1,353,600	Anticipated Savings During Construction Amount (-)
\$27,415,059	Project Implementation Price:

Cash Flow Assumptions:

- A 24-month construction and commissioning period prior to commencing the repayment term.
- First-year savings based on 3-year average utility rates for each specific building from 2013-2015, and an annual energy escalation rate of 3.50%.
- Year O represents the cumulative estimated savings that will be achieved during the construction period as ESMs are completed.
- Net of utility incentives based on Eversource Project Caps and Incentive Levels effective January 2016
- Operating lease with stepped payments with level net cash flow to match savings at 2.50% for 15-year term.
- Project Implementation Price includes ECG consulting service fee.



Environmental Impact of Proposed Energy Savings Measures

NORESCO is a proud member of the U.S. Green Building Council and Clinton Climate Initiative and a long-time Energy Star® Business Partner. In addition to the direct positive economic benefit this project will have to the City, this project will provide significant environmental benefits to the City and the surrounding community, consistent with the City's CO₂ reduction policy objectives.

Quantified in Tables 4 and 5 are the greenhouse gas emission reductions that will occur as a result of new higher efficiency equipment replacing the existing old, less efficient systems as well as new controls that will limit the equipment's use to when only needed by the building occupants.

Table 4: Energy Savings

Energy Source	Units	Value
Electricity	5,835,970	Kilowatt Hours
Natural Gas	551,022	Hundred Cubic Feet

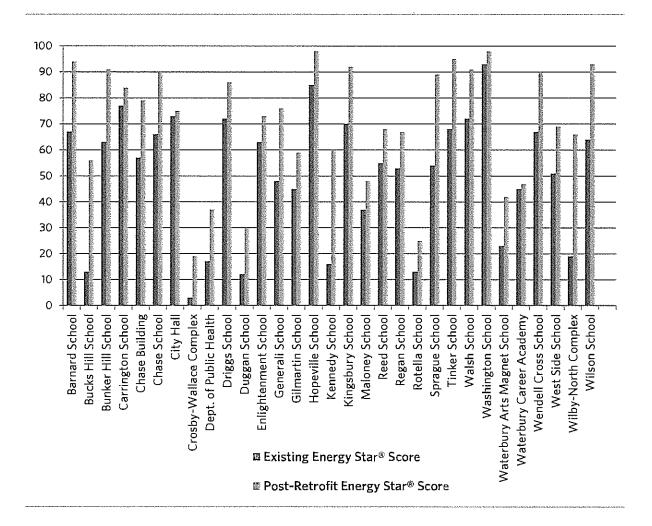
Table 5: Annual Emissions Reductions

Emission Type	Reductions
Carbon Dioxide (CO ₂)	13,228,626 lbs per year
Sulfur Oxides (SOx)	2,609 lbs per year
Nitrogen Oxides (NO _x)	14,046 lbs per year
Equivalent Acres of Trees Planted	1,811 acres
Equivalent Cars Removed from the Ro	



Energy Star® Rating Impact of Proposed Energy Savings Measures

NORESCO is a long-time Energy Star® Business Partner. The below Energy Star® scores are on a percentile basis, reflecting the improvements in the percentage of similar buildings outperformed by the specified building based on a standardized analytical framework.





GLOSSARY OF INDUSTRY TERMS & ACRONYMS

Please see the below list of common industry terms and acronyms.

AC Air Conditioning

ACCU Air-Cooled Condensing Unit
ACM Asbestos-Containing Material
AC&R Air Conditioning and Refrigeration

ACU Air Conditioning Unit

ADA Americans with Disabilities Act

AHU Air Handling Unit

Amp Ampere

ARRA American Recovery and Reinvestment Act of 2009

ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers

AVR Annual Verification Report

Btu British Thermal Unit
CAV Constant Air Volume

CBECS U.S. Department of Energy Commercial Building Energy Consumption Survey

CBW Construction Budget Worksheet

ccf Hundred Cubic Feet
CDD Cooling Degree Day

CEM Certified Energy Manager

cf Cubic Feet

CFL Compact Fluorescent Lamp
cfm Cubic Feet per Minute

CH Chiller

CHP Combined Heat and Power

CHW Chilled Water
CHWP Chilled Water Pump
CHWS Chilled Water Supply

CLTD Cooling Load Temperature Difference

CO₂ Carbon Dioxide
CO Carbon Monoxide
CRI Color Rendering Index
CRU Condensate Return Unit

CT Cooling Tower
CV Constant Volume
CW Condenser Water
CWP Condenser Water Pump

Cx Commissioning



CY Calendar Year

DAART Data Acquisition, Analysis, and Reporting Tool

DC Direct Current

DCV Demand-Controlled Ventilation

DDC Direct Digital Control
DG Diesel Generator

DHU Dehumidification Units

DHW Domestic Hot Water

DID Design Intent Document

DSM Demand-Side Management

DT Differential Temperature

DX Direct Expansion
EA Exhaust Air

ECTBC Energy Conservation Through Behavior Change®

EERC Energy Escalation Rate Calculator

EF Exhaust Fan

EH&S Environmental, Health, and Safety

EIR Energy Input Ratio

EMR Experience Modification Rate
EMS Energy Management System
ERS Energy Recovery System
ERV Energy Recovery Ventilator
ESA Energy Services Agreement
ESCO Energy Service Company
ESM Energy Saving Measure

ESPC Energy Savings Performance Contract

EUI Energy Use Intensity

fc Footcandle FCU Fan Coil Unit

ft Feet

FY Fiscal Year g Gram gal Gallon

GHG Greenhouse Gas gpf Gallon per Flush

GPH Geothermal Heat Pump gpm Gallon per Minute

GSHP Ground Source Heat Pump

GT Gas Turbine



H₂O Water

HAZMAT Hazardous Material

HBEA Human Behavior Energy AuditSM

HDD Heating Degree Day
HE Heat Exchanger

HET High-Efficiency Toilet
HEU High-Efficiency Urinal
HHW Heating Hot Water

HID High-Intensity Discharge

hp Horsepower HP Heat Pump

hr Hour

HRSG Heat Recovery Steam Generator
HTHW High-Temperature Hot Water

HV Heating and Ventilating

HVAC Heating, Ventilating, and Air Conditioning

HVAC&R Heating, Ventilating, Air Conditioning, and Refrigeration

HW Hot Water

HWP Heating Water Pump
HX Heat Exchanger

Hz Hertz

IAQ Indoor Air Quality

IESNA Illuminating Engineering Society of North America

IGEA Investment Grade Energy Audit

IPMVP International Performance Measurement and Verification Protocol

IR Infrared

IRR Internal Rate of Return

ISO International Organization for Standardization

kg kilogram kV kilovolt

kVA kilovolt-ampere

kWh kilowatt kWh kilowatt-hour

lb Pound

LBC Lamp/Ballast Combination

LED Light-Emitting Diode

If Linear Foot LP Lead Paint

LPS Low-Pressure Steam



m² Square Meter

M&V Measurement and Verification

MAU Makeup Air Unit

MBE Minority Business Enterprise

MBtu Thousand British Thermal Units

MH Metal Halide

MMBtu Million British Thermal Units

MW Megawatt

NAESCO National Association of Energy Service Companies

NG Natural Gas NO₂ Nitrogen Dioxide

NOAA National Oceanic and Atmospheric Administration

NO_x Nitrogen Oxide

NPV Net Present Value

NRHP National Register of Historic Places

NTP Notice to Proceed

O₂ Oxygen

O&M Operations and Maintenance

OA Outside Air

OAH Outside Air Humidity
OAT Outside Air Temperature

OM&R Operations, Maintenance, and Repair

OMR&R Operations, Maintenance, Repair, and Replacement
OSHA Occupational Safety and Health Administration

P.E. Professional Engineer

pf Power Factor

PIR Post-Installation Report
PM Preventive Maintenance

PM Project Manager
PO Purchase Order
POC Point of Contact

PPA Power Purchase Agreement
PPE Personal Protective Equipment

PV Photovoltaic

PVT Performance Verification Testing

QA Quality Assurance
QC Quality Control

QESP Qualified Energy Service Provider

RA Return Air



RAD Return Air Damper
RAT Return Air Temperature
RCx Retro-Commissioning
RFI Request for Information
RFP Request For Proposal

RTU Rooftop Unit SA Supply Air

SBE Small Business Enterprise
SDHW Solar Domestic Hot Water

SDVOBE Service Disabled Veteran-Owned Business Enterprise

sf Square Foot SF Supply Fan

SHPO State Historic Preservation Office

SO₂ Sulfur Dioxide

SOP Standard Operating Procedure

SOW Scope of Work
SO_x Sulfur Oxide
sqft Square Feet

SREC Solar Renewable Energy Credit
SSHP Site Safety and Health Plan
SVOB Small Veteran-Owned Business

SWH Solar Water Heating
TAB Test and Balance
TAB Test, Adjust, Balance

TABC Test, Adjust, Balance, and Commission

TELP Tax-Exempt Municipal Lease
TMY Typical Metrological Year
TRV Thermostatic Radiator Valve

ULF Ultra Low Flow

UMC Uniform Mechanical Code
UPC Uniform Plumbing Code
UPV Uniform Present Value

UTC United Technologies Corporation
UTC CCS UTC Climate, Controls, & Security

UV Ultraviolet

V Volt

VAV Variable Air Volume
VFD Variable Frequency Drive

VOBE Veteran-Owned Business Enterprise



VRF Variable Refrigerant Flow VSD Variable Speed Drive VV Variable Volume

w Watt

WAC Window Air Conditioning (Unit)
WBE Woman-Owned Business Enterprise

WIC Walk-in Cooler WIF Walk-in Freezer

WSHP Water Source Heat Pump

WUI Water Use Index

WTP Water Treatment Plant

WWTP Wastewater Treatment Plant

YTD Year To Date

ZREC Zero-Emissions Renewable Energy Credit







A. FACILITY PROFILE

1. Baseline Energy Consumption & Costs

NORESCO has collected and analyzed utility information for each City facility included in the project. All of the natural gas and electricity bills were collated to form an annual utility consumption baseline for each facility. NORESCO reviewed three years (January 2013 to December 2015) of historical energy data contained in the utility bills and averaged the consumption across the three years to create a representative starting point for baseline analysis. Energy consumption across the three years showed little variance, so, therefore, the three-year data set was averaged to determine baseline energy consumption. NORESCO also reviewed the utility data against historical weather data. The review found that historical heating degree days for Waterbury were within 1% of the heating degree days associated with the three year billing period. Therefore, no adjustment for weather has been included in the development of the baseline energy consumption.

Adjustments to historical energy consumption have been made to three buildings, these buildings being the Crosby-Wallace Complex, Wilby-North End Complex, and West Side Middle School. These adjustments account for operational deficiencies associated with the HVAC systems that will be corrected as part of the project. The baseline energy consumption in these buildings has been increased; however the overall increase to the total project baseline energy cost is a relatively small 2% increase.

Baseline energy consumption was multiplied by the current effective utility rates to determine baseline utility costs. NORESCO's review of the utility bills showed an increase in each year. Therefore NORESCO is using the most-recent utility bill data reviewed to determine baseline energy costs.

Utility costs associated with water and sewerage charges for the buildings were collected and analyzed. Given the relatively low rates for both water and sewer, it was determined that there would be no cost effective water or sewer ESMs included in the project.

Table A-1 provides the averaged billed baseline and adjusted utility baseline across the last three years for each building's electricity and natural gas consumption and costs.



Table A-1: Three-Year Averaged Project Baseline

Bannard School¹ 160,280 150,280 29,150 Bucks Hill School 281,600 281,600 95,399 Bunker Hill School 157,440 157,440 35,906 Carrington School³ 636,288 636,288 45,340 Chase Building 601,779 601,779 46,270 Chase School³ 251,040 251,040 40,127 City Hall³ 1,042,944 1,042,944 42,225 Crosby-Wallace Complex57 4,275,838 1,042,944 42,225 Crosby-Wallace Complex57 4,275,838 1,042,944 42,225 Dept. Public Health 1,063,888 1,063,888 29,397 Duggan School 320,920 31,362 30,365 Duggan School 320,920 32,054 36,187 Generali School 148,547 148,547 26,187 Keninedy School 143,400 143,400 25,184 Keninedy School 792,192 43,857 Reed School 7792,192 43,857 Police Headquarters	1	Consumption G (KWh)	consumption (kWh)	(ees)	Consumption (CCF)	Blectrical Cost	Electrical Cost	Gas Cost	Gas Cost	Energy Cost	Energy Cost
281,600 281,600 95,399 157,440 157,440 35,906 157,440 35,906 157,440 35,906 157,440 35,906 157,440 46,270 1,042,944 1,042,944 42,225 1,042,944 1,042,944 42,225 1,042,948 1,063,888 1,063,888 1,063,888 1,063,888 1,063,888 1,063,888 1,063,423 320,920 320,920 14,231 148,547 148,547 148,547 148,547 148,547 148,547 148,547 143,400 143,400 25,184 1,118,208 1,118,208 1,118,208 1,118,208 1,118,208 1,1872 1	School	160,280	160,280	29,150	29,150	\$24,839	\$24,839	\$28,027	\$28,027	\$52,865	\$52,865
16 (36,288) (36,288) (45,340) (57,440) (601,779) (601,779) (601,779) (601,779) (601,779) (601,779) (601,779) (601,779) (601,779) (601,779) (601,279) (70,42,944) (70,42,944) (70,42,944) (70,42,944) (70,42,944) (70,42,944) (70,42,948) (70,42,948) (70,42,948) (70,42,948) (70,42,948) (70,42,948) (70,42,948) (70,42,948) (70,42,948) (70,44,948) (III School	281,600	281,600	95,399	95,399	\$47,047	\$47,047	\$89,704	\$89,704	\$136,751	\$136,751
1,2 636,288 636,288 45,340 601,779 601,779 46,270 40,127 1,042,944 1,042,944 42,225 Complex ⁵⁷ 4,275,838 1,063,888 29,397 11,063,888 10,63,888 29,397 11,001 320,920 320,920 32,054 605,423 605,423 605,423 144,231 26,187 148,547 148,547 148,547 148,547 148,547 143,400 25,184 143,400 143,400 25,184 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,118,208 11,1872	-Iill School	157,440	157,440	35,906	35,906	\$25,848	\$25,848	\$36,435	\$36,435	\$62,284	\$62,284
601,779 601,779 46,270 251,040 251,040 40,127 1,042,944 1,042,944 42,225 Complex ^{5,7} 4,275,838 1,063,888 29,397 th 1,063,888 1,063,888 29,397 shool 320,920 320,920 14,231 shool 320,920 320,920 14,231 shool 320,920 320,920 14,231 shool 320,920 296,960 32,054 605,423 605,423 28,693 148,547 148,547 26,187 string 143,400 143,400 25,184 res 1,118,208 1,118,208 47,177 sers 1,118,208 1,118,208 233,280 233,280 11,872	on School ²	636,288	636,288	45,340	45,340	\$118,865	\$118,865	\$43,525	\$43,525	\$162,390	\$162,390
251,040 251,040 40,127 1,042,944 1,042,944 42,225 Complex ⁵⁷ 4,275,838 1,063,888 29,397 th 1,063,888 1,063,888 29,397 sep5,488 895,488 38,510 296,960 296,960 32,054 605,423 605,423 28,693 148,547 148,547 26,187 ers 1,118,208 1,118,208 43,857 cers 1,118,208 1,118,208 233,280 233,280 11,1872	uilding	601,779	601,779	46,270	46,270	\$94,248	\$94,248	\$53,253	\$53,253	\$147,501	\$147,501
1,042,944 1,042,944 42,225 Complex ⁵⁷ 4,275,838 4,329,296 303,653 th 1,063,888 1,063,888 29,397 s95,488 895,488 31,362 s95,960 320,920 14,231 c65,423 605,423 28,693 s66,423 605,423 26,187 s948,864 948,864 159,055 sers 1,118,208 1,118,208 47,177 crs 1,118,208 1,118,208 1,118,208	chool³	251,040	251,040	40,127	40,127	\$43,766	\$43,766	\$39,812	\$39,812	\$83,578	\$83,578
Complex ⁵⁷ 4,275,838 4,329,296 303,653 th 1,063,888 1,063,888 29,397 1,063,888 895,488 31,362 31,362 895,488 895,488 38,510 296,960 296,960 32,054 605,423 605,423 28,693 148,547 148,547 26,187 ers 1,118,208 1,118,208 47,177 cers 233,280 233,280 11,872	-	1,042,944	1,042,944	42,225	42,225	\$175,174	\$175,174	\$36,143	\$36,143	\$211,317	\$211,317
th 1,063,888 1,063,888 1,063,888 895,488 895,488 895,488 895,488 895,488 895,488 895,488 895,488 895,488 895,488 895,488 895,488 895,423 148,547 148,547 143,400 143,4	Wallace Complex ^{5,7}	4,275,838	4,329,296	303,653	393,584	\$689,016	\$695,246	\$253,540	\$328,629	\$942,556	\$1,023,875
213,293 213,293 895,488 895,488 296,960 296,960 296,960 296,960 148,547 148,547 948,864 948,864 113,400 143,400 792,192 792,192 ers 1,118,208 233,280 233,280	ıblic Health	1,063,888	1,063,888	29,397	29,397	\$175,871	\$175,871	\$31,021	\$31,021	\$206,893	\$206,893
895,488 895,488 1320,920 320,920 296,960 296,960 605,423 148,547 148,547 143,400 143,400 792,192 792,192 ers 1,118,208 233,280 233,280	chool	213,293	213,293	31,362	31,362	\$35,021	\$35,021	\$32,968	\$32,968	\$62,988	\$67,988
hool 320,920 320,920 296,960 296,960 605,423 605,423 148,547 148,547 948,864 948,864 II 143,400 143,400 792,192 792,192 ers 1,118,208 681,385 233,280 233,280	School	895,488	895,488	38,510	38,510	\$158,929	\$158,929	\$39,051	\$39,051	\$197,981	\$197,981
296,960 296,960 605,423 605,423 605,423 148,547 148,547 143,400 143,400 792,192 792,192 ers 1,118,208 681,385 681,385 233,280	nment School	320,920	320,920	14,231	14,231	\$53,784	\$53,784	\$17,658	\$17,658	\$71,442	\$71,442
605,423 605,423 148,547 148,547 948,864 948,864 1 143,400 143,400 792,192 792,192 ers 1,118,208 1,118,208 233,280 233,280	School	296,960	296,960	32,054	32,054	\$48,755	\$48,755	\$31,512	\$31,512	\$80,267	\$80,267
148,547 148,547 148,547 143,400 143,400 143,400 792,192 792,192 1,118,208 1,118,208 681,385 681,385 233,280 233,280	n School	605,423	605,423	28,693	28,693	\$114,098	\$114,098	\$28,618	\$28,618	\$142,716	\$142,716
948,864 948,864 1.1 143,400 143,400 792,192 792,192 1,118,208 1,118,208 681,385 681,385	e Schooi	148,547	148,547	26,187	26,187	\$24,388	\$24,388	\$30,927	\$30,927	\$55,315	\$55,315
143,400 143,400 ers 792,192 792,192 ers 1,118,208 1,118,208 681,385 681,385 233,280 233,280	/ School	948,864	948,864	159,055	159,055	\$158,695	\$158,695	\$137,090	\$137,090	\$295,785	\$295,785
ters 1,118,208 1,118,208 (681,385 681,385 233,280	ry School	143,400	143,400	25,184	25,184	\$23,545	\$23,545	\$28,939	\$28,939	\$52,484	\$52,484
1,118,208 1,118,208 (681,385 (681,385 233,280 (533,280)(533,280 (533,280 (533,280)(533,280 (533,280 (533,280)(533,280 (533,280)(533,280 (533,280)(533,280 (533,280)(533,280)(533,280 (533,280)(5	/ School	792,192	792,192	43,857	43,857	\$137,516	\$137,516	\$39,553	\$39,553	\$177,069	\$177,069
681,385 681,385 01 233,280 233,280	eadquarters	1,118,208	1,118,208	47,177	47,177	\$183,469	\$183,469	\$54,567	\$54,567	\$238,036	\$238,036
233,280 233,280	lool	681,385	681,385	30,443	30,443	\$124,665	\$124,665	\$67,856	\$67,856	\$192,522	\$192,522
	chool	233,280	233,280	11,872	11,872	\$37,991	\$37,991	\$12,668	\$12,668	\$50,659	\$50,659
Rotella School 73,098	chool	964,800	964,800	73,098	73,098	\$167,595	\$167,595	\$65,634	\$65,634	\$233,229	\$233,229
Silas Bronson Library 484,587 484,587 12,478	nson Library	484,587	484,587	12,478	12,478	\$72,978	\$72,978	\$16,824	\$16,824	\$89,802	\$89,802
Sprague School	School	188,133	188,133	43,580	43,580	068'0£\$	\$30,890	\$40,797	\$40,797	\$71,686	\$71,686

Information on this page is proprietary and subject to confidentiality restrictions

City of Waterbury, Connecticut Investment Grade Energy Audit · May 13, 2016 (rev. June 29, 2016)

A. Facility Profile Page | 2



Total Adjusted Baseline Energy Cost	\$61,214	\$63,896	\$32,564	\$447,320	\$274,580	\$47,854	\$356,300	\$738,406	\$60,490	\$36,319	\$36,319	36,259,697
Total Baseline Energy Cost	\$61,214	\$63,896	\$32,564	\$447,320	\$274,580	\$47,854	\$322,654	\$712,941	\$60,490	\$36,319	\$36,319	\$6,419,247
Adjusted Annual Gas Cost	\$32,745	\$31,605	\$15,780	\$127,909	\$4,523	\$24,900	\$80,305	\$198,733	\$32,888	N/A	N/A	965/038/18
Armual Gas Cost	\$32,745	\$31,605	\$15,780	\$127,909	\$4,523	\$24,900	\$49,603	\$176,311	\$32,888	N.A	N/A	985/25/18
Adjusted Ammal Electrical Cost	\$28,469	\$32,291	\$16,784	\$319,411	\$270,057	\$22,955	\$275,995	\$539,673	\$27,602	\$36,319	\$36,319	84979/098
Annual Electrical Cost	\$28,469	\$32,291	\$16,784	\$319,411	\$270,057	\$22,955	\$273,051	\$536,630	\$27,602	\$36,319	\$36,319	\$4,356,8881
Adjusted Annual Gas Consumption (CCF)	25,993	29,290	14,214	181,467	3,480	23,277	87,833	236,865	36,573	NA	∀ V	2,014,171
Amual Gas Consumption (CCF)	25,993	29,290	14,214	181,467	3,480	23,277	54,253	210,140	36,573	N/A	N/A	11,8163,938
Adjusted Annual Electrical Consumption (KWh)	173,400	196,680	102,227	1,996,800	1,712,160	139,813	1,625,994	3,214,566	168,120	372,960	372,960	26,635,715
Annual Electrical Consumption (KWH)	173,400	196,680	102,227	1,996,800	1,712,160	139,813	1,600,800	3,188,528	168,120	372,960	372,960	26,851,025
Building	Tinker School	Walsh School	Washington School	Waterbury Arts Magnet School	Waterbury Career Academy ⁶	Wendell Cross School	West Side School ⁷	Wilby-North Complex7	Wilson School	Buckingham Garage	Scovill Garage	Totals

1: Barnard School was closed in 2013 and most of 2014, and then reopened in the September 2014. Any utility consumption prior to September 2014 is not consistent with the current building operations; therefore, we are using January 2015 to December 2015 as the baseline. 2: Carrington School completed a building extension in 2013, which increased the building square footage from 45,916 to 127,391. Therefore, we are using January 2014 to December 2015 as the baseline to account for the consumption for the current square footage of the building.

3. Chase School has two electric meters with different rate structures, therefore, this electric baseline represents the combined average kWh consumption for both meters.

4: City Hall was recently renovated and reliable historic data was available for March 2015 to February 2016, therefore, we used this as the baseline.

5: Crosby-Wallace Complex historic electrical data was available for January 2014 to December 2015; therefore, we used this as the baseline.

6: Waterbury Career Academy opened in 2013; therefore, we are using January 2014 to December 2015 as the baseline.

ventilation required. In three schools, we noticed that many of the outside air damper assemblies were inoperable, which minimizes the resulting utility consumption and costs. Per the RFP, and 7: During the course of our audit, NORESCO evaluated the existing conditions of the air handling equipment and its ability to operate properly, specifically to introduce the proper amount of based on our design due diligence, we recommend improvements to these schools to correct these existing system deficiencies. This requires an adjusted average project baseline energy consumption and associated cost to account for the increase in ventilation to meet Code requirements.



2. Description of Buildings

NORESCO has audited the following buildings for inclusion in this project. The total square footage is 3,421,732. Table A-2 below provides a list of the buildings.

Table A-2: Description of Buildings

Building	Address	Sq.Ft.	Construction	Depta
Barnard School	11 Draher Street	48,600	1898	BOE
Bucks Hill School	330 Bucks Hill Road	77,194	1953	BOE
Bunker Hill School	170 Bunker Hill Avenue	54,156	1905	вое
Carrington School	24 Kenmore Avenue	127,391	2013	BOE
Chase Building	236 Grand Street	56,624	1912	DPW
Chase School	40 Woodtick Road	80,572	1920	ВОЕ
City Hall	235 Grand Street	90,000	1915	DPW
Crosby-Wallace Complex	300 Pierpont Road	397,604	1974	вое
Dept. of Public Health	18S South Main Street	46,573	1969	DPW
Driggs School	77 Woodlawn Terrace	63,501	1889	BOE
Duggan School	38 West Porter Terrace	75,418	2010	BOE
Enlightenment School	30 Church Street	40,777	1955	вое
Generali School	3196 East Main Street	59,091	1942	BOE
Gilmartin School	94 Spring Lake Avenue	75,000	2010	вое
Hopeville School	2 Cypress Street	59,000	1917	вое
Kennedy School	422 Highland Avenue	235,994	1964	ВОЕ
Kingsbury School	220 Columbia Boulevard	46,842	1917	ВОЕ
Maloney School	233 South Elm Street	92,000	1996	BOE
Police Headquarters	255 East Main Street	71,651	1978	WPD
Reed School	33 Griggs Street	79,858	2010	вое
Regan School	2870 North Main Street	31,000	1966	вое
Rotella School	380 Pierpont Road	106,000	2001	вое
Silas Bronson Library	267 Grand Street	40,000	1963	DPW
Sprague School	1448 Thomaston Avenue	64,502	1913	вое
Tinker School	809 Highland Avenue	54,976	1925	вое
Walsh School	55 Dîkeman Street	61,500	1930s	BOE
Washington School	685 Baldwin Street	41,118	1882	BOE
Waterbury Arts Magnet School	16 South Elm Street	292,000	2004	ВОЕ
Waterbury Career Academy	175 Birch Street	145,392	2013	BOE
Wendell Cross School	1255 Hamilton Avenue	41,098	1953	вое
West Side School	483 Chase Parkway	172,676	1976	BOE
Wilby-North Complex	534 Bucks Hill Road	434,416	1978	BOE
Wilson School	235 Birch Street	59,208	1928	вое
Buckingham Parking Garage	210 Bank Street		1970	DPW
Scovill Parking Garage	33 Scovill Street	***	1970	DPW
***************************************	V			



The following pages include a detailed facility profile for each building included in the project. The profile contains pertinent information for each building, including building description, occupancy schedule, HVAC and lighting systems, utility meter information, and applicable ESMs.



City of Waterbury · Barnard School

Building Description

Gross Area (ft²): 48,600 Conditioned Area (ft²): 48,600

Built: 1898

Renovations: 1922, 1940s, 2000, 2014

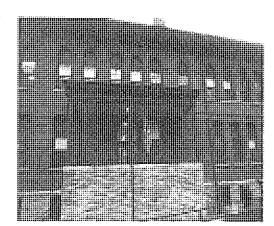
Primary Use: Adult Continuing Education

Floors: 2

Electric Tariffs: Eversource: Rate 30
Fuel Tariffs: Eversource: Rate 20

Occupancy Schedule

Day Type	Оссиралсу	HVAC
Monday-Friday	8:00 am - 9:00 pm	6:00 am - 10:00 pm
Weekend	As Needed	As Nooded



HVAC System

Plant Equipment								
Plant	Age	Туре	Mode	el Number	Сара	•	Fuel	Efficiency
(2) Steam Boilers	> 30 Years	Low Pressure Steam	HB Smith Mi	lls 450/Series 28	5,733		Natural Gas	82%
Equipment								
-	Туре .	Total SA CFM	Control	Total Fan HP	OA%	Pres	ent Condition	Areas Served
Steam Radiators/C		N/A	Man./TRV	N/A	N/A	Good		All

Lighting Systems	Energy Management System	EMS Setpoints

Primary:	4' 32 watt T8	Brand:	Honeywell 5000	Occupied Heating:	70°F
Secondary:	CFL	Type:	DDC/Pneumatic	Occupied Cooling:	-
Exterior:	Metal Halide/Incandescent	Age:	15 Years	Unoccupied Heating:	65°F
Exit Signs:	Incandescent	Condition:	Poor (Legacy)	Unoccupied Cooling:	-

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

		***************************************	*** <u>**********************************</u>			
Type	Description	Condition	Type	Account Number	Meter#	Service Address
Example of the second s						
Walls	Steel/Masonry	Goad	Electric	51208273052	890313312	11 Draher St
Windows	Double Pane	Good	Natural Gas	57428030050	515171	11 Draher St
Roaf	Steel/Wood Roof Deck	Good				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls Exterior Lighting Improvements EMS Upgrades & Expansion

Building Weatherization Pipe & Fitting Insulation Steam Traps & Thermostatic Radiator Valves Steam Boilers



City of Waterbury · Bucks Hill School

Building Description

Gross Area (ft²): 77,194
Conditioned Area (ft²): 77,194

Built: 1953 Renovations: 2001

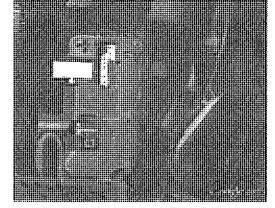
Primary Use: Elementary Education Grades K-5

Floors: 2

Electric Tariffs: Eversource: Rate 30
Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupancy	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekand	As Naeded	Ac Naadad



HVAC System

Plant Equipment								
Plant	Age	Туре	Mode	el Number	Capa	-	Fuel	Efficiency
(2) Steam Boilers	> 30/2 Years	Low Pressure Steam	HB Smith N	Aills 450	10,461		Natural Gas	80%
Equipment								
iD,	⁄Туре	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Radiators/Convect	• • • • •	N/A	Man/Pneu.	N/A	N/A	Good		All

Lighting Systems	Consumo Administração Constante	EMS Setpoints
righting systems	Energy Management System	CINIO Sethorius

Primary:	4' 32 watt T8	Brand:	Honeywell 5000	Occupied Heating:	72°F
Secondary:	CFL	Type:	DDC/Pneumatic	Occupied Cooling:	-
Exterior:	Metal Halide	Age:	15 Years	Unoccupied Heating:	65°F
Exit Signs:	Incandescent	Condition:	Poor (Legacy)	Unoccupied Cooling:	-

Domestic Water Systems

DHW Fuel: Gas

Building Envelope

Utility Meters

Comment of the Comment		100 0000 000 000 to 100 000 000 000 000 000 000 000 000 00				
Туре	Description	Condition	Туре	Account Number	Meter#	Service Address
Walls	Steel/Masonry/CMU	Good	Electric	51634573034	665052005	330 Bucks Hill Rd
Windows	Double Pane	Good	Natural Gas	57044820009	525756	330 Bucks Hill Rd
Roof	Steel/Concrete Roof Deck	Fair				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls

Exterior Lighting Improvements

Plug Load Controls

Pipe & Fitting Insulation

Steam Boilers

EMS Upgrades & Expansion

Steam Traps & Thermostatic Radiator Valves



City of Waterbury · Bunker Hill School

Building Description

Gross Area (ft²): 54,156 Conditioned Area (ft²): 54,156

Built: 1905

Renovations: 1927, 1950s

Primary Use: Elementary Education Grades K-5

Floors: 3

Electric Tariffs: Eversource: Rate 40

Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Оссиралсу	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment								
Plant	Age	Туре	Model Number		Capa	•	Fuel	Efficiency
(2) Steam Boilers	>30 Years	Low Pressure Steam	HB Smith Mi		7,506 ለ		Natural Gas	83%
Equipment								
ID/	Туре	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Radiators/Convect		N/A	Man/Pneu.	N/A	N/A	Fair		All

Lighting Systems	Energy Management System	EMS Setpoints
Lighting Dystems	Luci granagement by stem	LIMO DELPUNICO

Primary:	4′ 32 watt T8	8rand:	Honeywell 5000	Occupied Heating:	70°F
Secondary:	CFL	Туре:	DDC/Pneumatic	Occupied Cooling:	-
Exterior:	Metal Halide	Age:	15 Years	Unoccupied Heating:	65°F
Exit Signs:	Incandescent	Condition:	Poor (Legacy)	Unoccupied Cooling:	-

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

CARDERACTURE CHARACT				and the second s		<u> </u>
Type	Description	Condition	Туре	Account Number	Meter#	Service Address
		And the second s				
Walls	Steel /CMU/Brick	Fair	Electric	51584673032	890306992	170 Bunker Hill Ave
	, ,					
Window	Single/Double Pane	Poor	Natural Gas	57641180088	0415949	170 Bunker Hill Ave
***************************************	Single/ Doddie Lane	1 001	11010101003	370-1100000	0713777	1) O DOUGH THE AVE
Roof	Baliasted Roof Deck System	Fair				
KOUI	Danasteu Roui Deck System	i ali				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls

Exterior Lighting Improvements

Steam Traps & Thermostatic Radiator Valves

EMS Upgrades & Expansion

Plug Load Controls

Steam Boilers



City of Waterbury · Carrington School

Building Description

Gross Area (ft2): 127,391 Conditioned Area (ft²): 127,391

> Built: 2013

Renovations:

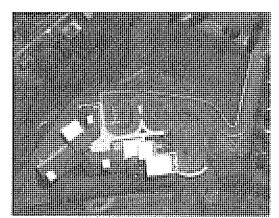
Primary Use: Elementary Education Grades K-5

Floors:

Electric Tariffs: Eversource: Rate 37 Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Оссирапсу	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment									
Plant	Age	Туре		Mode	l Number	Capa		Fuel	Efficiency
(2) HW Boilers	3 Years	Hot Water	A TOTAL STREET, SQUARE, SQUARE	n Mobility or All De State By a Milliony or y responser (\$1 may right		10,461		Natural Gas	84%
Equipment									
ID	/Туре	Total SA	CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
(2) Constant Volu	me AHUs, Conve	ctors 442,900)	DDC/Pneu	10		New		All Areas

Lighting Systems		٠,	gement System	EMS Setpoints		
	4' 32 watt T8		Honeywell 5000	Occupied Heating:		
Secondary:	CFL	Туре:	DDC/Pneumatic	Occupied Cooling:	74°F	

Exterior: Metal Halide 15 Years Unoccupied Heating: Exit Signs: incandescent Condition: Poor (Legacy) Unoccupied Cooling:

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

Maria de la Companya			Maria		ww.w./vii/ww/cii//	
Туре	Description	Condition	Туре	Account Number	Meter#	Service Address
Walis	Steel Frame/CMU	New	Electric	51295076046	891862222	24 Kenmore Ave
Windows	Double Pane	New	Natural Gas	F120F074044	001073333	57.17
AAIIIOOMZ	Double rane	MGM	ivaturai Gas	51295076046	891862222	24 Kenmore Ave
Roof	Metal Roof Deck System	New				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls **Exterior Lighting Improvements**

EM5 Upgrades & Expansion

Plug Load Controls



City of Waterbury · Chase Building

Building Description

Gross Area (ft²): 56,624
Conditioned Area (ft²): 56,624

Built: 1919

Renovations;

Primary Use: Office

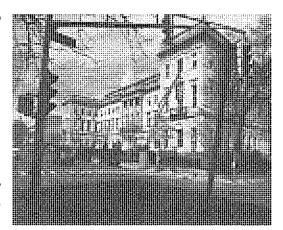
Floors: 3

Electric Tariffs: Eversource: Rate 30

Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupancy	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment									
Plant	Age	Type	Model Number		Capacity Fuel		Fuel	Efficiency	
(1) Steam Boiler	>30 Years	Low Pressure Steam	HB Smith Mills 450		4,200 l	мвн	Natural Gas	82%	
Equipment									
ID.	/Type	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served	
Radiators/Convec	tors	N/A	Pneu./TRV	N/A	N/A	Fair		All	

Lighting Systems		Energy Management System		EMS Setpoints	
	4' 32 watt T8	Brand:		Occupied Heating:	
Secondary:	CFL	Type:	N/A	Occupied Cooling:	-
Exterior:	Metal Halide	Age:	N/A	Unoccupied Heating:	-
Exit Signs:	Incandescent	Condition:	N/A	Unoccupied Cooling:	-
Domestic V	Vater Systems		Utility Meters		

DHW Fuel:	: Natural Gas		Type	Account Number	Meter#	Service Address
			Electric	51297373011	889041202	236 Grand St
			Electric	51307373027	889041612	236 Grand St, 3 rd Fl
			Electric	51397373010	889041182	236 Grand St, 4 th Fl
Building E	nvelope		Electric	51497373019	892467732	236 Grand St
Type	Description	Condition	Electric	51670473040	889041602	236 Grand St
Walls	Concrete/Masonry	Fair	Electric	51757473004	889041592	236 Grand St
Windows	Single Pane	Poor	Electric	51004373098	889041212	236 Grand St
Roof	Concrete Roaf Deck System	Fair	Natural Gas	57905400065	0496127	236 Grand St

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls
Exterior Lighting Improvements

Building Weatherization Pipe & Fitting Insulation Plug Load Controls Steam Boilers

EMS Upgrades & Expansion

Steam Traps & Thermostatic Radiator Valves

New Electrical Switchgear & Backup Power



City of Waterbury - Chase School

Building Description

Gross Area (ft²): 80,572
Conditioned Area (ft²): 80,572

Built: 1920

Renovations:

Primary Use: Elementary Education Grades K-5

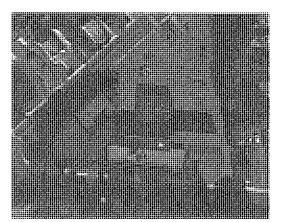
Floors: 2

Electric Tariffs: Eversource: Rates 30 and 40

Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupancy	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment								
Plant	Age	Type	Mode	l Number	Сара	city	Fuel	Efficiency
(2) Steam Boilers	>30 Years	Low Pressure Steam	HB Smith Se	ries 28	6,206 (ИВН	Natural Gas	81%
Equipment								
-	′Туре	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Dadieters (Comment		NI / A	M (D	AL / A	NI / A			A #5

Radiators/Convectors	N/A	Man/Pneu	N/A	N/A	Fair	All

Lighting Systems		٠,	agement System	EMS Setpoints	
	4' 32 watt T8		Honeywell 5000	Occupied Heating:	70°F
Secondary:	CFL	Type:	DDC/Pneumatic	Occupied Cooling:	-
Exterior:	Metal Halide	Age:	15 Years	Unoccupied Heating:	65°F
Frit Signs	Incandescent	Condition	Poor (Legacy)	Unoccupied Conting:	_

Domestic Water Systems Utility Meters

THE RESIDENCE OF THE PARTY OF T		VIII. TO THE REAL PROPERTY OF THE PARTY OF T	Appropriate to the second seco		6	
DHW Fuel	: Natural Gas		Type	Account Number	Meter#	Service Address
Building E	nvelope		Electric	51369473053	890310472	40 Woodtick Rd
Туре	Description	Condition	Electric	51696573088	890110952	40 Woodtick Rd
Walls	Steel/Masonry	Good	Electric	51865993018	890527782	40 Woodtick Rd
Windows	Double Pane	Fair	Natural Gas	57010570059	447923	Meriden Rd
Roof	Steel/Concrete Roof Deck	Fair				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls	Building Weatherization	Plug Load Controls
Exterior Lighting Improvements	Pipe & Fitting Insulation	Walk-In Cooler Controls
EMS Upgrades & Expansion	Steam Traps & Thermostatic Radiator Valves	Steam Boilers



City of Waterbury · City Hall

Building Description

Gross Area (ft2): 90,000 Conditioned Area (ft²): 90,000

> Built: 1915

Renovations: 2007-2011 Primary Use: Office

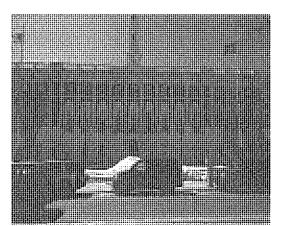
Floors:

Electric Tariffs: Eversource: Rate 30 and 37

Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Оссиралсу			
Monday-Friday	6:00 am - 9:00 pm	5:00 am - 9:00 pm		
Waskand	As Nandad	As blooded		



HVAC System

Plant Equipment							
Plant	Age	Туре		el Number	Capa		Efficiency
(3) HW Boilers	New	Hot Water			***************************************	Natural Gas	84%
Airside Eguipmen	ŧ						
)/Type	Total SA CFM	Control	Total Fan HP	OA%	Present Condition	Areas Served
AHUs, convectors		•	DDC	•	-	New	All

Lighting Systems		Energy Mana	gement System	EMS Setpoints		
	4' 32 watt T8	Brand:	JCI	Occupied Heating:	70°F	
Secondary:	CFL	Type:	DDC	Occupied Cooling:	74°F	
Exterior:	Metal Halide	Age:	New	Unoccupied Heating:	65°F	
Exit Signs:	Incandescent	Condition:	New	Unoccupied Cooling:	78°F	

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

	- commence of the commence of	diamagini ya kananyi kananyi k	District water and the party of		**********	
Туре	Description	Condition	Туре	Account Number	Meter#	Service Address
Walls	Steel/Masonry	New	Electric	51479015083	891053282	235 Grand Street
Windows	Double Pane	New	Electric	51635373087	542942008	235 Grand Street
Roof	Steel/Concrete Roof Deck	New	Natural Gas	57909515041	424395	26 Field Street

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls

Building Weatherization

Pipe & Fitting Insulation



City of Waterbury · Crosby-Wallace HS/MS Complex

Building Description

Gross Area (ft2): 397,604 Conditioned Area (ft2): 397,604

> Built: 1974 Renovations: Multiple

Primary Use: Secondary Education Grades 6 - 12

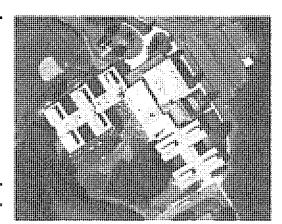
Floors:

Electric Tariffs: Eversource: Large Time of Day Rate 58

Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupancy	HVAC		
Monday-Friday	6:00 am - 9:00 pm	5:00 am - 10:00 pm		
Weekend	6:00 am - As Needed	5:00 am - As Needed		



HVAC System

Plant Equipment									
Plant	Age		Туре	Mode	Number	Сара	city	Fuel	Efficiency
(3) Steam Boilers	>30 Years	Low Pr	essure Steam	Cleaver-Broo	ks CB 600-250	31,383 /	мвн	Natural Gas	82%
Airside Equipment									
ID/	Туре		Total SA CFM	Control	Total Fan HP	OA%	Pres	ent Condition	Areas Served
(25) Constant Volu	me, Multi-zone	: AHUs	442,900	DDC/Pneu	477	0%	Fair		All Areas

Lighting Systems Energy Management System		•	EMS Setpoints		
	4' 32 watt T8		TAC/Barber-Coleman	Occupied Heating:	72°F
Secondary:	CFL	Type:	DDC/Pneumatic	Occupied Cooling:	74°F

Unoccupied Heating: Exterior: Metal Halide Varies 65°F Age: Condition: Exit Signs: Incandescent Fair-poor Unoccupied Cooling: 80°F

Domestic Water Systems

DHW Fuel: Steam to HW

Building Envelope

Utility Meters

grade de l'addresses de l'alternation		***************************************	the company of the co			
Type	Description	Condition	Туре	Account Number	Meter#	Service Address
Walls	Masonry/CMU	Good	Electric	51016553026	891208052	300 Pierpont Rd
Windows	Double Pane	Fair	Natural Gas	57783260086	326554	300 Pierpont Rd
Roof	Metal/Concrete Roof Deck	Fair				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls EM5 Upgrades & Expansion Plug Load Controls Exterior Lighting Improvements **Building Weatherization** Walk-in Cooler Controls Variable Speed Chillers & Pumps Pipe & Fitting Insulation Hot Water Boilers & Pool Heating Systems Air Handling Unit Damper Refurbishments Steam Traps & Thermostatic Radiator Valves



City of Waterbury · Department of Public Health

Building Description

Gross Area (ft²): 46,573 Conditioned Area (ft²): 46,573

Built: 1969

Renovations: -

Primary Use: Office

Floors: 5

Electric Tariffs: Eversource: Rate 37
Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Оссирапсу	HVAC
Monday-Friday	6:00 am - 9:00 pm	5:00 am - 10:00 pm
Weekend	As Needed	As Needed



Plant Equipment					XXX			
Plant	Age	Туре	Mod	el Number	Siz	e	Fuel	Efficiency
(6) HW Boilers	15 Years	Hot Water	5lant-Fin Ca	ravan 300	1,800 N	л 8Н	Natural Gas	84%
Airside Equipment	ŧ							
<u> </u>	/Type	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
(2) Variable Air V		15 OOO	רטכ	120	2004		Many (1) Eair	All Arose

Lighting Systems			agement System	EMS Setpoints	
	4' 32 watt T8		TAC Vista	Occupied Hea	
Secondary:	CFL	Type:	DDC	Occupied Coc	ding: 72°F
Exterior:	Metal Halide	Age:	5 Years	Unoccupied Hea	ting: 60°F
Exit Signs:	Incandescent	Condition:	Poor	Unoccupied Cod	line: 85°F

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

	The second secon			a and the damped and a second		
Type	Description	Condition	Type	Account Number	Meter#	Service Address
HOUSE TO PRODUCE AND A CONTROL						
Walis	Steel/Masonry/CMU	Good	Electric	51133315044	891747212	185 South Main St
Windows	Double Pane	Good	Natural Gas	57621215052	447024	185 South Main St
Roof	Metal Roof Deck System	Good				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls Exterior Lighting Improvements

EMS Upgrades & Expansion Building Weatherization

Pipe & Fitting Insulation



City of Waterbury · Driggs School

Building Description

Gross Area (ft²): 63,501 Conditioned Area (ft²): 63,501

Built: 1889

Renovations:

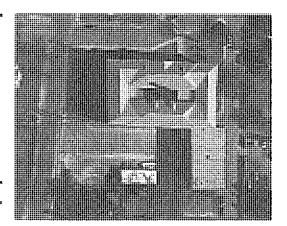
Primary Use: Elementary Education Grades K-5

Floors: 3/2.5

Electric Tariffs: Eversource: Rate 40
Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Оссирапсу	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment								
Plant	Age	Type		del Number	Siza	_	Fuel	Efficiency
(2) Steam Boilers	> 30 Years/New	Low Pressure Stea		n Series 28	6,206 N		Natural Gas	81%
Equipment								
ID,	′Туре	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
(2) AHUs; Radiator	s/Convectors	10,000	DDC/Pneu	10	_	Fair		All

Lighting Systems Energy Management System EMS Setpoints

				White the second	
Primary:	4' 32 watt T8	Brand:	Honeywell 5000	Occupied Heating:	72°F
Secondary:	CFL	Type:	DDC/Pneumatic	Occupied Cooling:	
Exterior:	Metal Hallde	Age:	15 Years	Unoccupied Heating:	65°F
Exit Signs:	Incandescent	Condition:	poor (Legacy)	Unoccupied Cooling:	-

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

Туре	Description	Condition	Type	Account Number	Meter#	Service Address
		FORCING PROPERTY AND ADDRESS OF THE PROPERTY O				
Walis	Steel/Wood/Masonry	Good	Electric	51377173042	890335722	77 Woodlawn Terr
Windows	Double Pane	Good	Natural Gas	57164250078	419353	77 Woodlawn Terr
Roof	Wood Roof Deck System	Fair				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls Exterior Lighting Improvements EMS Upgrades & Expansion Building Weatherization Pipe & Fitting Insulation Steam Traps & Thermostatic Radiator Valves
Plug Load Controls



City of Waterbury - Duggan School

Building Description

Gross Area (ft²): 75,418 Conditioned Area (ft²): 75,418

> Built: 2010 Renovations: 2011

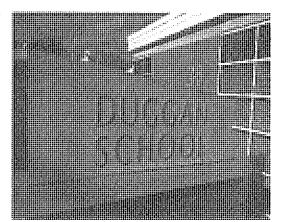
Primary Use: Elementary Education Grades K-5

Floors:

Electric Tariffs: Eversource: Rate 37 Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupancy	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment									
Plant	Age		Туре	Mode	el Number	Siz	е	Fuel	Efficiency
Condensing Boilers	5 Years	Hot	Water	K8 5000		15,000	мвн	Naturai Gas	88%
Airside Equipment									
ID/1	уре		Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Constant and Variab	le Air V olume	AHUs	80,000	DDC	260	20%	New	A CONTRACTOR OF STREET, STREET	All Areas

Lighting Systems			igement System	EMS Setpoints		
	4′ 32 watt T8	Brand;		Occupied Heating:		
Secondary:	CFL	Туре;	DDC	Occupied Cooling:	74°F	
Exterior:	Metal Halide	Age:	5 Years	Unoccupied Heating:	65°F	
Exit Signs:	Incandescent	Condition:	New	Unoccupied Cooling:	78°F	

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

	A CALL TO THE PROPERTY OF THE		produced in the second second	No. of the second secon		
Туре	Description	Condition	Туре	Account Number	Meter#	Service Address
Walls	Steel/Wood/Masonry	New	Electric	51492485040	891048502	952 Bank S t
Windows	Double Pane	New	Natural Gas	57862655040	424565	952 Bank St
Roof	Steel/Wood Roof System	New				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls **Building Weatherization** Walk-in Cooler Controls **Exterior Lighting Improvements** Plug Load Controls Solar Photovoltaics



City of Waterbury · Enlightenment School

Building Description

Gross Area (ft²): 40,777
Conditioned Area (ft²): 40,777

Built: 1955 Renovations: 2010

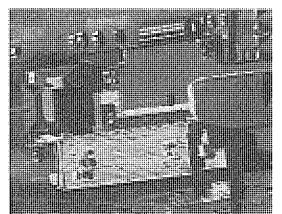
Primary Use: Secondary Education Grades 6-12

Floors:

Electric Tariffs: Eversource: Rate 30
Fuel Tariffs: Eversource: Rate 20

Occupancy Schedule

Day Type	Occupancy	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment									
Plant	Age		Туре		el Number	Siz	_	Fuel	Efficiency
HW Boilers	6 Years	Hot V	/ater	KB 2500		5,000 /	ивн	Natural Gas	86%
Airside Equipmer	nt.								
	D/Type		Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Constant and Var			45,000	DDC	145	20%	New		All Areas

Lighting Systems			gement System	EMS Setpoints		
Primary:	4' 32 watt T8	Brand:	TAC/Barber-Coleman	Occupied Heating:	72°F	
Secondary:	CFL	Type:	DDC	Occupied Cooling:	74°F	
Exterior:	Metal Halide	Age:	6 Years	Unoccupied Heating:	65°F	
Exit Signs:	incandescent	Condition:	Good	Unoccupied Cooling:	78°F	

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

Industrial State County of the Print		**************************************	Sweets to the Seas most w		Commence of the commence of th	
Type	Description	Condition	Туре	Account Number	Meter#	Service Address
Walls	Steel/Masonry/CMU	Good	Electric	51357215045	892057722	30A Church St
Windows	Double Pane	Good	Natural Gas	57450470075	496109	30 Church St
Roof	Concrete/Metal Roof Deck	Good				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls Building Weatherization

Pipe & Fitting Insulation

Plug Load Controls



City of Waterbury · Generali School

Building Description

Gross Area (ft²): 59,091 Conditioned Area (ft²): 59,091

> Built: 1942

Renovations:

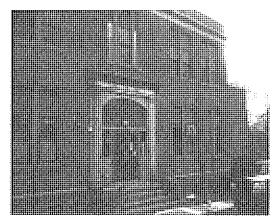
Primary Use: Elementary Education Grades K-5

Floors:

Electric Tariffs: Eversource: Rate 40 Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Оссиралсу	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Waakand	Ar Naadad	As Naadad



HVAC System

Plant Equipment								
Plant	Age	Туре	Model	Number	Size	е	Fuel	Efficiency
(2) Steam Boilers	>30 Years	Low Pressure Steam	Weil McLain I	Model 88	6,206 N	ΛВΉ	Natural Gas	83%
Equipment								
ID/	′Туре	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Radiators/Convect	ors	N/A	Man/Pneu	N/A	N/A	Goo		All Areas

Lighting Systems		0,	igement System	EMS Setpoints		
Primary:	4' 32 watt T8	Brand:	Honeywell 5000	Occupied Heating:		
Secondary:	CFL	Type:	DDC/Pneumatic	Occupied Cooling:	-	
Exterior:	Metal Halide	Age:	15 Years	Unoccupied Heating:	65°F	
Exit Signs:	Incandescent	Condition:	Poor (Legacy)	Unoccupied Cooling:	-	

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

			Control of the Contro			
Туре	Description	Condition	Туре	Account Number	Meter#	Service Address
Walls	Steel/Masonry	Fair	Electric	51039673082	890399232	3196 East Main St
Windows	Double Pane	Fair	Electric	51405673047	890399252	3196 East Main St
Roof	Steel/Concrete Roof Deck	Poor	Natural Gas	57407140078	529352	3196 East Main St

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls **Building Weatherization** Plug Load Controls Exterior Lighting Improvements Pipe & Fitting Insulation Walk-in Cooler Controls EMS Upgrades & Expansion Steam Traps & Thermostatic Radiator Valves Steam Boilers



City of Waterbury · Gilmartin School

Building Description

Gross Area (ft²): 75,000 Conditioned Area (ft²): 75,000

Built: 2010

Renovations:

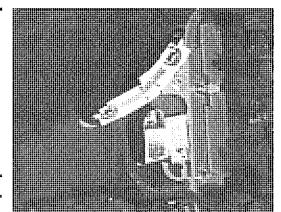
Primary Use: Elementary Education Grades K-5

Floors: Z

Electric Tariffs: Eversource: Rate 37
Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Оссирансу	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weakend	As Naodad	Ar Needed



HVAC System

Plant Equipment									
Plant	Age	7	Гуре		Number	Size		Fuel	Efficiency
(2) HW Boilers	6 Years	Hot Wate		Lochinvar Po		10,000 ME		Natural Gas	86%
Airside Equipment									
ÌE)/Type		Total SA CFM	Control	Total Fan HP	OA%	. ,	ent Condition	Areas Served
AHUs, ERVs, DOA, Pumps		, Heat	60,000	DDC	115	20%	New		All Areas

Lighting Systems		_,	agement System	EMS Setpoints		
Primary:	4' 32 watt T8	Brand:		Occupied Heating:	70°F	
Secondary:	CFL	Type:	DDC	Occupied Cooling:	74°F	
Exterior:	Metal Halide	Age:	6 Years	Unoccupied Heating:	60°F	
Exit Signs:	incandescent	Condition:	Good	Unoccupied Cooling:	78°F	

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

Carrier Strategy Control Control	e gapaig yn raw gapee y tropig yn grannwy yn affir ar afle wyf haar mae maller feel delynau'i ar lan dele sidd				A CONTRACTOR OF THE PROPERTY O	
Туре	Description	Candition	Туре	Account Number	Meter#	Service Address
Walis	Steel/Masonry/CMU	New	Electric	51890494065	891800762	107 Wyoming Ave
Windows	Double Pane	New	Natural Gas	57209315084	521050	107 Wyoming Ave
Roof	Metal Roof Deck System	New				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls

Building Weatherization

Plug Load Controls



City of Waterbury · Hopeville School

Building Description

Gross Area (ft²): 59,000 Conditioned Area (ft²): 59,000

> Built: 1917 Renovations: 1980s

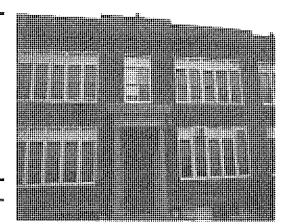
Primary Use: Elementary Education Grades K-5

Floors: 2

Electric Tariffs: Eversource: Rate 40
Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupancy	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment								
Plant	Age	Туре	Mode	Number	Siz	_	Fuel	Efficiency
(2) Steam Boilers	New	Low Pressure Steam	HB Smith Se	ries 28	4,998 N		Natural Gas	83%
Equipment								
ID,	/Туре	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Radiators/Convect		N/A	Man/Pneu	N/A	N/A	Fair		All Areas

Lighting Systems		Energy Mana	igement System	EMS Setpoints		
	4′ 32 watt T8		Honeywell 5000	Occupied Heating:		

 Secondary:
 CFL
 Type:
 DDC/Pneumatic
 Occupied Cooling:

 Exterior:
 Metal Halide
 Age:
 15 Years
 Unoccupied Heating:
 65°F

 Exit Signs:
 Incandescent
 Condition:
 Poor (Legacy)
 Unoccupied Cooling:

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

		(2-111-11-11-11-11-11-11-11-11-11-11-11-1	War you by the All Maridian Andrews and the			
Type	Description	Condition	Type	Account Number	Meter#	Service Address
Walis	Steel/Masonry	Fair	Electric	51764473013	890399102	2 Cypress St
	B 14 B	~ /				
Windows	Double Pane	Good	Natural Gas	57780300067	297354	2 Cypress St
0	C+!/C+- B! D!	r				
Roof	Steel/Concrete Roof Deck	Fair				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls Exterior Lighting Improvements EMS Upgrades & Expansion Building Weatherization Pipe & Fitting Insulation Steam Traps & Thermostatic Radiator Valves Plug Load Controls



City of Waterbury · Kennedy School

Building Description

Gross Area (ft²): 235,994 Conditioned Area (ft²): 235,994

> Built: 1964 Renovations: 2015

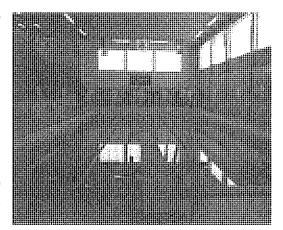
Primary Use: Secondary Education Grades 9-12

Floors: 2/3

Electric Tariffs: Eversource: Rate 56
Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Оссирапсу	H VA C
Monday-Friday	6:00 am - 9:00 pm	5:00 am - 10:00 pm
Weekend	6:00 am - As Needed	5:00 am - As Needed



HVAC System

Plant Equipment								
Plant	Age	Туре		del Number	Siz	_	Fuel	Efficiency
(2) Steam Boilers	New/>20 Years	Low Pressure Stea		Lain Model 88	9,526 N	1 ВН	Natural Gas	82%
Equipment								
ID/	Type Type	Total SA CFM	Control	Total Fan HP	OA%	, , , ,	ent Condition	Areas Served
Constant and Varia Radiators/Convect		42,000	DDC/Pneu	28	10%	Fair		Origina! Building

Lighting Systems	Energy Management System	EMS Setpoints
------------------	--------------------------	---------------

		P-0-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-				
Primary:	4′ 32 watt T8	Brand:	TAC/Barber~Coleman	Occupied Heating:	72°F	
Secondary:	CFL	Type:	DDC/Pneumatic	Occupied Cooling:	74°F	
Exterior:	Metal Halide	Age:	20 Years	Unoccupied Heating:	65°F	
Exit Signs:	ìncandescent	Condition:	Good	Unoccupied Cooling:	78°F	

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

Participation of the Control of the		hard or free explorer to the control of the control	r system type an smithe en it has et he heart for promitie mann	mineral contract the second of		
Туре	Description	Condition	Type	Account Number	Meter#	Service Address
					TO SHARE THE PROPERTY OF THE P	
Walls	Steel/Masonry/CMU	Good	Electric	51220653042	891801092	422 Highland Ave
Windows	Double Pane	Fair	Natural Gas	57409920030	379301	422 Highland Ave
Roof	Concrete/Metal Roof Deck	Fair				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls	EMS Upgrades & Expansion	Steam Traps & Thermostatic Radiator Valves
Exterior Lighting Improvements	Building Weatherization	Plug Load Controls
Air Handling Unit Damper Refurbishments	Pipe & Fitting Insulation	Hot Water Boilers & Pool Heating Systems



City of Waterbury · Kingsbury School

Building Description

Gross Area (ft²): 46,842 Conditioned Area (ft²): 46,842

> Built: 1917 Renovations: 1980s

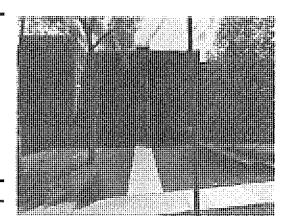
Primary Use: Elementary Education Grades K-5

Floors: 3/1

Electric Tariffs: Eversource: Rate 40
Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupancy	НVАС
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment								
Plant	Age	Туре	Mode	l Number	Siz	-	Fuel	Efficiency
(2) Steam Boilers	42 Years	Low Pressure Steam	HB Smith Mi	lis 450	7,506 N		Natural Gas	83%
Equipment								
lD/	′Туре	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Radiators/Convect	ors	N/A	Man/Pneu	N/A	N/A	Fair		All Areas

Lighting Systems Energy Management System EMS Setpoints

4' 32 watt T8 Honeywell 5000 72°F Primary: Occupied Heating: Brand: CFL DDC/Pneumatics Secondary: Type: Occupied Cooling: Exterior: Metal Halide 20 Years Unoccupied Heating: 65°F Age: Exit Signs: Incandescent Unoccupied Cooling: Condition: Poor (Legacy)

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

project contract the second section is the		**************************************				
Type	Description	Condition	Type	Account Number	Meter#	Service Address
MACHINE CONTRACTOR OF THE PARTY			POR A THE PROPERTY OF THE PROP			
Walls	Steel/Masonry	Fair	Electric	51983173097	890375362	220 Columbia Blvd
Windows	Double Pane	Fair	Natural Gas	57566380093	356614	220 Columbia Bivd
Ropf	Steel/Concrete Roaf Deck	Good				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls Exterior Lighting Improvements EMS Upgrades & Expansion Building Weatherization Pipe & Fitting Insulation Steam Traps & Thermostatic Radiator Valves Plug Load Controls



City of Waterbury · Maloney School

Building Description

Gross Area (ft²): 92,000 Conditioned Area (ft²): 92,000

Built: 1996

Renovations:

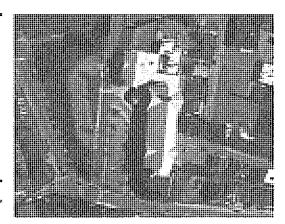
Primary Use: Elementary Education Grades K-5

Floors: 2

Electric Tariffs: Eversource: Rate 56
Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupancy	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment								
Plant	Age	Туре		l Number	Siz	-	Fuel	Efficiency
(2) HW Boilers	20 Years	Hot Water	HB Smith Series 28		9,034 N		Natural Gas	82%
Airside Equipment								
ID.	/Type	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Constant and Varia			DDC/Pneu	- V-1 de sales que recente e que récessor e en manar que régles que rédende	20%	Fair		All areas

Lighting Systems		٠,	gement System	EMS Setpoints	
	4' 32 watt T8		TAC/Barber-Coleman	Occupied Heating:	72°F
Secondary:	CFL	Type:	DDC	Occupied Cooling:	74°F
Exterior:	Metal Halide	Age:	20 Years	Unoccupied Heating:	65°F
Exit Signs:	Incandescent	Condition:	Fair	Unoccupied Cooling:	78°F

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

P		F		200 Marie - Construction of the Construction o		
Type	Description	Condition	Туре	Account Number	Meter#	Service Address
Walls	Steel/Masonry/CMU	Good	Electric	51792793093	891834842	233 South Elm St
Windows	Double Pane	Good	Natural Gas	57325120020	465559	233 South Elm St
Roof	Metal Roof Deck System	Good				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Cantrols Exterior Lighting Improvements

Building Weatherization

Walk-in Cooler Controls



City of Waterbury · Police Headquarters

Building Description

Gross Area (ft²): 71,651 Conditioned Area (ft²): 71,651

Built: 1978

Renovations:

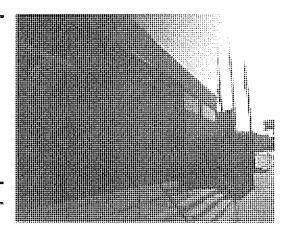
Primary Use: Police Department

Floors: 3

Electric Tariffs: Eversource: Rate 37
Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Оссирапсу	HVAC
Monday-Friday	24/7	24/7
Weekend	24/7	24/7



HVAC System

Plant Equipment				•				
Plant	Age	Туре		l Number	Siz	-	Fuel	Efficiency
(2) HW Boilers	20 Years	Hot Water	HB Smith Series 28		3,672 N		Natural Gas	82%
Airside Equipment								
lD.	/Туре	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
(4) Constant and Variable Volume AHUs			DDC/Pneu	75.5	10%	Fair		All areas

Lighting Systems			igement System	EMIS Setpoints	
	4′ 32 watt T8		Siemens	Occupied Heating:	
Secondary:	CFL	Type:	DDC	Occupied Cooling:	74°F
Exterior:	Metal Halide	Age:	20 Years	Unoccupied Heating:	-
Exit Signs:	Incandescent	Condition:	Fair	Unoccupied Cooling:	-

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

Printed to the Parish of the Control					, 1	
Туре	Description	Condition	Type	Account Number	Meter #	Service Address
		HAT SAN GER CHESTON ENGINEERING SOLVEN				
Walls	Steel/Masonry/CMU	Good	Electric	51406553024	B90966032	255 East Main St
Windows	Double Pane	Good	Natural Gas	57544B60091	424510	255 East Main St
Roof	Concrete/ Metal Roof Deck	New				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls Buildi Exterior Lighting Improvements Pipe 8

Building Weatherization Pipe & Fitting Insulation Solar Photovoltaics



City of Waterbury · Reed School

Building Description

Gross Area (ft²): 79,858 Conditioned Area 79,858

(ft²):

Built: 2012

Renovations: -

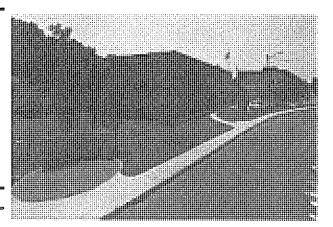
Primary Use: Elementary Education Grades K-5

Floors: 2

Electric Tariffs: Eversource: Rate 37
Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Туре	Occupancy	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	a needed	As Needed



HVAC System

Plant Equipment								
Plant	Age	Туре	•		Model Number Size		Fuei	Efficiency
(3) HW Boilers	4 Years	Hot Water	HB Si	mith Series 28	1	0,000 MBH	Natural Gas	83%
Equipment								
	ID/Type		SA CFM	Control	Total Fan Hi	-,,,,	Present Condition	Areas Served
(8) Constant and AHUs, Radiant H				DDC		****	New	All Areas

Lighting Systems			gement System	EMS Setpoints		
	4' 32 watt T8	Brand:		Occupied Heating:		
Secondary:	CFL	Type:	DDC	Occupied Cooling:	74°F	
Exterior:	Metal Halide	Age:	24 Years	Unoccupied Heating:	65°F	
Exit Signs:	Incandescent	Condition:	Good	Unoccupied Cooling:	78°F	

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

		garangan yangan sanggaran sanggaran sanggaran sa	principle and marketing a distribution			
Type	Description	Condition	Type	Account Number	Meter#	Service Address
				a a magana da minus de parte de parte de parte de la complexa de la productiva de la companya de la desidad de		
Walls	Steel/Masonry/Glass	New	Electric	51809695075	891857252	33 Griggs St
Windows	Double Pane	New	Natural Gas	57365616077	525733	33 Griggs St
Roof	Steel/Flat Metal Roof Deck	New				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls Exterior Lighting Improvements

Building Weatherization

Pipe & Fitting Insulation

Plug Load Controls



City of Waterbury · Regan School

Building Description

Gross Area (ft²): 31,000 Conditioned Area (ft²): 31,000

Built: 1966 Renovations: 2000

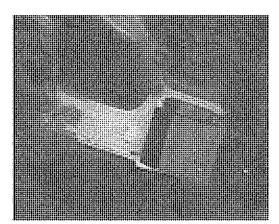
Primary Use: Elementary Education Grades K-5

Floors: 2

Electric Tariffs: Eversource: Rate 30
Fuel Tariffs: Eversource: Rate 20

Occupancy Schedule

Day Type	Оссирапсу	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment								
Plant	Age	Туре		l Number	Siz	-	Fuel	Efficiency
(2) HW Boilers	15 Years	Hot Water	HB Smith Sea		5,230 N		Natural Gas	83%
Airside Equipment								
ID	/Type	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Convectors, UVs		N/A	DDC/Pneu	N/A	N/A	N/A		All Areas

Lighting Systems	Energy Management System	EMS Setpoints
righting by scome	ziong, managament by stem	2.11.0 00.00.11.0

Primary:	4' 32 watt T8	Brand:	Honeywell 5000	Occupied Heating:	72°F
Secondary:	CFL	Туре:	DDC/Pneumatics	Occupied Cooling:	-
Exterior:	Metal Halide	Age:	15 Years	Unoccupied Heating:	65°F
Exit Signs:	Incandescent	Condition:	Poor (Legacy)	Unoccupied Cooling:	-

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

Туре	Description	Condition	Туре	Account Number	Meter#	Service Address
Walls	Steel/Masonry/CMU	Good	Electric	51174553057	890591952	2870 North Main St
Windows	Double Pane	Good	Natural Gas	57755640083	505971	2870 North Main St
Roof	Steel/Metal Roof, Gravel	Fair				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls Exterior Lighting Improvements

EMS Upgrades & Expansion Building Weatherization

Plug Load Controls



City of Waterbury · Rotella School

Building Description

Gross Area (ft²): 106,000 Conditioned Area (ft²): 106,000

> Built: 2001

Renovations:

Primary Use: Elementary Education Grades K-5

Floors:

Electric Tariffs: Eversource: Rate 56 Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupanty	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	Ar Needed	As Needed





HVAC System

Plant Equipment								
Plant	Age	Туре	Mode	Number	Siz	е	Fuel	Efficiency
(2) HW Boilers	15 Year s	Hot Water	Burnham		8,940 1	ивн	Natural Gas	82%
Airside Equipment	ŧ							
ID	/Type	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
(11) Constant and	VAV AHUs		DDC/Pneu		20%	Goo		All

Lighting Systems		-	EMS Setpoints	
4' 32 watt T8			Occupied Heating:	72°F
CFL	Type:	DDC	Occupied Cooling:	74°F
Metal Halide	Age:	15 Years	Unoccupied Heating:	65°F
Incandescent	Condition:	Good	Unoccupied Cooling:	78°F
	4' 32 watt T8 CFL Metal Halide	4' 32 watt T8 Brand: CFL Type: Metal Halide Age:	4' 32 watt T8 Brand: TAC CFL Type: DDC Metal Halide Age: 15 Years	4' 32 watt T8 Brand: TAC Occupied Heating: CFL Type: DDC Occupied Cooling: Metal Halide Age: 15 Years Unoccupied Heating:

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

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ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls **Exterior Lighting Improvements**

Building Weatherization Plug Load Controls

Walk-In Cooler Controls



City of Waterbury · Silas Bronson Library

Building Description

Gross Area (ft²): 40,000 Conditioned Area (ft²): 40,000

Built: 1963

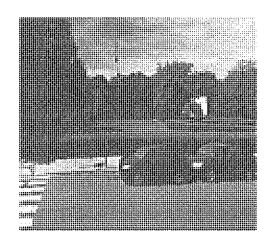
Renovations: 1968, 2014
Primary Use: Library

Floors: 2

Electric Tariffs: Eversource: Rate 30
Fuel Tariffs: Eversource: Rate 20

Occupancy Schedule

Day Type	Occupancy	HVAC		
Monday-Thursday	9:00 am - 8:00 pm	7:00 am - 9:00 pm		
Friday	9:00 am - 5:00 pm	7:00 am - 6:00 pm		



HVAC System

Plant Equi	pment						
Plan	nt Ag	е Тур	oe l	Model Number	Size	Fuel	Efficiency
			gaman (d. 1900) yan da san yan da san da			nikk periodoja nebilokoja ne monobleja de progregaj krybitologi de problekturkju.	
Airside Eq	uipment						
	ID/Type	Tota	al SA CFM Contr	ol Total Fan	HP OA%	Present Condition	Areas Served

Lighting Systems	Energy Management System	EMS Setpoints

Primary:	4' 32 watt T8	Brand:	Occupied Heating:
Secondary:	CFL	Туре:	Occupied Cooling:
Exterior:	Metal Halide	Age:	Unoccupied Heating:
Exit Signs:	Incandescent	Condition:	Unoccupied Cooling:

Domestic Water Systems

DHW Fuel:

Building Envelope

Utility Meters

Туре	Description	Condition	Туре	Account Number	Meter#	Service Address
Walls	Steel/Masonry/Glass	Good	Electric	51407373026	893727682	267 Grand St
Windows	Double Pane	Good	Natural Gas	57326030020	515173	267 Grand St
Roof	Steel/Metal Roof Deck	Good				
Rooi	Steely Metal Root Deck	4004				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls Exterior Lighting Improvements

Building Weatherization

Pipe & Fitting Insulation



City of Waterbury · Sprague School

Building Description

Gross Area (ft²): 64,502 Conditioned Area (ft²): 64,502

Built: 1913

Renovations: 1940s, 1950s, 1960s

Primary Use: Elementary Education Grades K-5

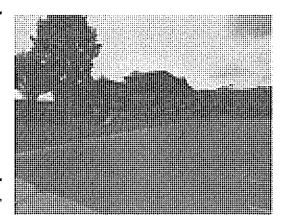
Floors: 2

Electric Tariffs: Eversource: Rate 40

Fuel Tariffs: Eversource: Rate 10 and 30

Occupancy Schedule

Day Type	Оссиралсу	H V AC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



EAAC Cotnointe

HVAC System

Lighting Customs

Plant Equipment	·							
Plant	Age	Туре		l Number	Siz	_	Fuel	Efficiency
(2) Steam 8oilers	> 30 Years	Low Pressure Steam	Weil-McLain Model 88		6,2061		Natural Gas	82%
Airside Equipment								
ID/	/Туре	Total SA CFM	Control	Total Fan HP	0A%		ent Condition	Areas Served
Radiators/Convect	ors	N/A	Man/Pneu	N/A	N/A	Fair		All

Lighting Sys	stems			ENIS Setpoints	
	4' 32 watt T8	•	Hoпeywell 5000	Occupied Heating:	65°F
Secondary:	CFL	Туре:	DDC/Pneumatic	Occupied Cooling:	N/A
Exterior:	Metal Halide	Age:	20 Years	Unoccupied Heating:	65°F
Exit Signs:	Incandescent	Condition:	Poor (Legacy)	Unoccupied Cooling:	N/A

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

Type	Description	Condition	Туре	Account Number	Meter#	Service Address
Walis	Steel/Masonry	Good	Electric	51853873057	890591772	1448 Thomaston Ave
Windows	Double Pane	Good	Natural Gas	57164740003	424969	1448 Thomaston Ave
Roof	Concrete Roof Deck System	Fair	Natural Gas	57838330058	434818	1448 Thomaston Ave

ESM Opportunities and Facility Upgrades

 Interior Lighting Improvements & Controls
 8uilding Weatherization
 Plug Load Controls

 Exterior Lighting Improvements
 Pipe & Fitting Insulation
 Walk-in Cooler Controls

 EMS Upgrades & Expansion
 Steam Traps & Thermostatic Radiator Valves
 Steam Boilers



City of Waterbury · Tinker School

Building Description

Gross Area (ft²): 54,976 Conditioned Area (ft²): 54,976

Built: 1925

Renovations:

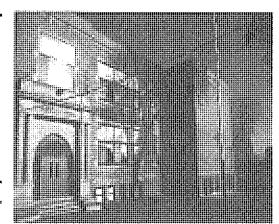
Primary Use: Elementary Education Grades K-5

Floors: 3/2

Electric Tariffs: Eversource: Rate 40
Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupancy	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	6:00 am - 10:00 pm	4:00 am - 10:00 pm



HVAC System

Plant Equipment								
Plant	Age	Туре	Type Model Number		Siz	_	Fuel	Efficiency
(2) Steam Boilers	New/15 yr	Low Pressure Steam	Weil-McLain Model 88		5,474 N		Natural Gas	82%
Airside Equipment								
	′Туре	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Radiators/Convect		N/A	Man/Pneu	N/A	N/A	Fair		All

Lighting Systems Energy Management System EMS Setpoints

·							
Primary:	4' 32 watt T8	Brand:	Honeywell 5000	Occupied Heating:	72°F		
Secondary:	CFL	Туре:	DDC/Pneumatics	Occupied Cooling:	-		
Exterior:	Metal Halide	Age:	20 Years	Unoccupied Heating:	65°F		
Exit Signs:	Incandescent	Condition:	Poor (Legacy)	Unoccupied Cooling:	-		

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

· · · · · · · · · · · · · · · · · · ·			A			
Туре	Description	Condition	Туре	Account Number	Meter#	Service Address
Walls	Steel/Masonry	Fair	Electric	51864373063	890375132	809 Highland Ave
Windows	Double/Single Pane	Fair/Poor	Natural Gas	57563850049	447908	809 Highland Ave
Roof	Steel/Concrete Roof Deck	Fair				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls	
Exterior Lighting Improvements	
EMS Upgrades & Expansion	

Building Weatherization Pipe & Fitting Insulation Steam Traps & Thermostatic Radiator Valves Plug Load Controls



City of Waterbury - Walsh School

Building Description

Gross Area (ft2): Conditioned Area (ft²): 61,500

> Built: 1930s Renovations: 1956, 1990

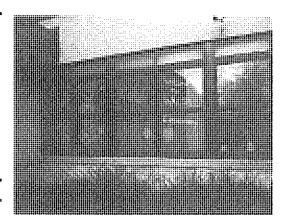
Primary Use: Elementary Education Grades K-5

Floors:

Electric Tariffs: Eversource: Rate 40 Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupancy	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment								
Plant	Age	Туре	Model Number Size		Fuel	Efficiency		
(2) Steam Boilers	25 Years	Low Pressure Steam	HB Smith Series 28 6,206 MBH		Natural Gas	83%		
Airside Equipment								
·	/Туре	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Radiators/Convect		N/A	DDC/Pneu	N/A	N/A	Fair		All Areas

Lighting Systems Energy Management System **EMS Setpoints**

Primary:	4′ 32 watt T8	Brand:	Honeywell 5000	Occupied Heating:	70°F
Secondary:	CFL	Type:	DDC	Occupied Cooling:	-
Exterior:	Metal Halide	Age:	20 Years	Unoccupied Heating:	65°F
Exit Signs:	Incandescent	Condition:	Poor (Legacy)	Unoccupied Cooling:	-

Domestic Water Systems

DHW Fuel: Steam to HW

Building Envelope

Utility Meters

Type	Description	Condition	Type	Account Number	Meter#	Service Address		
Walls	Steel/Masonry/CMU	Fair	Electric	51051073021	890307032	29 Ashley St		
Windows	Double Pane	Fair	Natural Gas	57036470052	424814	55 Dikeman St		
Roof	Steel/Concrete Roof Deck	Fair						

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls **Building Weatherization** Plug Load Controls **Exterior Lighting Improvement** Walk-In Cooler Controls Pipe & Fitting Insulation EMS Upgrades & Expansion Steam Traps & Thermostatic Radiator Valves



City of Waterbury · Washington School

Building Description

Gross Area (ft²): 41,118
Conditioned Area (ft²): 43,118

Built: 1882

Renovations: -

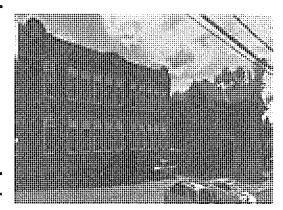
Primary Use: Elementary Education Grades K-5

Floors: 2

Electric Tariffs: Eversource: Rate 40
Fuel Tariffs: Eversource: Rate 20

Occupancy Schedule

Day Type	Оссирапсу	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment								
Plant	Age	Туре	Model Number			Size Fuel		Efficiency
(2) HW Boilers	15 Years	Hot Water	HB Smith Series 28		5,474 i		Natural Gas	82%
Airside Equipment	ŧ							
ID	/Type	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
Convectors		N/A	Мал/Рпеи	N/A	N/A	Fair		All Areas

Lighting Systems	Energy Management System	EMS Setpoints

			And the second s				
Primary:	4' 32 watt T8	Brand: Hoлeywell 5000		Occupied Heating:	72°F		
Secondary:	CFL	Type:	DDC	Occupied Cooling:	-		
Exterior:	Metal Halide	Age:	20 Years	Unoccupied Heating:	65°F		
Exit Signs:	Incandescent	Condition:	Poor (Legacy)	Unoccupied Cooling:	-		

Domestic Water Systems

DHW Fuel: Steam to HW

Building Envelope

Utility Meters

3 [-									
Туре	Description	Condition	Туре	Account Number	Meter#	Service Address			
Walls	Steel/Wood/Masonry	Fair	Electric	51024473068	890375282	685 Baldwin St			
Windows	Double Pane	Good	Natural Gas	57883100091	521353	Baldwin St			
Roof	Wood/EPDM Roof Deck	Good							

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls Exterior Lighting Improvements

EMS Upgrades & Expansion Building Weatherization

Plug Load Controls



City of Waterbury · Waterbury Arts Magnet School

Building Description

Gross Area (ft²): 292,000
Conditioned Area (ft²): 292,000

Built: 2004

Renovations:

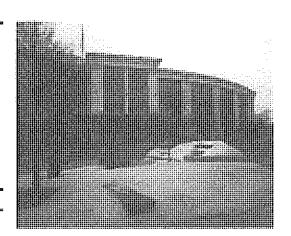
Primary Use: Secondary Education Grades 6 - 12

Floors: 4/5

Electric Tariffs: Eversource: Rate 56
Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupancy	HVAC
Monday-Friday	6:00 am - 10:00 pm	5:00 am - 10:00 pm
Weekend	6:00 am - 10:00 pm	4:00 am - 10:00 pm



HVAC System

Plant Equipment								
Plant	Age	Type		el Number	5iz	-	Fuel	Efficiency
(3) HW Boilers	12 Years	Hot Water	Unilux Water Tube		18,750		Natural Gas	83%
Equipment								
	/Type	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
(14) Constant and		312,700	DDC	508	5%	Good		All Areas

Lighting Systems			igement System	EMS Setpoints			
-	4' 32 watt T8	Brand:	Siemens	Occupied Heating:			
Secondary:	CFL	Type:	DDC	Occupied Cooling:	70°F		
Exterior:	Metal Halide	Age:	12 Years	Unoccupied Heating:	65°F		
Exit Signs:	Incandescent	Condition:	Fair	Unoccupied Cooling:	78°F		

Domestic Water Systems

DHW Fuel: natural gas

Building Envelope

Utility Meters

Type	Description	Condition	Туре	Account Number	Meter #	Service Address	
Walls	Steel/Masonry/CMU	Good	Electric	51936993021	891852512	1 School St	
Windows	Double Pane	Good	Natural Gas	57582370060	409954	200 East Main St	
Roof	Metal/Rubber Roof System	Good					

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls

EMS Upgrades & Expansion

Plug Load Controls

Exterior Lighting Improvements

Steam Traps & Thermostatic Radiator Valves



City of Waterbury · Waterbury Career Academy

Building Description

Gross Area (ft²): 145,392 Conditioned Area (ft²): 145,392

> Built: 2013 Renovations: -

Primary Use: Secondary Education Grades 9-12

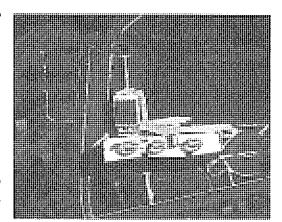
Floors: 4

Electric Tariffs: Eversource: Rate 30 and 56

Fuel Tariffs: Eversource: Rate 10

Occupancy Schedule

Day Type	Occupancy	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment						
Plant	Age	Туре	Model Number	Size	Fuel	Efficiency
	initial contract to the second of the second					

Airside Equipment

· ···=-== = - -- · · · · = · · · ·						
ID/Type	Total SA CFM	Control	Total Fan HP	OA%	Present Condition	Areas Served

Lighting Systems	Energy Management System	EMS Setpoints
<u> </u>		**************************************
E 1		

Primary:	4' 32 watt T8	Brand:	Automated Logic	Occupied Heating:	72°F
Secondary:	CFL	Туре:	DDC	Occupied Cooling:	74°F
Exterior:	Metal Halide	Age:	3 Years	Unoccupied Heating:	65°F
Exit Signs:	Incandescent	Condition:	New	Unoccupied Cooling:	78°F

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

Company of the contract of the			THE RESERVE OF THE PARTY OF THE			
Туре	Description	Condition	Type	Account Number	Meter#	Service Address
Walls	Steel/Masonry/Glass	Good	Electric	51640346060	892903232	175 Birch St, Fire Pump
Windows	Double Pane	Good	Electric	51831716048	891971302	175 Birch St
Roof	Steel/Metal Roof Deck	Good	Natural Gas	57568866032	529315	175 Birch St

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls

Exterior Lighting Improvements

Pipe & Fitting Insulation

Steam Traps & Thermostatic Radiator Valves



City of Waterbury · Wendell Cross School

Building Description

Gross Area (ft²): 41,098 Conditioned Area (ft²): 41,098

Built: 1953

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Renovations: 1970s, 2003

Primary Use: Elementary Education Grades K-5

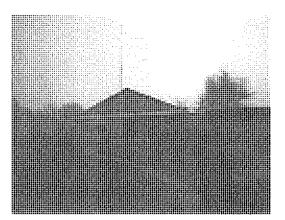
Floors: 2

Electric Tariffs: Eversource: Rate 40

Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Occupancy	HVAC		
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm		
Weekend	As Needed	As Needed		



HVAC System

Plant Equipment								
Plant			Model Number		Size		Fuel	Efficiency
(2) Steam Boilers	New	Low Pressure Steam	HB Smith Series 28		4,400		Natural Gas	83%
Equipment								
	/Type	Total SA CFM	Control	Total Faπ HP	OA%		ent Condition	Areas Served
Radiators/Convect		N/A	Man/Pneu	N/A	N/A	N/A		Ali

Lighting Systems	Energy Management System	EMS Setpoints	
	and the same of th		
Primary: 4'32 watt T8	Brand: Honeywell 5000	Occupied Heating:	

Secondary: CFL Type: DDC Occupied Cooling:
Exterior: Metal Halide Age: 20 Years Unoccupied Heating: 65°F

Exit Signs: Incandescent Condition: Poor (Legacy) Unoccupied Cooling: -

Domestic Water Systems

DHW Fuel: Gas

Building Envelope

Utility Meters

Type	Description	Condition	Туре	Account Number	Meter#	Service Address
Walls	Steel/Masonry/CMU	Good	Electric	51666773015	890398752	1255 Hamilton Ave
Windows	Double Pane	Good	Natural Gas	57566380028	424914	1255 Hamilton Ave
Roof	Steel/Concrete Roof Oeck	Good				

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls Exterior Lighting Improvements

EMS Upgrades & Expansion Pipe & Fitting Insulation Steam Traps & Thermostatic Radiator Valves Plug Load Controls



City of Waterbury · West Side School

Building Description

Gross Area (ft2): 172,676 Conditioned Area (ft²): 172,676

> Built: 1976

Renovations:

Primary Use: Secondary Education Grades 6-8

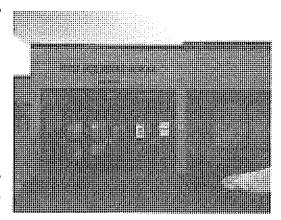
Floors:

Electric Tariffs: Eversource: Rate 40 and 56

Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Оссиралсу	HVAC
Monday-Friday	6:00 am - 9:00 pm	5:00 am - 10:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment								
Plant	Age	Туре		Number	Siz	-	Fuel	Efficiency
(3) Steam Boilers	> 30 Years	Low Pressure Steam	HB Smith Mi	lls 4500	21,213 A		Natural Gas	82%
Airside Equipment								
ID/	Туре	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
(14) Constant and \	/ariable Volume	233,200	DDC/Pneu	306	0%	Fair		All

Lighting Systems	Energy Management System	EMS Setpoints

Primary:	4' 32 watt T8	Brand:	Honeywell 5000	Occupied Heating:	70°F
Secondary:	CFL	Туре:	DDC	Occupied Cooling:	74°F
Exterior:	Metal Halide	Age:	20 Years	Unoccupied Heating:	65°F
Exit Signs:	Incandescent	Condition:	Poor (Legacy)	Unoccupied Cooling:	78°F

Domestic Water Systems

DHW Fuel: Steam to HW

Building Envelope

Utility Meters

Туре	Description	Condition	Туре	Account Number	Meter#	Service Address
Walls	Steel/Masonry/CMU	Fair	Electric	51004673034	890527332	483 Chase Pkwy
Windows	Double Pane	Fair	Electric	51346653033	58883541	483 Chase Pkwy
Roaf	Concrete/Metal Roof Deck System	Poor	Natural Gas	57145950069	515185	483 Chase Pkwy

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls EMS Upgrades & Expansion Plug Load Controls Exterior Lighting Improvements Pipe & Fitting Insulation Walk-In Cooler Controls Air Handling Unit Damper Refurbishments Steam Traps & Thermostatic Radiator Valves Hot Water Boilers & Pool Heating Systems



City of Waterbury · Wilby-North End HS/MS Complex

Building Description

Gross Area (ft2): 434,416 Conditioned Area (ft2): 434,416

> Built: 1978

Renovations:

Primary Use: Secondary Education Grades 6-12

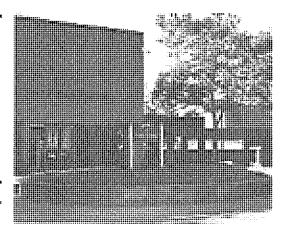
Floors:

Electric Tariffs: Eversource: Rate 30 and 56

Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Оссирансу	HVAC		
Monday-Friday	6:00 am - 9:00 pm	5:00 am - 10:00 pm		
Weekend	As Needed	As Needed		



HVAC System

Plant Equipment								
Plant	Age	Туре	Mode	l Number	Size	<u>-</u>	Fuel	Efficiency
(3) Steam Boilers	> 30 Years	Low Pressure Steam	Cleaver-Broo	ks CB 600-150	18,831 N	ΛВН	Natural Gas	82%
Equipment								
ID,	′Туре	Total SA CFM	Control	Total Fan HP	OA%		ent Condition	Areas Served
(41) Canstant and	/AV AHUs	378,200	DDC/Pneu	541	0%	Fair		Α[I

Lighting Systems	Energy Management System	EMS Setpoints
------------------	--------------------------	---------------

			the state of the s	No. 37 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3			
Primary:	4' 32 watt T8	Brand:	TAC/Barber-Coleman	Occupied Heating:	70°F		
Secondary:	CFL	Type:	DDC/Pneumatic	Occupied Cooling:	74°F		
Exterior:	Metal Halide	Age:	20 Years	Unoccupied Heating:	65°F		
Exit Signs:	Incandescent	Condition:	Fair	Unoccupied Cooling:	78°F		

Domestic Water Systems

DHW Fuel: Steam to HW

Building Envelope

Utility Meters

COLUMN TO SERVICE AND ADDRESS OF THE PARTY O						Milky Mickey Millians
Туре	Description	Condition	Туре	Account Number	Meter#	Service Address
Walis	Steel/Masonry/CMU	Fair	Electric	51649553062	891795542	568 Bucks Hill Rd
Windows	Double Pane	Poor	Electric	51721993095	890336412	330 Bucks Hill Rd
Roof	Flat Metal Roof Deck System	Fair	Natural Gas	57371950056	424827	460 Bucks Hill Rd

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls EMS Upgrades & Expansion Plug Load Controls Exterior Lighting Improvements **Building Weatherization** Walk-In Cooler Controls Air Handling Unit Damper Refurbishments Pipe & Fitting Insulation Hot Water Boilers & Pool Heating Systems Steam Traps & Thermostatic Radiator Valves



City of Waterbury · Wilson School

Building Description

Gross Area (ft2): 59,208 Conditioned Area (ft²): 59,208

> Built: 1928

Renovations: 1950s, 1990s

Primary Use: Elementary Education Grades K-5

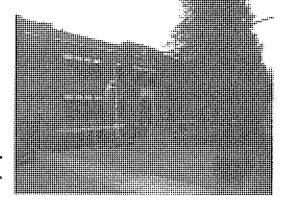
Floors:

Electric Tariffs: Eversource: Rate 30 and 40

Fuel Tariffs: Eversource: Rate 30

Occupancy Schedule

Day Type	Оссирансу	HVAC
Monday-Friday	6:00 am - 6:00 pm	5:00 am - 9:00 pm
Weekend	As Needed	As Needed



HVAC System

Plant Equipment								
Plant	Age	Туре	Mode	l Number	Siz	e	Fuel	Efficiency
(2) Steam Boilers	> 30 Years	Low Pressure Steam	HB Smith Se	ries 28	7,506 N	ивн	Natural Gas	82%
Equipment								
ID,	Type Type	Total SA CFM	Control	Total Fan HP	0A%	, , , ,	ent Condition	Areas Served
Radiators/Convect		N/A	Man/Pneu	N/A	N/A	Fair		Ali Areas

Lighting Systems	Energy Management System	EMS Setpoints
=-g,g =) 5151115	Energy Management System	FIAID Defboures

Primary:	4' 32 watt T8	Brand:	Honeywell 5000	Occupied Heating:	72°F	
Secondary:	CFL	Type:	DDC/Pneumatic	Occupied Cooling:	-	
Exterior:	Metal Halide	Age:	20 Years	Unoccupied Heating:	65°F	
Exit Signs:	Incandescent	Condition:	Poor (Legacy)	Unoccupied Cooling:	-	

Domestic Water Systems

DHW Fuel: Natural Gas

Building Envelope

Utility Meters

Туре	Description	Condition	Type	Account Number	Meter#	Service Address	
The second secon							
Walls	Steel/Wood/Masonry	Fair	Electric	51178993077	890307312	233 Birch St	
Windows	Double Pane	Fair	Electric	51259673028	891852742	201 Birch St	
Roof	Steel/Concrete Roof Deck	Fair	Natural Gas	57535440002	515167	201 Birch St	

ESM Opportunities and Facility Upgrades

Interior Lighting Improvements & Controls **Building Weatherization** Walk-In Cooler Controls **Exterior Lighting Improvements** Steam Traps & Thermostatic Radiator Valves Steam Boilers

EMS Upgrades & Expansion Plug Load Controls

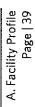




Table A-3 highlights the energy savings measures (ESMs) for each building.

Table A-3: Energy Savings Measures by Building

New Electrical Switchgear & Backup Power Generation					`							and the same of th				
Zolst Photovolotia											>					
Hot Water Boilers & Pool Heating Systems			-					>			-					<u> </u>
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ziorino Cooler Controls			-			>					>		>		-	
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Steam Traps & Thermostatic Select Valves	`	>	>		>	>		>		>			>		>	>
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Ruilding Weatherization	>	>	4,40		>	>	>	>	>	>	· >	>	>	\	>	>
Energy Management System Upgrades & Expansion	>	>	>	>	`>	>		>	>	>			>		` `	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
Asnaler Unit Damper Reintbirdings					:		-	>								\ <u>\</u>
Variable Speed Chillers & Pumps								>								
Exterior Lighting Improvements	>	`	>	>	>	>		`	`	`	>		>		. `>	
Interior Lighting Lorinto के Controls	>	>	>	>	>	>	>	>	>	>	>	`	>	>	>	\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \
				li V					1	į						
ellng)(a)								
ESMs by Building		[io]	lool	loo				Crosby-Wallace Complex	Depts of Public Health			Seltion	_	je.	ē	=
ESMS	Barmand School	Bucks HIII School	Bunker Hill School	Carrington School	Chase Building	Selfibel	=	-Wellete	Highlic	Selico	Duggan Sehool	Enlightenment School	Gerrerell School	Offmerdin Sohool	Hopeville Sahool	Kennedy School
	Barman	Bucks	Bunker	Centing	Chase	Chase School	Citty/Hall	Grosby	Deptro	Driggs School	inggeni	Brillght	General	ellmen	Hopew	Kenmee



Backup Power Generation					ridhen.														
고 Seectrical Switchgear 요																			***************************************
20181 Photovoltaics			<i></i>						-		******							Top on the stand	P. (1981)
loof & Pollets & Pool Easting Systems			:								1				>	>			
syallog meat?								>					-				>		
Walk-in Cooler Controls					g. 1. 10. 1	>	,	>		\ <u>\</u>		>	-		>	>	` `		
Plug Load Controls	>			>	>	>		>	`	>	>	`	>	`\	>	>	>		
Steam Traps & Thermostatic Radiator Valves	>							>	>	\$				>	>	, >	>		School address
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Energy Management System Upgrades & Expansion	>				>			>	>	>	`>	>		>	>	>	>		
Air Handler Unit Damper Refurbishments															>	>			mo
Variable Speed Chillers & Pumps									;				*****						
Exterior Lighting Improvements	>	>	>	>	>	`	>	`	`>	\	>	`	>	>	>	`	, >	\	>
gnihtlatior Lighting elovino के टीलान्थ्यां हैं	>	\$	>	>	>	`	>	>	>	>	>	>	>	>	>	>	>		
<u> </u>												Waterbury Arts Magnet School	emy					agen	1
ESMs by Building			25				tainy.			n.	=	/largine	Waterbury Career Academy	leed		xald		Buckingham Parking Garage	Helge
iMis by	chio	hooi	(quent		<u>-</u>	lgie	Silas Branson Library	llooli	<u> </u>	- <u>-</u>	Weshington School	AME	Сакев	Wendell Cross School	teliterel	Wilby-Neith Complex	100	n Penk	III g. Gr
R	s (Suna	Maloney School	Heed	Reed School	Regen School	Rokella Setrool	Skanise	Sprague Sehool	Tinker Seliotel	Walsh School	Imgten	thursy.	bury	ellicii	Sides	New	in Seln	ilgliein	Park
	Kingsbury School	Malo	Police Headquarters	Reed	Regar	Rotel	Sllas	Spre	Tinke	Walst	West	Weite	Wate	Went	West Side School	Willby	Wilson School	Buck	Seovill Panking Garage

Information on this page is proprietory and subject to confidentiality restrictions



3. Energy Star® Scores

The Energy Star® ratings for each building are listed in Table A-4 and graphically in Graph A-1. Energy Star® scores and on a scale from 1 to 100, with a score of 50 representing median energy performance relative to similar property types nationwide. Scores of 75 of greater indicate a building is a top performer and it may be eligible for Energy Star® certification. The building comparison data is sourced by Energy Star® through the United States Department of Energy Information Administration Commercial Building Energy Consumption Survey (CBECS) survey conducted once every four years. The calculations take into account the impact of weather variations as well as key property use details such as the building square footage, percent occupancy, and amount of heated and cooled space.

Several buildings do not have an Energy Star® score because the Energy Star® Portfolio Manager only provides scores for 21 of the over 80 property types available in the Energy Star® Portfolio Manager. Electric and natural gas consumption for each building was entered for the years 2013, 2014, and 2015. The Energy Star® scores are based on the most recent year of data -- 2015.

100 90 80 70 60 50 40 30 20 10 City Hall School Chase Building School Carrington School Crosby-Wallace Complex Dept. of Public Health Gilmartin School School Wilby-North Complex **Bucks Hill School** Bunker Hill School Chase School Driggs School Duggan School **Enlightenment School** Hopeville School Kennedy School Kingsbury School Maloney School Rotella School Sprague School Tinker School Walsh School Washington School Waterbury Arts Magnet School Waterbury Career Academy Wendell Cross School West Side School Wilson School Regan 5 Reed ! Generali ■ Existing Energy Star® Score ■ Post-Retrofit Energy Star® Score

Graph A-1: Existing and Post-Retrofit Energy Star® Score Rankings



Table A-4: Energy Star® Existing and Post-Retrofit Scores

Building			i=Retrofit
D C	Property Type		y Star® Score
Barnard School Bucks Hill School	K-12 School	67	94
	K-12 School	13	56
Bunker Hill School	K-12 School	63	91
Carrington School	K-12 School	77	84
Chase Building	Office	57	79
Chase School	K-12 School	66	90
City Hall	Office	73	75
Crosby-Wallace Complex	K-12 School	3	19
Dept. of Public Health	Office	17	37
Driggs School	K-12 School	72	86
Duggan School	K-12 School	12	30
Enlightenment School	K-12 School	63	73
Generali School	K-12 School	48	76
Gilmartin School	K-12 School	45	59
Hopeville School	K-12 School	85	98
Kennedy School	K-12 School	16	60
Kingsbury School	K-12 School	70	92
Maloney School	K-12 School	37	48
Police Headquarters	Police Station	Not Available	
Reed School	K-12 School	42	68
Regan School	K-12 School	53	67
Rotella School	K-12 School	13	25
Silas Bronson Library	Library	Not Available	
Sprague School	K-12 School	54	89
Tinker School	K-12 School	68	95
Walsh School	K-12 School	72	91
Washington School	K-12 School	93	98
Waterbury Arts Magnet School	K-12 School	23	42
Waterbury Career Academy	K-12 School	4 5	47
Wendell Cross School	K-12 School	67	90
West Side School	K-12 School	51	69
Wilby-North Complex	K-12 School	19	. 66
Wilson School	K-12 School	64	93



SECTION B: UTILITY INFORMATION



B. UTILITY INFORMATION

1. Rate Summary Table

NORESCO analyzed the most recent electricity tariffs from the City's electric utility company, Eversource. The most recent tariffs were chosen to calculate the savings for this project, as they are the most up-to-date representation for how the utility company charges for demand, power factor, and consumption.

For the electricity supply cost, NORESCO used the most recent contract with the City's electricity supplier, Direct Energy. A summary of the most recent electricity rates for each building are provided in Table B-1. Note that there are five electricity rates structures (30, 37, 40, 56, and 58) across the buildings.

Table B-1: Electricity Rates for Calculating Savings

	Secret 4	Margin	al Electricit	y Rates	Blended Electricity Rates
Building	Rate Code	\$/kW	\$/KVA	\$/kWh	\$/kWh
Barnard School	30	\$19.49	_	\$0.0974	\$0.1550
Bucks Hill School	30	\$19.49		\$0.0974	\$0.1671
Bunker Hill School	40	-		\$0.1642	\$0.1642
Carrington School	37	\$1 1. 69	•	\$0.1391	\$0.1868
Chase Building	30	\$19.49	F	\$0.0974	\$0.1566
Chase School (Note 1)	30 & 40	\$6.34	-	\$0.1461	\$0.1743
City Hall	37	\$11.69	-	\$0.1391	\$0.1680
Crosby-Wallace Complex	58		\$15.64	\$0.1166	\$0.1606
Department of Public Health	37	\$11.69	-	\$0.1381	\$0.1653
Driggs School	40	-		\$0.1642	\$0.1642
Duggan School	37	\$11.69	-	\$0.1391	\$0.1775
Enlightenment School	30	\$19.49		\$0.0974	\$0.1676
Generali School	40	-	-	\$0.1642	\$0.1642
Gilmartin School	58	\$11.69		\$0.1391	\$0.1885
Hopeville School	40	-	_	\$0.1642	\$0.1642
Kennedy School	56		\$15.38	\$0.1169	\$0.1672
Kingsbury School	40	-	-	\$0.1642	\$0.1642
Maloney School	56		\$15.38	\$0.1169	\$0.1736
Police Headquarters	37	\$11.69	-	\$0.1409	\$0.1641
Reed School	37	\$11.69		\$0.1391	\$0.1830
Regan School	30	\$19.49		\$0.0974	\$0.1629



		Mary mal	# bestred,	i Machini	Marridadi Esretxardiş Satera
Balanc	lain Lide	A, WW	S/SVA	1/3W5	5,7km/h
Piceballya Schrega			\$15.18	\$44.11654	\$0,1737
Silas Bronson Library	40	\$19.49	_	\$0.0974	\$0.1506
Sprague School	40			\$0.1642	\$0.1642
Tinker School	40	-	***	\$0.1642	\$0.1642
Walsh School	40			\$0.1642	\$0.1642
Washington School	40	-	-	\$0.1642	\$0.1642
Waterbury Arts Magnet School	56		\$15.38	\$0.1169	\$0.1600
Waterbury Career Academy	56	-	\$15.38	\$0.1169	\$0.1577
Wendall Cross School	40			\$0.1642	\$0.1642
West Side School	56	•	\$15.38	\$0.1169	\$0.1697
Wilby-North End Complex	56		\$15.18	\$0.1169	\$0.1679
Wilson School	40	-	-	\$0.1642	\$0.1642
Buckingham Parking Garage	30	\$19.49		\$0.0974	\$0.1550
Scovill Parking Garage	30	\$19.49	-	\$0.0974	\$0.1671

Note 1: There are two meters with different rate structures (Rate 30 & 40), so this is a weighted average. Rate 40 does not have a demand unit cost, only energy.

Like the electricity, the natural gas rates are based on the latest available data. Natural gas is both distributed and supplied by Eversource. The last fiscal year of data (January 2015 to December 2015) was analyzed to calculate the latest natural gas utility rate by dividing the annual cost of natural gas by the consumption over the same annual period. The last fiscal year of natural gas costs, consumption, and rates are summarized in Table B-2.

Table B-2: Natural Gas Rates for Calculating Savings

1 Phrile Hace	Sas Raie IGF)
Barnard School	\$0.961
Bucks Hill School	\$0.940
Bunker Hill School	\$1.015
Carrington School	\$0.960
Chase Building	\$1.151
Chase School	\$0.992
City Hall	\$0.856
Crosby-Wallace Complex	\$0.835



	ral Gas Rate \$/CCF)
Department of Public Health	\$1.055
Driggs School	\$1.051
Duggan School	\$1.014
Enlightenment School	\$1.241
Generali School	\$0.983
Gilmartin School	\$0.997
Hopeville School	\$1.181
Kennedy School	\$0.862
Kingsbury School	\$1.149
Maloney School	\$0.902
Police Headquarters	\$1.157
Reed School	\$0.9394
Regan School	\$1.067
Rotella School	\$0.898
Silas Bronson Library	\$1.34B
Sprague School	\$0.936
Tinker School	\$1.260
Walsh School	\$1.079
Washington School	\$1.110
Waterbury Arts Magnet School	\$0.705
Waterbury Career Academy	\$1.300
Wendall Cross School	\$1.070
West Side School	\$0.914
Wilby-North End Complex	\$0.839
Wilson School	\$0.899

2. Rebate & Subsidy Information

NORESCO has extensive experience with utility incentive programs. We will work diligently to obtain any available incentives. All incentive monies will be credited to the City. NORESCO has conducted a preliminary evaluation of the electric and gas incentives offered by Eversource. Incentives are available for several of the technologies under their Comprehensive Project Initiative for Existing Building Retrofit. The Comprehensive Initiative offers greater incentives than single measure projects by utilizing benefits from quicker savings measures such as LED lighting to support measures that have a longer payback if done individually.



The Comprehensive Initiative incentive levels require that multiple buildings are included in the project and the savings are generated from both electricity and natural gas. This project meets both of those criteria. In addition, the incentive levels are detailed below:

- Total Project Incentive is up to 50% of installed cost
- Neither electric nor gas can exceed 85% of the total project savings
- Comprehensive "Project Cap" for all ESMs is \$0.40/kWh saved and \$3.50/CCF saved

The estimated Comprehensive Initiative incentive apportioned out by ESM is summarized in Table B-3.

Table B-3: Summary of Utility Incentives

	Energy Savings Measures	Estimated Incentives
1	Interior Lighting Improvements & Controls	\$489,680
2	Exterior Lighting Improvements	\$264,504
3	Variable Speed Chillers & Pumps	\$35,049
4	Air Handling Unit Damper Refurbishments	\$46,024
5	Energy Management System Upgrades & Expansion	\$1,536,934
6	Building Weatherization	\$146,921
7	Pipe & Fitting Insulation	\$268,882
8	Steam Traps & Thermostatic Radiator Valves	\$272,573
9	Plug Load Controls	\$60,372
10	Walk-In Cooler Controls	\$29,329
11	Steam Boilers	\$103,757
12	Hot Water Boilers & Pool Heating Systems	\$445,829
13	Solar Photovoltaics	\$0
14	New Electrical Switchgear & Backup Power Generation	\$0
	Totals	\$ 5 4699,8354

Note: The estimated incentive values shown in Table B-3 are based on \$0.30/kWh saved and \$3.50/CCF saved.



SECTION C:SAVINGS OPPORTUNITIES SUMMARY



C. SAVINGS OPPORTUNITIES SUMMARY

1. Summary Table of All ESMs

The savings opportunities for the recommended energy savings measures (ESMs) are summarized in Table C-1, with further breakouts in Table C-2. Table C-3 lists includes the ESM-by-ESM breakdown.

Table C-1: Savings Opportunities for the Energy Savings Measures

	Energy Savings Measures	Implementation Price (Note 1)	Estimated Incentives	Anticipated Annual Cost Savings	Simple Payback Net of Incentives
1	Interior Lighting Improvements & Controls	\$2,099,167	\$489,680	\$344,408	4.7
2	Exterior Lighting Improvements	\$986,487	\$264,504	\$127,455	5.7
3	Variable Speed Chillers & Pumps	\$1,205,847	\$35,049	\$43,149	27.1
4	Air Handling Unit Damper Refurbishments	\$321,805	\$46,024	\$29,038	9.5
5	Energy Management System Upgrades & Expansion	\$5,345,037	\$1,536,934	\$621,167	6.1
6	Building Weatherization	\$584,590	\$146,921	\$47,528	9.2
7	Pipe & Fitting Insulation	\$804,356	\$268,882	\$79,239	6.8
8	Steam Traps & Thermostatic Radiator Valves	\$784,163	\$272,573	\$93,420	5.5
9	Plug Load Controls	\$176,810	\$60,372	\$27,543	4.2
10	Walk-In Cooler Controls	\$147,423	\$29,329	\$13,11 5	9.0
11	Steam Boilers	\$5,984,134	\$103,757	\$69,948	84.1
12	Hot Water Boilers & Pool Heating Systems	\$7,407,670	\$445,829	\$153,827	45.3
13	Solar Photovoltaics	\$305,388	\$0	\$27,863	11.0
14	New Electrical Switchgear & Backup Power Generation	\$1,255,855	\$0	\$0	N/A
	Project Totals	\$27,415,059	\$3,699,854	\$1,677,700	14:1

Note: The SOW Sum includes an allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered on the project, including the abatement of lead and asbestos that may be encountered. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.

In addition, the SOW Sum includes a design allowance in the amount of \$50,000 for ECM 13 that may be used to add additional scope to that measure after execution of the Contract at the request of the City. Use of this allowance will be authorized by execution of a change order by both Parties. Any funds remaining in the allowance may also be allocated to additional work at the City's request through execution of a change order or remitted to the City at the end of the Interim Period.



Table C-2: Annual Energy and Cost Savings

Energy Savings Measures	Guaranteed Electric (kW) Savings	Guaranteed Electric (kVA) Savings	Guaranteed Electric (KWh) Savings	Guaranteed Natural Gas (CCF) Savings	Total Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Total Anticipated Annual Cost Savings
Interior Lighting Improvements & Controls	3,723	5,769	1,632,263	(17,522)	\$328,590	\$15,818	\$344,408
Exterior Lighting Improvements	421	0	881,676	0	\$118,342	\$9,113	\$127,455
Variable Speed Chillers & Pumps	0	404	116,829	0	\$21,355	\$21,794	\$43,149
Air Handling Unit Damper Refurbishments	0	597	153,414	0	\$29,038	\$0	\$29,038
Energy Management System Upgrades & Expansion	0	. 0	2,603,237	215,990	\$532,897	\$88,270	\$621,167
Building Weatherization	0	0	13,417	40,828	\$47,528	\$	\$47,528
Pipe & Fitting Insulation	0	0	0	76,824	\$79,239	0\$	\$79,239
Steam Traps & Thermostatic Radiator Valves	O	0	0	77,878	\$83,348	\$10,072	\$93,420
Plug Load Controls	0	0	201,247	0	\$27,543	\$0	\$27,543
Walk-In Cooler Controls	0	0	177,779	0	\$13,115	\$	\$13,115
Steam Boilers	0	0	0	29,645	\$31,412	\$38,536	\$69,948
Hot Water Boilers & Pool Heating Systems	0	0	0	127,380	\$115,659	\$38,168	\$153,827
Solar Photovoltaics	0	0	136,116	0	\$20,377	\$7,486	\$27,863
New Electric Switchgear & Backup Power Generation	0	0	0	0	0\$	\$0	\$0
Totals	नगर	67770	5,885,9770	250/155	·新/448/443	\$229,257	\$1,677,700



Table C-3: Building-by-Building Annual Energy and Cost Savings by ESM by Building

Energy Savings Measures	Guaranteed Electric (kW) Savings	Guarantee Electric (kVA) Savings	Guaranteed Electric (kWh) Savings	Guaranteed Natural Gas (CCF) Savings	Total Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Total Anticipated Annual Cost Savings
		Barnard Schoo	Settool	lle The second s			
Interior Lighting Improvements & Controls	105.8		22,077	-259	\$4,245	\$84	\$4,329
Exterior Lighting Improvements		-	5,199	American Comments of the Comme	\$542	\$159	\$701
EMS Upgrades & Expansion				1,302	\$1,341	\$1,807	\$3,148
Building Weatherization		Day danakang		2,265	\$2,333		\$2,333
Pipe & Fitting Insulation				1,357	\$1,397	The state of the s	\$1,397
Steam Traps & Thermostatic Radiator Valves		Proposition of a second second		1,898	\$1,955	\$531	\$2,486
Steam Bollers				4,075	\$4,197	\$1,350	\$5,546
Subtotals	105.8	0	27,276	10,638	\$16,009	\$3,930	\$19,940
		Bucks HIII Schoo	School				
Interior Lighting Improvements & Controls	185.8		25,264	-296	\$6,216	\$348	\$6,564
Exterior Lighting Improvements			19,504		\$2,035	\$321	\$2,357
EMS Upgrades & Expansion				11,279	\$11,361	\$1,480	\$12,840
Building Weatherization				96	\$97		\$97
Pipe & Fitting Insulation	-		-	1,989	\$2,004		\$2,004
Steam Traps & Thermostatic Radiator Valves				8,615	\$8,678	\$531	\$9,208
Plug Load Controls	- Andrews of Anna Control of A		5,476	- Paring way manusa	\$571	Pamilio and amode	\$571
Subtotals	185.8	0	50,244	21,683	\$30,962	\$2,680	\$33,642
		Bunker Hill School	II Seliool				
Interior Lighting Improvements & Controls	142.3		17,588	-206	\$2,869	\$335	\$3,205
Exterior Lighting Improvements			5,712		\$1,005	\$175	\$1,180
EMS Upgrades & Expansion				1,381	\$1,501	\$730	\$2,230

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C. Savings Opportunities Summary Page | 3



Energy Savings Measures	Guaranteed Electric (kW) Savings	Guarantee Electric (kVA) Savings	Guaranteed Electric (kWh) Savings	Guaranteed Natural Gas (CCF) Savings	Total Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Total Anticipated Annual Cost Savings
Pipe & Fitting Insulation				7,238	\$7,867	v	\$7,867
Steam Traps & Thermostatic Radiator Valves			about the state of	3,710	\$4,033	\$531	\$4,564
Plug Load Controls			5,919		\$1,041	Patrice NVVVe SISS	\$1,041
Steam Bollers			The second secon	2,558	\$2,780	\$1,350	\$4,130
Subtotals	142.3	Ο	29,219	14,681	\$21,097	\$3,121	\$24,218
		Carrington Sehoo	Seltool				
Interior Lighting Improvements & Controls	409.2		57,731	909-	\$13,105	\$752	\$13,857
Exterior Lighting Improvements			1,848		\$275	\$89	\$364
EMS Upgrades & Expansion	-			2,074	\$2,132	, MPs crabillitis (Fig. 1 %	\$2,132
Plug Load Controls			6,194		\$923		\$923
Subtotals	409.2	0	65,773	1,468	\$16,434	\$841	\$17,275
		Chase Bull	illding				
Interior Lighting Improvements & Controls	222.6		70,962	-827	\$11,029	\$686	\$11,715
Exterior Lighting Improvements			11,953		\$1,247	\$135	\$1,382
EMS Upgrades & Expansion	om us subsection			2,331	\$2,873	-TERLAP - SEASON - VA	\$2,873
Building Weatherization			178	625	\$789		\$789
Pipe & Fitting Insulation	3.000	-		843	\$1,040	-	\$1,040
Steam Traps & Thermostatic Radiator Valves				8,049	\$9,924	\$2,655	\$12,579
Plug Load Controls			15,978		\$1,667	- PRAMALU	\$1,667
Steam Boilers				4,871	\$6,006	\$30,483	\$36,489
Subtotals	222.6	0	120'66	15,892	\$34,575	\$33,959	\$68,534
		Chase Schoo	elicol				
Interior Lighting Improvements & Controls	207.8	en. romane	25,352	-297	\$5,062	\$381	\$5,444

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Energy Savings Measures	Guaranteed Electric (kW) Savings	Guarantee Electric (KVA) Savings	Guaranteed Electric (kWh) Savings	Guaranteed Natural Gas (CCF) Savings	Total Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Total Anticipated Annual Cost Savings
Exterior Lighting Improvements			13,250		\$2,073	\$242	\$2,315
EMS Upgrades & Expansion				1,230	\$1,308	\$1,095	\$2,403
Building Weatherization				1,054	\$1,120		\$1,120
Pipe & Fitting Insulation	-			1,872	\$1,989		\$1,989
Steam Traps & Thermostatic Radiator Valves			Property and the control of the cont	3,069	\$3,262	\$531	\$3,793
Plug Load Controls			3,201	The second of th	\$501	-	\$501
Walk-In Cooler Controls			3,470		\$543		\$543
Steam Boilers				5,036	\$5,352	\$1,350	\$6,702
Subtotals	207.8	0	45,273	11,964	\$21,209	\$3,599	\$24,808
		City/Hal	<u> </u>				
Interior Lighting Improvements & Controls	ω		1,950	-20	\$372	\$41	\$413
Building Weatherization			494	631	\$653		\$653
Pipe & Fitting Insulation				748	\$686		\$686
Subtotals	8	0	2,444	1,359	\$1,711	\$41	\$1,752
		Grosby-Wallace Complex	ee Complex				
Interior Lighting Improvements & Controls	and the second second	1,609.50	295,344	-3,050	\$61,112	\$1,634	\$62,746
Exterior Lighting Improvements			95,716		\$11,950	\$1,259	\$13,210
Variable Speed Chillers & Pumps		404	116,829	4	\$21,355	\$21,819	\$43,174
Air Handling Unit Damper Refurbishments		223.9	47,289		\$9,655		\$9,655
EMS Upgrades & Expansion			171,8	90,270	\$189,882	\$13,276	\$203,158
Building Weatherization			3,862	8,083	\$7,712		\$7,712
Pipe & Fitting Insulation		The state of the s	THE CONTRACT OF THE CONTRACT O	16,648	\$14,891		\$14,891
Steam Traps & Thermostatic Radiator Valves				897	\$802	\$531	\$1,333

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C. Savings Opportunities Summary Page | 5



Energy Savings Measures	Guaranteed Electric (KW) Savings	Guarantee Electric (kVA) Savings	Guaranteed Electric (kWh) Savings	Guaranteed Natural Gas (CCF) Savings	Notal Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Anticipated Annual Cost
Plug Load Controls			32,961		\$4,115	of the base of the same	\$4,115
Walk-In Cooler Controls		Victorial Control Cont	17,067	e seminar de la companya de la compa	\$2,131		\$2,131
Hot Water Boilers & Pool Heating Systems		Samuel Control		58,652	\$52,461	\$21,622	\$74,083
Subtotals	О	2,237.40	1,483,239	171,500	\$376,067	\$60,141	\$436,207
		Department of Public Health	Public Health				
Interior Lighting Improvements & Controls	132.7		52,343	-560	\$8,771	\$330	\$9,101
Exterior Lighting Improvements			10,586		\$1,566	\$146	\$1,712
EMS Upgrades & Expansion				10,584	\$29,674		\$29,674
Building Weatherization				947	\$1,156	7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7	\$1,156
Pipe & Fitting Insulation				546	\$618		\$618
Subtotals	132.7	0	62,929	11,517	\$41,784	\$477	\$42,261
		Driggs Schoo	chool				
Interior Lighting Improvements & Controls	145.6		17,975	-211	\$2,925	\$264	\$3,190
Exterior Lighting Improvements			6,859		\$1,206	\$69	\$1,275
EMS Upgrades & Expansion			119,727	906	\$1,021	\$1,704	\$2,725
Building Weatherization			572	166	\$1,116		\$1,116
Pipe & Fitting Insulation			- Marine	2,858	\$3,219		\$3,219
Steam Traps & Thermostatic Radiator Valves				1,984	\$2,234	\$531	\$2,765
Plug Load Controls			5,745	-	\$1,010		\$1,010
Subtotals	145,6	0	150,878	6,528	\$12,732	\$2,568	\$15,300
		Duggan Sehoo	ichool				
Interior Lighting Improvements & Controls	132.1		28,874	-307	\$5,623	\$486	\$6,108
Exterior Lighting Improvements			17,835		\$2,658	\$401	\$3,059

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Energy Savings Measures	Guaranteed Electric (kW) Savings	Guarantee Electric (KVA) Savings	Guaranteed Electric (kWh) Savings	Guaranteed Natural Gas (CCF) Savings	Total Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Total Anticipated Annual Cost Savings
Building Weatherization			607	814	\$974		\$974
Plug Load Controls			6,357	Some the annual	\$947	Town B. Case	\$947
Walk-in Cooler Controls			5,188		\$773		\$773
Solar Photovoltaics			88,027		\$13,118	\$4,847	\$17,965
Subtotals	132,1	0	146,888	507	\$24,093	\$5,564	\$29,658
		Enlightenment School	ent School				
Interior Lighting Improvements & Controls	99		8,988	96-	\$2,188	66\$	\$2,287
Building Weatherization	THE REAL PROPERTY AND ADDRESS OF THE PERTY ADDRESS OF THE PERTY AND ADDRESS OF THE PERTY AND ADDRESS OF THE PERTY AND ADDRESS OF THE PERTY ADDRESS OF THE PERTY AND ADDRESS OF THE PERTY ADDR			208	\$675		\$675
Pipe & Fitting insulation				572	\$760		\$760
Plug Load Controls	1	:	5,860		\$611		\$611
Subtotals	99	0	14,848	984	\$4,233	66\$	\$4,332
		Generali Sohoo	School				
Interior Lighting Improvements & Controls	185.1		27,478	-317	\$4,499	\$351	\$4,851
Exterior Lighting Improvements	WELLA CO. ST. ST. ST. ST. ST. ST. ST. ST. ST. ST		8,738	000 M 100 M	\$1,537	\$239	\$1,776
EMS Upgrades & Expansion				1,443	\$1,520	\$1,217	\$2,738
Building Weatherization	Maharata			1,743	\$1,835	ontonen or	\$1,835
Pipe & Fitting Insulation				2,422	\$2,551		\$2,551
Steam Traps & Thermostatic Radiator Valves				2,239	\$2,358	\$531	\$2,888
Plug Load Controls			3,611		\$635		\$635
Walk-In Cooler Controls			3,904		\$687	n ann ann ann a	\$687
Steam Bollers				3,033	\$3,194	\$1,350	\$4,543
Subtotals	185.1	0	43,731	10,563	\$18,817	\$3,688	\$22,505

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C. Savings Opportunities Summary Page | 7



Energy Savings Measures	Guaranteed Electric (KW) Savings	Guarantee Electric (RVA) Savings	Guaranteed Electric (kWh) Savings	Guaranteed Natural Gas (CCF) Savings	Total Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Total Anticipated Annual Cost Savings
	and the second s	ज्ञामहासी इलेक्ट्र	School				
Interior Lighting Improvements & Controls	224.5	100000000000000000000000000000000000000	27,476	-284	\$6,602	\$574	\$7,176
Building Weatherization			230	292	\$346		\$346
Plug Load Controls			2,915		\$434	P WHILE	\$434
Subtotals	224.5	0	30,621	σ.	\$7,382	\$574	\$7,956
		Hopevilles	Sehool				
Interior Lighting Improvements & Controls	169,3		24,349	-285	\$3,921	\$281	\$4,203
Exterior Lighting Improvements	Marine Park Service		12,093		\$2,127	\$312	\$2,440
EMS Upgrades & Expansion				1,786	\$2,259	\$1,186	\$3,445
Building Weatherization				2,812	\$3,558		\$3,558
Pipe & Fitting Insulation				1,956	\$2,475		\$2,475
Steam Traps & Thermostatic Radiator Valves				3,367	\$4,259	\$531	\$4,790
Plug Load Controls			3,617		\$636		\$636
Subtotals	169,3	0	40,059	969'6	\$19,235	\$2,311	\$21,546
		Kerrnedy Sohoo	Selibool				
Interior Lighting Improvements & Controls		563.7	98,128	-1,110	\$20,546	\$662	\$21,208
Exterior Lighting Improvements			30,861		\$3,863	\$282	\$4,146
Air Handling Unit Damper Refurbishments			11,041	Personal de la companya de la compa	\$1,382	PPA a minter ETM deletion	\$1,382
EMS Upgrades & Expansion			60,350	9,271	\$16,115	\$13,276	\$29,391
Building Weatherization		,	339	2,219	\$2,091		\$2,091
Pipe & Fitting Insulation				8,106	\$7,485		\$7,485
Steam Traps & Thermostatic Radiator Valves				13,897	\$12,831	\$531	\$13,362
Plug Load Controls			13,234		\$1,657		\$1,657



Energy Savings Measures	Guaranteed Electric (KW) Savings	Cuarantee Electric (kVA) Savings	Guaranteed Electric (KWh) Savings	Suaranteed Natural Gas (CCF) Savings	Anticipated Energy Costs Savings	Anticipated O&M Costs Savings	Anticipated Annual Cost Savings
Hot Water Boilers & Pool Heating Systems				18,452	\$17,036		\$17,036
Subtotals	0	563.7	213,953	50,835	\$83,007	\$14,751	\$97,758
		Kingsbury School	Seltoti				
Interior Lighting Improvements & Controls	105,7		13,879	-159	\$2,246	\$200	\$2,446
Exterior Lighting Improvements			5,957		\$1,048	\$81	\$1,129
EMS Upgrades & Expansion				1,971	\$2,426	\$730	\$3,156
Building Weatherization	-			1,138	\$1,401		\$1,401
Pipe & Fitting Insulation				2,266	\$2,790		\$2,790
Steam Traps & Thermostatic Radiator Valves				2,773	\$3,415	\$531	\$3,945
Plug Load Controls			2,903		\$511	The state of the s	\$511
Subtotals	105.7	0	22,739	7,989	\$13,835	\$1,542	\$15,377
		Maloney Schoo	school				
Interior Lighting Improvements & Controls	or name and a second	268.1	33,852	-349	\$8,318	\$450	\$8,768
Exterior Lighting Improvements			41,540		\$5,200	\$694	\$5,894
Building Weatherization			220	606	\$949		\$949
Walk-in Cooler Controls			10,898		\$1,364	general verificati	\$1,364
Subtotals	0	268.1	86,860	260	\$15,831	\$1,143	\$16,974
		Police Headque	illarters				
Interior Lighting Improvements & Controls	211.2		71,918	-731	\$12,593	\$793	\$13,386
Exterior Lighting Improvements	41.6		45,859		\$7,442	\$312	\$7,755
Building Weatherization			1,105	1,552	\$2,090	The salver and	\$2,090
Pipe & Fitting Insulation				2,544	\$3,152		\$3,152
Solar Photovoltaics	***************************************		48,089	- VII	\$7,259	\$2,648	206'6\$



Energy Savings Measures	Guaranteed Electric (kW) Savings	Guarantee Electric (kVA) Savings	Guaranteed Electric (kWh) Savings	Guaranteed Natural Gas (CCF) Savings	Total Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Total Anticipated Annual Cost Savings
Subtotals	252.8	0	166,971	3,365	\$32,537	\$3,660	\$36,197
		Reed School	Hicol				
Interior Lighting Improvements & Controls	153.1		22,346	-237	\$4,681	\$284	\$4,965
Exterior Lighting Improvements			407		\$61	\$15	\$76
Building Weatherization				1,648	\$3,935		\$3,935
Pipe & Fitting Insulation				570	\$1,361		\$1,361
Plug Load Controls			7,278	Plantage of the Argentine for the Control of the Co	\$1,085	And the state of t	\$1,085
Subtotals	153.1	0	30,031	1,981	\$11,122	\$299	\$11,422
		Regan Schoo	eltool				
Interior Lighting Improvements & Controls	120.8		16,088	-189	\$3,985	\$233	\$4,219
Exterior Lighting Improvements			18,466		\$1,926	\$251	\$2,178
EMS Upgrades & Expansion	Annana a a a anan			1,071	\$1,224	\$730	\$1,954
Building Weatherization				494	\$564		\$564
Plug Load Controls			3,538	-	\$369	-	\$369
Subtotals	120.8	0	38,092	1,376	\$8,068	\$1,214	\$9,283
		Rotella Schoo	ishool			100	
Interior Lighting Improvements & Controls		202.7	24,910	-254	\$6,212	\$322	\$6,535
Exterior Lighting Improvements			56,191		\$7,034	\$1,160	\$8,195
Building Weatherization			422	535	\$568		\$568
Plug Load Controls	**************************************		7,475		\$936		\$936
Walk-In Cooler Controls			7,670		\$960		\$960
Subtotals	0	202.7	96,668	281	\$15,710	\$1,483	\$17,193

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Energy Savings Measures	Guaranteed Electric (KW) Savings	Guarantee Electric (kVA) Savings	Guaranteed Electric (kWh) Savings	Guaranteed Natural Gas (CCF) Savings	Total Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Total Anticipated Annual Cost Savings
Interior Lighting Improvements & Controls	773	Alama inclination and	77.100	OEC	122.64	4100	40000
	The second section of the second section of the second section	Control (process of process) and the second of the second	771 ¹ 17		100,54	0010	V40,04
Building Weatherization			5,460	1.348	\$2,075 \$2,075	0 54	\$2.075
Pipe & Fitting Insulation				585	\$845		\$845
Subtotals	72.3	0	30,899	1,674	\$7,150	\$224	\$7,375
		Sprague Schoo	Selfool				
Interior Lighting Improvements & Controls	121,5		16,493	-191	\$2,710	\$233	\$2,943
Exterior Lighting Improvements			11,927		\$2,098	\$265	\$2,364
EMS Upgrades & Expansion	-			3,629	\$3,639	\$2,255	\$5,894
Building Weatherization		The manufacture of the second parameters of th		492	\$494		\$494
Pipe & Fitting Insulation				2,392	\$2,399	The state of the s	\$2,399
Steam Traps & Thermostatic Radiator Valves				6,460	\$6,478	\$531	\$7,008
Plug Load Controls	- A STATE OF THE PARTY OF THE P		5,820		\$1,024		\$1,024
Walk-In Cooler Controls			2,494		\$439		\$439
Steam Boilers	nga chu d a mili iliannaga	-	-	4,582	\$4,595	\$1,350	\$5,944
Subtotals	121.5	0	36,734	17,364	\$23,877	\$4,633	\$28,510
		Tinker Sehoo	ehool				
Interior Lighting Improvements & Controls	136.8		19,593	-229	\$3,137	\$213	\$3,350
Exterior Lighting Improvements	***************************************		3,916		\$689	\$142	\$831
EMS Upgrades & Expansion				1,244	\$1,679	\$730	\$2,409
Building Weatherization	Modernia 15A document			1,639	\$2,212	No disease lang sees	\$2,212
Pipe & Fitting Insulation				1,927	\$2,600		\$2,600

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Energy Savings Measures	Guaranteed Electric (kW) Savings	Guarantee Electric (kVA) Savings	Guaranteed Electric (KWh) Savings	Guaranteed Natural Gas (GCF) Savings	lotal Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Anticipated Amual Cost Savings
Steam Traps & Thermostatic Radiator Valves				5,542	\$7,479	\$531	\$8,009
Plug Load Controls			2,460	Amendment of the second of the	\$433	Annual Section 1997 (1997) (1997) (1997)	\$433
Subtotals	136.8	0	25,969	10,123	\$18,229	\$1,616	\$19,845
		Walsh Schoo	iehool				
Interior Lighting Improvements & Controls	145.2		19,425	-226	\$3,154	\$291	\$3,446
Exterior Lighting Improvements			10,613		\$1,867	\$152	\$2,020
EMS Upgrades & Expansion	·			1,380	\$1,595	\$730	\$2,325
Building Weatherization				442	\$511	<i>*</i>	\$511
Pipe & Fitting Insulation			-	3,460	\$4,000	900 MW	\$4,000
Steam Traps & Thermostatic Radiator Valves				1,565	\$1,809	\$531	\$2,340
Plug Load Controls			6,352		\$1,117	- TOTAL AND	\$1,117
Walk-In Cooler Controls			2,934		\$516		\$516
Subtotals	145.2	0	39,324	6,621	\$14,570	\$1,704	\$16,274
		Washington School	n School				
Interior Lighting Improvements & Controls	71.3		8,441	86-	\$1,368	\$136	\$1,504
Exterior Lighting Improvements			8,874		\$1,561	\$228	\$1,789
EMS Upgrades & Expansion	-			1,571	\$1,869	\$2,544	\$4,413
Building Weatherization				522	\$621		\$621
Plug Load Controls			3,078		\$541		\$541
Subtotals	71.3	0	20,393	1,995	\$5,960	\$2,908	\$8,868
	M	aterbury Ants	Waterbury, Arts Magnet School				in Till
Interior Lighting Improvements & Controls		794.8	163,917	-1,727	\$32,310	\$1,831	\$34,141
Exterior Lighting Improvements	NEWS STATES OF THE STATES OF T		12,382		\$1,550	\$374	\$1,925

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Energy Savings Measures	Guaranteed Electric (kW) Savings	Guarantee Electric (kVA) Savings	Guaranteed Electric (kWh) Savings	Guaranteed Natural Gas (CCF) Savings	Total Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Total Anticipated Annual Cost Savings
EMS Upgrades & Expansion			405,434	1,901	\$52,189		\$52,189
Plug Load Controls	Transcent of the September of the Septem		11,215		\$1,404		\$1,404
Walk-In Cooler Controls			16,336		\$2,045		\$2,045
Subtotals	0	794.8	609,284	174	\$89,498	\$2,206	\$91,703
	Visit in the second second	Waterbury Career Academy	eer Academy				
Interior Lighting Improvements & Controls		168.8	32,346	-340	\$6,358	\$352	\$6,710
Exterior Lighting Improvements			1,069		\$134	25	\$141
Building Weatherization			1,174	1,615	\$2,395		\$2,395
Plug Load Controls			10,544		\$1,320		\$1,320
Subtotals	0	168.8	45,133	1,275	\$10,206	\$359	\$10,566
		Wandell Cross School	ss Scheol				
Interior Lighting Improvements & Controls	87.9		10,985	-127	\$1,787	\$158	\$1,945
Exterior Lighting Improvements			12,663		\$2,227	\$266	\$2,493
EMS Upgrades & Expansion				2,057	\$2,358	\$730	\$3,087
Pipe & Fitting Insulation				1,618	\$1,854		\$1,854
Steam Traps & Thermostatic Radiator Valves	assessed as a			3,293	\$3,774		\$3,774
Plug Load Controls			3,151		\$554		\$554
Subtotals	87.9	0	26,799	6,841	\$12,553	\$1,154	\$13,708
		West Side School	School				
Interior Lighting Improvements & Controls		692.1	105,904	-1,106	\$23,577	\$98\$	\$24,445
Exterior Lighting Improvements			38,921		\$4,872	\$417	\$5,289
Air Handling Unit Damper Refurbishments		149.2	34,143	·	\$6,731	-	\$6,731
EMS Upgrades & Expansion			439,139	14,136	\$68,818	\$30,145	\$98,963

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Energy Savings Measures	Guaranteed Electric (KW) Savings	Guarantee Electric (kVA) Savings	Guaranteed Electric (KWh) Savings	Guaranteed Natural Gas (CCF) Savings	Total Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Otal Anticipated Annual Cost Savings
Pipe & Fitting Insulation	MANAGEM PARTY			4,942	\$4,841	rivi Bellino I submi	\$4,841
Steam Traps & Thermostatic Radiator Valves	egentation of the second of th	The Company of the Co	Anne Control of Comment of Anne and Ann	2,147	\$2,103	The second of th	\$2,103
Plug Load Controls	·		6,054		\$758		\$758
Walk-in Cooler Controls			11,781		\$1,475		\$1,475
Hot Water Boilers & Pool Heating Systems	-			12,099	\$11,850	\$16,590	\$28,440
Subtotals	0	841.3	635,942	32,218	\$125,023	\$48,021	\$173,044
		Wilby-North End Complex	ndleomplex				
Interior Lighting Improvements & Controls		1,469,30	225,677	-2,331	\$50,048	\$1,665	\$51,713
Exterior Lighting Improvements			56,866		\$7,119	\$799	\$7,918
Air Handling Unit Damper Refurbishments		223.9	60,941		\$11,270		\$11,270
EMS Upgrades & Expansion			704,417	20,967	\$133,989	\$13,276	\$147,265
Building Weatherization			2,629	4,403	\$4,286		\$4,286
Pipe & Fitting Insulation			- Station de Salaria	9,362	\$8,415	**************************************	\$8,415
Steam Traps & Thermostatic Radiator Valves				1,698	\$1,526		\$1,526
Plug Load Controls			16,358		\$2,048		\$2,048
Walk-in Cooler Controls			12,558		\$1,572	and the second s	\$1,572
Hot Water Boilers & Pool Heating Systems	A MARION INCOME.	-		38,176	\$34,312		\$34,312
Subtotals	0	1693.2	1,079,446	102,275	\$254,585	\$15,740	\$270,325
		Wilson School	ehool				
Interior Lighting Improvements & Controls	160.4		20,414	-239	\$3,360	\$307	\$3,667
Exterior Lighting Improvements	-		7,757	Palamenta tuonine	\$1,364	\$85	\$1,453
EMS Upgrades & Expansion				2,206	\$2,125	\$730	\$2,855
Building Weatherization	merandos de Por-			1,010	\$973		\$973

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C. Savings Opportunities Summary Page | 14



Energy Savings Measures	Guaranteed Electric (kW) Savings	Guarantee Electric (kVA) Savings	Guaranteed Electric (kWh) Savings	Guaranteed Natural Gas (CCF) Savings	Total Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Total Anticipated Annual Cost Savings
Steam Traps & Thermostatic Radiator Valves				6,674	\$6,429	\$531	\$6,960
Plug Load Controls			3,954		\$69\$		\$69\$
Walk-in Cooler Controls			3,470		\$610		\$610
Steam Boilers				5,490	\$5,288	\$1,350	\$6,638
Subtotals	160.4	0	35,595	15,141	\$20,845	\$3,006	\$23,851
		Buckingham Parking Garage	rking Garage				
Exterior Lighting Improvements	202.8		163,181		\$21,256		\$21,256
Subtotals	202.8	0	163,181	0	\$21,256		\$21,256
		Secoli Parki	Parking Garage				
Exterior Lighting Improvements	176.8		139,468		\$18,239	AND THE RESIDENCE OF THE PROPERTY OF THE PROPE	\$18,239
Subtotals	176.8	0	139,468	o	\$18,239		\$18,239
Total	4,144	6,7770	5,835,970	551,022	\$1,448,443	\$22,03.257	\$1,677,7700

C. Savings Opportunities Summary Page | 15



The anticipated O&M cost savings were determined based on our review of the City's outsourced repair costs and other material expenses for during the construction period, however, they are escalated 3.0% per year to account for the two year construction period and the expected equipment being replaced within this project. The following table summarizes the sources for these savings. These savings are not included increase in service costs during that time. These savings start in Year 1 of the performance period.

Table C-4: Review of City's Outsourced Repair Costs

<u>. m</u>	Energy Savings Measures	O&M Savings (\$)	Source
_	Interior Lighting Improvements & Controls	8 8 6 8	I nese yearly savings are a result of the reduction of material costs for replacement lamps over the contract term when converting from fluorescent to LED.
7	Exterior Lighting Improvements	\$9,113	These savings are a result of the reduction of material costs for replacement lamps and ballasts over the contract term when converting from fluorescent to LED.
m	Variable Speed Chillers & Pumps	\$21,794	The following expenses were provided by the City represent a typical year costs basis to estimate yearly savings associated with the Crosby chillers replacement:
		V. V	• On February 28, 2014, an expense of \$4,091 was paid to Trane for the replacement of mineral oil for both chillers at Crosby.
			• On February 28, 2014, an expense of \$1,966 was paid to Trane for the replacement of an oil pressure transducer on chiller #1 at Crosby.
			• On May 15, 2014, an expense of \$1,128 was paid to Trane for (9.5) hours of labor of troubleshooting the chillers at Crosby.
			• On May 21, 2014, an expense of \$2,252 was paid to Trane for (7) hours of labor on the chillers at Crosby.
			• On August 4, 2014, an expense of \$2,471 was paid to Industrial Pump & Valve for repair of a condenser water pump at Crosby.
· · · · · · · · · · · · · · · · · · ·			• On August 4, 2014, an expense of \$2,490 was paid to Industrial Pump & Valve for repair of a condenser water pump at Crosby.
water and the second			• During FY14, '15, and '16, the City paid an average of \$24,582 yearly for service agreements with Trane to maintain (8) chillers throughout the City. The Crosby chillers represent 25% of this contract, for a total 0 &M savings associated with the Trane service agreement of \$6,146.
4	Air Handling Unit	0\$	None.
	Damper		
	Refurbishments		



Source	These estimated savings are a result of the reduction of material costs for the repair and replacement of pneumatic thermostats, pneumatic actuators, steam valves, and chilled water valves, which will be replaced at Crosby, Wilby, West Side, and Kennedy schools as part of the EMS scope of work. Additional O&M savings from a reduction of the existing Service Agreements is included, as well as, other EMS time and material repair costs.	None	None	These estimated savings are a result of the reduction of material costs for the repair and replacement of pneumatic thermostats, pneumatic actuators, and steam valves, which will be replaced with new Thermostatic Radiator Valves at Barnard, Buck's Hill, Bunker Hill, Chase, Crosby, Driggs, Generali, Hopeville, Kennedy, Sprague, Tinker, Walsh, Wendell Cross, West Side, Wilby, Wilson, and Chase Building.	None	None	The following expenses were provided by the City, which account for the savings: On October 29, 2014, an expense of \$7,621 was paid to All State Boiler for boiler parts. On June 9, 2015, an expense of \$1,750 was paid to MJ Fahy for boiler work at Chase Building. On October 8, 2015, an expense of \$26,950 was paid to MJ Fahy for boiler repair work at Chase Building.	The following expenses were provided by the City, which account for the savings: • On February 10, 2015, an expense of \$18,900 was paid to CT Boiler Repair for repairs to boiler #3 at Crosby. • On March 31, 2015, an expense of \$1,458 was paid to CT Boiler Repair for repairs to boiler #1 at Crosby. • On October 31, 2015, an expense of \$9,650 was paid to Shoreline Boiler to repairs to boiler #1 at Crosby. • On December 1, 2015, an expense of \$3,230 was paid to Shoreline Boiler to repair (6) lower nipples on the boiler #2 at West Side. • On December 1, 2015, an expense of \$2,740 was paid to Shoreline Boiler to repair (8) lower nipples on the boiler #3 at West Side.
OKM Savings (\$)	\$88,270	Ö S	O \$4	\$10,072	\$0	0	\$38,536	\$38,168
Energy Savings Measures	Energy Management System Upgrades & Expansion	Building Weatherization	Pipe & Fitting Insulation	Steam Traps & Thermostatic Radiator Valves	Plug Load Controls	Walk-In Cooler Controls	Steam Boilers	Hot Water Boilers & Pool Heating Systems
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Source			
	None	None	
O&M Savings (\$)	\$0	\$0	\$221,771
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Energy Savings Measures	13 Solar Photovolaics	14 New Electric Switchgear & Backup Power Generation	
Energ	13 S.	4 Z Q Q	



2. Detailed Description of Each Recommended ESM

Please see the following tabbed sections for detailed descriptions of the 14 energy savings measures recommended for this project. We also include the following information in the appendices:

- Appendix 1: Savings Calculations
- Appendix 2: 35% Drawings
- Appendix 3: Equipment Cutsheets
- Appendix 4: Audit Data



ESM 1:INTERIOR LIGHTING IMPROVEMENTS & CONTROLS



ESM 1: Interior Lighting Improvements & Controls

Benefits: This measure will reduce the amount of energy used to illuminate the interior of the buildings. In addition to energy savings, the interior lighting improvements will require less-frequent lamp replacement than the equipment they are replacing, and the high-efficiency lamp replacement costs are subsidized by the electric utility. Our lighting solution consists primarily of high-efficiency light-emitting diode (LED) linear lamps that have a rapid payback. NORESCO will also upgrade the City's lighting controls in some of the schools, through the addition of occupancy-based controls, which will reduce energy consumption by shutting off lighting during periods of inactivity. This ESM is a major savings driver that helps fund other needed infrastructure improvements in Waterbury's buildings. This lighting system is proven reliable and can be easily maintained by the City's in-house electrical department.

Buildings: Barnard Adult Education Bucks Hill School

Bunker Hill School Carrington School

Chase Building Chase School

City Hall Crosby-Wallace Complex

Department of Public Health Driggs School

Duggan School Enlightenment School

Generali School Gilmartin School

Hopeville School Kennedy High School

Kingsbury School Maloney School

Police Headquarters Reed School

Regan School Rotella School

Silas Bronson Library Sprague School

Tinker School Walsh School

Washington School Waterbury Arts Magnet School

Waterbury Career Academy School Wendell Cross School

West Side School Wilby-North End Complex

Wilson School

Summary: NORESCO will optimize the existing lighting systems by upgrading the existing T8 lighting with linear TLED lamps. NORESCO will achieve this by retrofitting existing 32-watt 4-ft and U-tube fluorescent luminaries with high-efficiency, 12.5- and 16.5-watt, TLED lamps compatible with existing electronic ballasts; retrofitting existing 2-ft and 3-ft fluorescent luminaries with high-efficiency, 8- and 10.5-watt, TLED lamps compatible with existing electronic ballasts; replacing



incandescent lighting with new high-efficiency LED lamps or luminaries; and replacing high intensity discharge (HID) luminaries with new high-efficiency LED luminaries. NORESCO will also install wireless ceiling-mounted sensors in selected classroom and corner-mounted sensors in selected hallways in nine Waterbury schools.

Implementation Cost: \$2,099,731

Energy Cost Savings: \$344,408

Annual Energy Reduction: 3,723 kW · 5,769 kVA · 1,632,263 kWh · (17,522) CCF

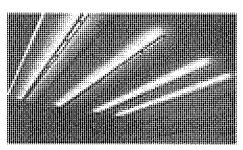
M&V Protocol: Option A

INTERIOR LIGHTING IMPROVEMENTS

Detailed Description

Existing Description

The existing interior lighting systems at the Waterbury schools and City buildings are lit primarily by linear 4-ft 32-watt standard efficiency "800 series" T8 fluorescent lamps with electronic instant start ballasts. Throughout the hallways, restrooms and offices there are also luminaries that use 2-ft, 3-ft, and U-tube T8 fluorescent lamps with electronic instant start ballasts. The primary lighting system in most of the school gymnasiums is comprised of newly



Direct/indirect lighting at the Reed Elementary School will be retrofitted with linear TLED lamps to provide the 310° light output needed for this lighting design.

installed 4- and 6-lamp T5HO high-bay luminaries, while a few remaining schools have gymnasium lighting consist of 3- and 4-lamp T8 luminaries. The lighting in the gymnasium at Gilmartin consists of high wattage compact fluorescent high-bay luminaries. Lighting in most all of the school gymnasiums is controlled by luminaire-mounted occupancy sensors. There are, however, eight schools that currently have manual lighting controls for the gymnasium lighting: Bunker Hill, Carrington, Duggan, Gilmartin, Hopeville, Maloney, Reed, Walsh, and Wilson. Most classrooms, offices, and many hallways are equipped with occupancy sensors at the schools and in offices within the City buildings. However, many classrooms, offices, hallways, and cafeterias use manual controls, and these locations could benefit from occupancy sensors. More detail about the existing use of and NORESCO's recommendation for occupancy sensors within each facility can be found in the Lighting Controls section below.

Incandescent luminaries were observed in several of the schools and City office buildings. Within classrooms, offices, libraries, and hallways these luminaries included recessed down-light luminaries, vanity and flood luminaires. In restrooms, mechanical/electrical and janitorial closets, there are surface mounted drums. Table 1 lists the existing lighting systems at each Waterbury facility.



Table 1: Summary of Existing Interior Lighting Systems at Each Facility

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Stylle Stylle	and Electroni Ballast 2. Fluorescen Fixture with FO1778 Lam and Electroni Ballast and	2' Fluorescen Fixture with FT21T5 Lanit and Electronia Fixture with FT40T5 Lam and Electronia	3' Fluorescen Fixture with Fiz5T8 Lamps and Electroni Ballast Fixture with Fixture with Fixture with Magnetic Magnetic	3' Fluoresca Fixture with F30T12/25 Lamps and Energy- Efficient Magnetic Ballast
蓋	and Balk For Balk	2' Fluor FTZ1T5 And Ele 2' Fluor Fixture FT40T9 and Ele	3 Fluor Fixture F2578 L Ballast 3 Fluor Fixture F30712 and Sta Magnet	3. Fluor Fixture F30712 Lamps Energy Efficien Magnet Ballast

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ESM 1: Interior Lighting Improvements & Controls Page | 4

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ESM 1: Interior Lighting Improvements & Controls Page | 5



Existing Fixture Types	4' Fluorescent Fixture with FP28T5 Lamps and Electronic Ballast	4' Fluorescent Fixture with FP2815 Lamps and Electronic Ballast and Battery Backup 4' Fluorescent	Fixture with FP54T5 HO Lamps and Electronic Ballast	4' Fluorescent Fixture with FT40T5 Lamps and Electronic Ballast	4' Fluorescent Fixture with FT40T5 Lamps and Electronic Ballast and Battery Backup	6' Fluorescent Fixture with F72T8 Lamp and Electronic Ballast	8' Fluorescent Fixture with F32T8 Lamps
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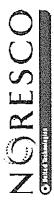
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ESM 1: Interior Lighting Improvements & Controls Page | 6



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Existing Fixture Types Types Incandescent Lamp	incandescent Fixture with High-wattage Screw-in Compact Fluorescent Lamp Incandescent Incandescent Quartz Fixture with 500w Quartz Lamp	Metal Halide Downlight Fixture Metal Halide Flood Fixture	Metal Halide Pole Fixture Metal Halide Wall Mounted Fixture	No existing fixture Uplight/Downli ght Flucrescent with F3ZT8 Lamps and Electronic Ballast	Uplight/Downll ght Fluorescent with FP28T5 Lamps and
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Recommended Improvements

NORESCO has taken a comprehensive approach to improving the lighting system performance and energy efficiency at each school and City office building. This ESM identified by NORESCO will maximize the overall electric savings and maintain the design intent of the existing equipment.

Interior Lighting

Maintenance on aging lighting systems compounded by new regulations for the proper recycling/disposal of fluorescent and HID lamps and ballasts is a problem for almost every facility. Federal regulations have compelled manufacturers to develop new products with higher lumens per watt and lower mercury content. These advancements in lighting technologies provide new opportunities for achieving significant cost saving advantages over the existing T8 systems and an even greater savings on T12 systems.

NORESCO will use a combination of relamping, retrofitting, and/or replacing of existing luminaries with a combination of energy-efficient TLED lamps, LED retrofit kits, and new LED luminaries.

Existing fluorescent luminaries with 2-ft, 3-ft, 4-ft, and Utube T8 lamps will be relamped with low wattage energy saving 8-, 10.5-, 12.5, and 16.5-watt TLED lamps and the existing electronic ballasts will be reused. The existing

TLED lamps will be installed in luminaires throughout the City of Waterbury's facilities.

electronic ballasts will be able to power the TLED lamps throughout each site. NORESCO verified this by inspecting the ballasts in numerous luminaries in each school and office building, along with interviewing Tony Cicchiello, City Electrical Foreman, and Angelo, City Electrician, during our IGEA process. For further testing of the TLED lamps on existing ballast, NORESCO provided several cases of TLED lamps to the electrical department, who installed the lamps in various luminaries throughout many of the schools and City buildings to observe how the lamps performed. At last report, TLED lamps are functioning as designed on existing ballasts.

There are also T8 fluorescent luminaries in various locations throughout the schools and City buildings that utilize battery ballasts for emergency egress lighting. We installed TLED lamps in some of these fixtures to see if the existing battery ballast would power up the lamps in the event power was lost, and we established that the lamp/ballast combination worked properly. NORESCO was not able to test/sample all luminaires that utilized battery ballasts; therefore, NORESCO will provide an additional eighty (80) fluorescent battery ballasts as shelf stock with the understanding that if any existing battery ballasts fail to power up the new TLED lamp(s), ballasts from this shelf stock will be used to replace them; the City's in-house electrical department will replace the battery ballast with a new one.

Some buildings contain linear fluorescent fixtures with battery back-up ballasts. Depending on the age, manufacturer and condition of the existing ballasts, some may not be operational now, or may not operate properly with the new TLED lamps. An allowance to replace up to twenty (20) battery backup ballasts has been included in the project scope to address these existing conditions.



Existing fluorescent luminaires containing linear T12 lamps and magnetic ballast will be retrofit by removing existing lamps and ballasts, from the luminaire, and new electronic ballasts and TLED lamps will be installed. Areas such as gymnasiums, hallways, cafeterias, and libraries at some of the schools that use newly installed T5 lamps and electronic ballasts are not recommended to be retrofit.

There are a mix of incandescent, compact fluorescent, and HID recessed down-lights throughout hallways, offices, classrooms, and libraries in some of the facilities. All down-light luminaries containing HID lamps will be retrofit with LED recessed down-lights kits. The existing HID lamp, reflector, retention clips and yoke will be removed, and new LED driver and retrofit housing will be installed, secured, and wired to the existing J-box and trim.

Incandescent luminaries will be relamped with low wattage LED screw-in lamps, and new LED drum fixtures will replace existing incandescent drums. All luminaries will be of similar style to the existing to maintain the building architectural details. Existing CFL luminaries that already contain low wattage lamps are not recommended to be retrofit.

Scope of Work

Table 2 summarizes the retrofits to the interior lighting systems for the City of Waterbury.

Table 2: Interior Retrofit Types and Quantities

Lighting Improvements	Total Fixture Counts	New Fixture Counts	Lamp Counts
New 2' Wrap Fixture with 2' 8.5w LED T8 Linear Lamps and Elec. Normal-Power High Efficiency Ballast	35	35	70
New 4' LED High Bay with 113w LED Module and Dimming Driver, and Occupancy Sensor	30	30	LED Module
New 4' Wrap Fixture with 12w LED T8 Linear Lamps and Elec. Normal-Power High Efficiency Ballast	2	2	8
New Drum Fixture with LED Module and Driver	72	72	LED Module
Fixtures with 2' T8 Fluorescent Lamps, Relamp with 2' 8.5w LED T8 Linear Lamps, Reuse Existing Electronic Ballast	2,033	0	4,149
Fixtures with 3' T8 Fluorescent Lamps, Relamp with 3' 10.5w LED T8 Linear Lamps, Reuse Existing Electronic Ballast	163	0	248
Fixtures with 4' T8 Fluorescent Lamps, Relamp with 4' 12w LED T8 Linear Lamps, Reuse Existing Dimming Electronic Ballasts	165	0	990
Fixtures with 4' T8 Fluorescent Lamps, Reuse Existing Electronic Ballast	26,492	0	59,810
Fixtures with 4' T8 Fluorescent lamps, Relamp with 4' 12w LED T8 Linear Lamps, Reuse, Existing Electronic Ballast and Battery Backup	94	0	388
Fixtures with Incandescent Screw-in Lamps, Relamp with LED Screw-in Lamp	1,349	0	1,349
Fixtures with U-Bend T8 Fluorescent Lamps, Relamp with U-8ent 16.5w LED T8 Lamps, Reuse Existing Electronic Ballast	386	0	738



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Fixtures with 2' T12 Fluorescent Lamps, Retrofit with 2' 8.5w LED T8 Linear Lamp, with new Elec. Normal-Power High-Efficiency Ballast	5	0	5
Fixtures with 3' T12 Fluorescent Lamps, Retrofit with 3' 10.5w LED T8 Linear Lamp, with new Elec. Normal-Power High-Efficiency Ballast	6	0	6
Fixtures with 8' T12 Fluorescent Lamps, Retrofit with 4' 12w LED T8 Linear Lamps, with new Elec. Normal-Power High Efficiency Ballast	118	0	276
Retrofit with Downlight Hard-Wire Kit with LED Module and Driver	54	0	LED Module
Retrofit with LED strips 22w and Electronic Driver	2	0	4
Remove HID Fixture in Stairwell at Maloney	7	0	1
Total	31,119	189	68,266

Table 3 on the following pages summarizes the retrofits to be implemented at each facility. A comprehensive room-by-room detailed scope of work is included in *Appendix 1: Savings Calculations*.



Table 3: Summary of Interior Lighting Systems at Each Facility

FixtureTypes	New 2' Wrap Fixture with 2' 8.5w LED T8 Linear Lamps and Elec. Normal-Power High- Efficiency Ballast	New 4' LED High Bay with 113w LED Module and Dimming Driver, and Occupancy Sensor	New 4' Wrap Fixture with 12w LED T8 Linear Lamps and Elec. Normal-Power High- Efficiency Ballast	New Drum Fixture with LED Module and Driver	Relamp with 2' 8.5w LED T8 Linear Lamps, Reuse Existing Electronic Ballast	Relamp with 3'10.5w LED T8 Linear Lamps, Reuse Existing Electronic Ballast	Relamp with 4'12w LED T8 Linear Lamps, Reuse Existing Dimming Electronic Ballasts	Relamp with 4'12w LED TB Linear Lamps, Reuse Existing Electronic
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	Relamp with 4' 12w LED T8 Linear Lamps, Reuse, Existing Electronic Ballast and Battery Backup	Relamp Existing Incandescent with LED Screw-in Lamp	Relamp with U-Bent 16.5w LED TB Lamps, Reuse Existing Electronic Ballast	Relamp with U-Bent 16.5w LED T8 Lamps, Reuse Existing Electronic Ballast and Battery Backup	Retrofit with 2' 8.5w LED T8 Linear Lamp, with New Elec. Normal- Power High-Efficiency Ballast	Retrofit with 3 10.5w LED T8 Linear Lamp, with New Elec. Normal- Power High-Efficiency Ballast Retrofit with 3 10.5w LED T8 Linear Lamps, with New Elec. Normal- Power High-Efficiency Ballast	Retroft with 4' 12w LED T8 Linear Lamps, with New Elec. Normal- Power High-Efficiency

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City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and Customer shall relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. otherwise interfere with the ESM implementation and installation process.

Hazardous Materials Abatement Allowance

warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this additional work through execution of a change order or remitted to the City.



Interface with Existing Systems & Operations

The majority of work performed under this ESM will be completed after normal business hours. The impact on building occupants should be nominal. NORESCO will coordinate all work with facility personnel to minimize the impact on the all occupants.

Maintenance Procedures

The project maintenance costs will be lowered by reducing the quantities of lamps and luminaires to be maintained over the term of the contract.

Special Operating Requirements

Beyond the normal end-of-life replacements, there are no special operating requirements associated with the lighting improvement measures.

Equipment Information

Manufacturer & Type

NORESCO is vendor neutral, and we will work with any lighting manufacturers to ensure competition and best option and value for the City of Waterbury. Installed equipment will be on the Design Lights Consortium-qualified products list to expedite incentive application reviews and approvals by Eversource. The new lighting equipment will be manufactured by one or more of the companies listed below, or by a suitable alternative.

Lamps

- Phillips Lighting Company, 200 Franklin Square Drive, Somerset, NJ 08875, 908-563-3000
- Green Creative, LLC, 1200 Bayhill Drive, Suite 220, San Bruno, CA 94066, 866-774-5433
- Osram-Sylvania, Inc., 100 Endicott Street, Danvers, MA 01923, 800-544-4828
- TCP, Inc., 325 Campus Drive, Aurora, OH, 44202, 800-324-1496

Ballast

- Osram-Sylvania, Inc., 100 Endicott Street, Danvers, MA 01923, 800-544-4828
- Philips Lighting Company, 200 Franklin Square Drive, Somerset, NJ 08875, 908-563-3000
- RemPhos Technologies, LLC, 90 Holten Street, Danvers, MA 01923, 877-997-3674

Luminaires

- Lithonia, PO Box A, Conyers, GA 30012, 800-858-7764
- CREE, 4600 Silicon Drive, Durham, North Carolina 27703, 866-924-3645
- RAB, 170 Ludlow Avenue, Northvale, NJ 07647, 888-RAB-1000
- Spectrum Lighting, Inc., 994 Jefferson Street Fall River, MA 02721, 508-678-2303

Savings Calculations

A room-by-room lighting audit with the wattages and quantities of luminaries in each building is provided in *Appendix 1: Savings Calculations*. The existing luminaire types and quantities in the room-by-room lighting audit are based on observations made during the walkthroughs of each facility. During



our site visits data loggers were installed and the data from them used to help confirm the occupancy patterns and the amount of time lights are left on with the space empty. During the IGEA, NORESCO installed additional data loggers within many of the schools to log hours that lights were left on and when the rooms are occupied/unoccupied. We used the data logger analysis along with published hours of operation to help define run hours for room types throughout the facilities.

To calculate the direct lighting savings, luminaries have been grouped with other luminaries sharing the same baseline Lamp, Ballast, Combination (LBC) group, post-installation LBC group, and hours of operation. For each group of LBC, energy savings during each time of use period are calculated as follows:

• $ES_{lighting} = (P_{base} \times N_{base} - P_{post} \times N_{post}) \times H_{base}$

Where:

ES_{lighting} = energy savings (kWh) for the lighting retrofits

P_{base} = electrical power (kW) per luminaire for appropriate baseline LBC group

P_{post} = electrical power (kW) per luminaire for appropriate post-installation LBC group

H_{base} = existing annual operating hours defined by luminaire's pre hours group

N_{base} = number of luminaries in representative baseline LBC group

N_{post} = number of luminaries in representative post-installation LBC group

Cost savings are determined by multiplying the energy and demand savings for each applicable LBC by the approved incremental energy costs. The results of these calculations are summed for total electric demand (kW) and energy (kWh) savings.

NORESCO determines the contribution to HVAC peak demand savings by applying a diversity factor to the gross connected lighting load (kW). The lamp ballast combination's (LBC's) hours group determines the demand diversity factor already applied to the demand savings for direct lighting. For each group of luminaires in conditioned spaces, NORESCO calculated the HVAC monthly demand savings as follows:

DScooling =
$$\frac{(DS_{lighting} + DS_{controls}) \times C_{energy} \times HC}{C_{capacity} \times EFF}$$

Where:

DS_{cooling} = energy savings (kWh) for the HVAC interaction

DS_{lighting} = energy savings (kWh) for the lighting retrofits (from conditioned spaces only)

DS_{controls} = energy savings (kWh) for the on/off controls (from conditioned spaces only)

 C_{energy} = conversion factor = 3,413 Btu/kWh

HC = heat contribution of luminaires to conditioned spaces, stipulated at 75 percent

C_{capacity} = conversion factor = 12,000 Btu/ton-hr, cooling capacity

EFF = mechanical cooling efficiency, in kW/ton

The results of these calculations are summed for total electric demand (kW) and energy (kWh) savings. Interactive heating effects are calculated using the following equation:

• HP =
$$\frac{(ES_{lighting} + ES_{controls}) \times C_{energy} \times HC}{C_{MMBtu} \times EFF \times SEA_{heating}}$$

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Where:

HP_{cooling} = heating penalty, in MMBtu, for the HVAC interaction

ES_{lighting} = energy savings (kWh) for the lighting retrofits (in conditioned spaces only) ES_{controls} = energy savings kWh) for the on/off controls (in conditioned spaces only)

 C_{energy} = conversion factor = 3,413 Btu/kWh

HC = heat contribution of luminaires to conditioned space, stipulated at 75 percent

C_{MMBtu} = conversion factor = 1,000,000 MMBtu/Btu

EFF = mechanical heating efficiency, as a percentage

SEA_{heating} = heating season, in percent of year

To determine cost savings, we multiplied the energy and demand savings of all luminaire groups (minus the heating penalty) by the approved incremental energy costs.

Design Considerations

After an analysis of the existing lighting systems and in consideration of the Illuminating Engineering Society of North America (IESNA) guidelines presented in *The Lighting Handbook, 10th Edition,* NORESCO has identified a scope of work that will generate significant energy savings and reduce maintenance costs while providing appropriate light levels. NORESCO will follow the illuminance targets recommended by IESNA as the standards of comfort for The City of Waterbury facilities. Table 4 shows a sample of those recommended targets.

Table 4: IESNA-Recommended Maintained Illuminance Targets for Education/Office Facilities (Except)

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Art	Horizontal @ 2' 6" AFF. Vertical @ 4' AFF	50 fc	30 fc
Auditorium Testing	Horizontal @ 2' 6" AFF. Vertical @ 4' AFF	30 fc	10 fc
Computer (LCD and LED Devices)	Horizontal and Vertical @ Height of Device	15 fc	5.0 fc
Home Economics	At All Food Prep and Detailed Work Areas	50 fc	20 fc
Reading/Writing (Black Ink and Pencil)	Horizontal @ 2' 6" AFF. Vertical @ 4' AFF	30 fc	7 . 5 fc
Reading/Writing (RGB lnk)	Horizontal @ 2' 6" AFF. Vertical @ 4' AFF	40 fc	7.5 fc
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CSA/ISO Types I and II	Horizontal @ 2' 6" AFF. Vertical @ 3' 6" AFF	30 fc	15 fc
CSA/ISO Type III	Horizontal @ 2' 6" AFF. Vertical @ 3' 6" AFF	15 fc	5 fc
	Enablishion Soleston		
Breakout Passageways	Horizontal @ floor. Vertical @ 4' AFF	10 fc	3 fc
Independent Passageways	Horizontal @ floor. Vertical @ 5' AFF	5 fc	3 fc
	Lookings		



Application and Tasks	Notes	Maintained Illuminance Targets		
		Horizontal	Vertical	
Day	Horizontal @ floor, Vertical @ 5' AFF	10 fc	5 fc	
Night	Horizontal @ 2′ 6″ AFF. Vertical @ 5′ AFF	5 fc	2 fc	
Information Desk	Horizontal @ floor. Vertical @ 5' AFF	30 fc	10 fc	
Luminaires	Torlers/Isocker Rooms Horizontal @ Top of Fixture. Vertical @ 3'-5' AFF	15.fc	5 fc	
General	Horizontal @ floor. Vertical @ 3'-5' AFF	5 fc	3 fc	
Vanities	Horizontal @ 3' AFF. Vertical @ 3-5' AFF	15 f∈	20 fc	
	Office Facilities			
Pencil and Pen	Reading/Writing Ballpoint/Rollerpoint/Felt Tip	30 fc	7.5 fc	
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6-pt Font	Horizontal @ 2′ 6″ AFF. Vertical @ 4′ AFF	50 fc	7.5 fc	
8- and 10-pt Font	Horizontal fc @ floor. Vertical fc @ 4' AFF	30 fc	5.0 fc	
12-pt Font	Horizontal fc @ floor. Vertical fc @ 4′ AFF	20 fc	5.0 fc	
	Lounges			
Break		10 fc	5 fc	
	Reception/Waiting			
Reception Desk	The second secon	40 fc	15 fc	
Waiting		20 fc	10 fc	
	Зиранні Зрике с			
Break Rooms/Lunch Rooms	Horizontal @ 2' 6" AFF. Vertical @ 4' AFF	10 fc	3 fc	
Copy/Print Rooms	Horizontal @ 3′ 6″ AFF. Vertical @ 3′ 6″ AFF	30 fc	10 fc	

Footnotes: fc= foot-candle; AFF = above finished floor



LIGHTING CONTROLS

Detailed Description

Existing Description

Our IGEA revealed that many of the City's schools and office buildings have existing lighting occupancy controls in classrooms, offices, hallways, and gymnasiums. However, the lighting in some of these areas within the schools operates with manual switches and not occupancy sensors. During the IGEA process, we spoke with some teachers whose classrooms have manual controls -- we were told that some of the classrooms once had occupancy sensors but that the sensor stopped working at some point and a manual switch was installed. Classrooms, hallways, and offices that do not have lighting controls are excellent candidates for the installation of additional lighting controls.

Recommended Improvements

NORESCO will install occupancy sensors in classrooms and corridors at Sprague, Bucks Hill, Regan, Kingsbury, Driggs, Wilson, Chase, Walsh and Bunker Hill schools. These schools currently have occupancy sensors in most of the classrooms and corridors, but, during the IGEA, we found some areas that do not. We will install wireless ceiling-mounted occupancy sensors in selected classroom and corner-mounted occupancy sensors in selected hallways. Lighting controls save energy based on activity in the lighted space, so we will install occupancy sensors in select areas to automatically shut off lights where occupancy is infrequent yet lights are typically left on.

Scope of Work

Table 5 shows the quantities of lighting controls that NORESCO will install in the selected schools. A comprehensive room-by-room detailed scope of work is included in *Appendix 1: Savings Calculations*.

Table 5: Quantity of Lighting Controls to Be Installed

Building	Lighting Controls	Oty
Sprague School	Corner-Mounted Hall Wireless Occupancy Sensor and Power Packs	22
Direct Hill Calcast	Ceiling-Mounted Wireless Occupancy Sensors and Power Packs	12
Bucks Hill School	Corner-Mounted Hall Wireless Occupancy Sensor and Power Packs	21
D	Ceiling-Mounted Wireless Occupancy Sensors and Power Packs	1
Regan School	Corner-Mounted Hall Wireless Occupancy Sensor and Power Packs	21
Kingsbury School	Ceiling-Mounted Wireless Occupancy Sensors and Power Packs	5
D.: C-LI	Ceiling-Mounted Wireless Occupancy Sensors and Power Packs	5
Driggs School	Wall Switch Wireless Occupancy Sensor	2
Wilson School	Corner-Mounted Hall Wireless Occupancy Sensor and Power Packs	13
Chase School	Ceiling-Mounted Wireless Occupancy Sensors and Power Packs	8
Walsh School	Corner-Mounted Hall Wireless Occupancy Sensor and Power Packs	18
Bunker Hill School	Corner-Mounted Hall Wireless Occupancy Sensor and Power Packs	6
	Total	134



Interface with Existing Systems & Operations

The majority of work performed under this ESM will be completed after normal business hours. The impact on building occupants should be nominal. NORESCO will coordinate all work with facility personnel to minimize the impact on the all occupants.

Equipment Information

Manufacture & Type

NORESCO will install lighting control equipment manufactured by one of the following manufacturers or will use equipment of similar quality.

- Lutron, 7200 Suter Road, Coopersburg, PA 18036, 888-588-7661
- Sensor Switch, 1170 Peachtree Street, NE Suite 2300, Atlanta, GA 30309, 800-922-9641

Savings Calculations

To calculate the lighting control savings, luminaires have been grouped with other luminaires sharing the same baseline LBC group, post-installation LBC group, and hours of operation. NORESCO will verify energy savings based on the actual installed quantities. For each group of luminaires, we will calculate the energy savings during each time of use period as follows:

• $ES_{controls} = \{(P_{post} \times H_{base}) - (P_{post} \times H_{post})\} \times N_{post}$

Where:

ES_{controls} = Energy savings (kWh) for the on/off controls

P_{post} = Electrical power (kW) per luminaire for appropriate post-installation LBC group

H_{base} = Baseline annual operating hours defined by luminaire's pre-hours group

H_{post} = Post-Installation annual operating hours defined by luminaire's post hours group

N_{post} = Number of fixtures in representative post-installation LBC group

For each group of fixtures in this ESM, we calculated the monthly demand savings for the lighting controls as follows:

• $DS_{controls} = P_{post} \times DF_{controls} \times N_{post}$

Where:

DS_{controls} = monthly demand savings (kW) for the lighting controls

P_{post} = electrical power (in kW) per luminaire for appropriate post LBC group

DF_{controls} = diversity factor; as a percentage

 N_{post} = number of fixtures in representative post-installation LBC group

The results of these calculations are summed for total electric demand (kW) and energy (kWh) savings. Cost savings are determined by multiplying the energy and demand savings for each applicable LBC by the approved incremental energy costs.



ESM 2:

EXTERIOR LIGHTING IMPROVEMENTS



ESM 2: Exterior Lighting Improvements

Benefits: This measure will reduce the amount of energy used to illuminate the exterior perimeter, walkways and parking lots at each facility. In addition to energy savings, the exterior lighting improvements will require less-frequent lamp replacement than the equipment they are replacing, and the high-efficiency lamp replacement costs are subsidized by the electric utility. Our lighting solution consists of high-efficiency light-emitting diode (LED) lamps and luminaries that have a rapid payback. This ESM is a major savings driver that helps fund other needed infrastructure improvements in Waterbury's buildings. This lighting system is proven reliable and can be easily maintained by the City's in-house electric department.

Buildings:	Barnard Adult Education	Bucks Hill School

Bunker Hill School Carrington School

Chase Building Chase School

Crosby-Wallace Complex Department of Public Health

Driggs School Duggan School

Generali School Hopeville School

Kennedy High School Kingsbury School

Maloney School Police Headquarters

Reed School Regan School

Rotella School Silas Bronson Library

Sprague School Tinker School

Walsh School Washington School

Waterbury Arts Magnet School Waterbury Career Academy School

Wendell Cross School West Side School

Wilby-North End Complex Wilson School

Buckingham Parking Garage Scovill Parking Garage

Summary: NORESCO will optimize the exterior lighting systems by upgrading existing High Intensity Discharge (HID) luminaries with new LED luminaries. NORESCO will achieve this by: replacing existing building-mounted and pole-mounted metal halide (MH) and High Pressure Sodium (HPS) luminaries with new high-efficiency LED luminaries. For exterior fluorescent luminaires in walkways and parking garages, NORESCO will upgrade them by retrofitting existing 32-watt 4-ft luminaries with high-efficiency, 12.5-watt, TLED lamps compatible with existing electronic ballasts.



Wall-mounted flood luminaire at Bucks Hill

Implementation Cost: \$986,752

Energy Cost Savings: \$127,455

Annual Energy Reduction: 421 kW · 881,676 kWh

M&V Protocol: Option A

Detailed Description

Existing Description

NORESCO will retrofit or replace existing exterior lighting luminaries with more energy efficient LED lighting options. Exterior lighting at the schools and City buildings consists mainly of one or a combination of the following lighting types:

- Recessed down-lights
- Surface-mounted drums
- Surface-mounted four-foot vapor tight luminaires with 32-watt T8 lamps

Elementary School will be replaced with new LED wall-mounted flood luminaire that have Surface-mounted wall packs and sconces a rated life of over 100,000 hours, which will require many fewer lamp change outs by the Building-mounted flood lights facilities department. Pole-mounted parking lot/area lighting

The exterior lighting consists of a combination of building mount and pole-mounted HID, fluorescent, and incandescent luminaires. The HID luminaires have either metal halide (MH) or high-pressure sodium (HPS) lamps and ballasts.

Most all schools have a variety of building-mounted HID wall packs and flood lights. The lamp wattages vary for these luminaires and range from 70- to 400-watts and upwards of 1,000-watt flood lights at some schools. The parking lot and area pole lighting at the schools consist of cobra head, shoebox, and post top luminaires and range from 100- to 400-watts.

The perimeter building-mounted wall packs and flood lights at the City buildings is also HID, and the lamp wattages range from 50- to upwards of 1,000-watt flood lights at some buildings. The parking lot and area pole lighting at the City buildings and parking garages consist of cobra head and shoebox luminaires and range from 100- to 400-watts.

For the metal halide light source, the white light source offers some great advantages, but there are several significant drawbacks including shorter lamp life, long warm-up period, and color shifting.

For HPS, the light sources are very efficient, offering a high lumens/watt ratio; however, they have some major drawbacks as well, including poor color rendering, golden-yellowish appearance, and long warm-up period. Table 1 details the existing exterior lighting systems within the facilities included in the scope.



The predominant lighting type throughout the three parking garages -- at Police Headquarters, Buckingham, and Scovill -- is surface-mounted 4-ft vapor tight luminaires with two or three 32-watt T8 lamps. There is also a mix of incandescent and compact fluorescent luminaires at these facilities. These luminaries ranged from recessed down-light, surface-mounted and flood luminaires. The new luminaries installed will provide benefits of:

- Reduced energy consumption by 15% to 90%, depending on the luminaire application
- Increased longevity from a range of up to 20 years
- Reduced exterior light pollution, as LED optics direct lumen output with more efficient and precise control compared to the existing conventional HID reflector systems
- Established lighting uniformity by aiming the light toward distant points within the targeted task area, boosting minimum illumination levels
- Instant on/off capability, this enables increased lighting control usage
- Reduced maintenance through longer life lamps, ballasts, and drivers than the existing luminaries



Table 1: Summary of Existing Interior Lighting Systems at Each Facility

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Existing Fixture Types	4. Fluorescent with F32T8 Lamps and Electronic Ballast 4. Fluorescent with F28T5 Lamps and Electronic Ballast	4 Fluorescent with F3278 Lamps and Electronic Ballast B Fluorescent with F3278 Lamps and Electronic Ballast	8' Fluorescent with F96T12/65w Lamps and Energy Efficient Magnetic Ballast 8' Fluorescent with F32T8 Lamps and Electronic Ballast	Compact Fluorescent Fixture or Lamp Existing LED



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Existing Fixture Types	Fixture with Screw-In Compact Fluorescent Lamp High Pressure Sodium Canopy Fixture	High Pressure Sodium Fixture High Pressure Sodium Flood Fixture	High Pressure Sodium Pole Fixture High Pressure Sodium Post Top Fixture	High Pressure Sodium Wall Pack Fixture Incandescent Fixture or Lamp	Metal Halide Bollard Fixture Metal Halide Canopy Fixture	Metal Halide Downlight Fixture Metal Halide Fixture

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ECAA 2.

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ESM 2: Exterior Lighting Improvements Page | 5



Existing Fixture Types	Metal Halide Flood Fixture Metal Halide Pole Fixture	Metal Hallde Recessed Fixture Metal Hallde Wall Pack Fixture	No Existing Fixture Wall Pack with FT40T5 Lamps and Electronic Ballast and Battery Backup
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ESM 2: Exterior Lighting Improvements Page | 6



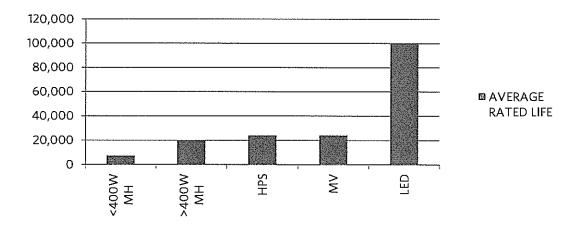
Recommended Improvements

NORESCO has taken a comprehensive approach to improving the lighting system performance and energy efficiency at each school and city office building. This ESM identified by NORESCO will maximize the overall electric savings, and maintain the design intent of the existing equipment.

Maintenance on aging lighting systems compounded by new regulations for the proper recycling/disposal of fluorescent and HID lamps and ballasts is a problem for almost every facility. Federal regulations have compelled manufacturers to develop new products with higher lumens per watt and lower mercury content. These advancements in lighting technologies provide new opportunities for achieving significant cost saving advantages over the existing HID systems.

NORESCO will replace the existing HID building-mounted wall packs, flood lights, and pole lighting at each facility with similar style luminaries that use LED technology. NORESCO will use solid state LED technology for maximum performance and energy savings. One of the largest advantages of LED technology over HID technology is the rated life of the source. Replacing the existing systems to a high-performance, LED system would result in over75% longer life compared to HID systems as shown in Figure 1.

Figure 1: Rated Life Expectancy Comparison of LED to HID Sources



LED lights are also "green" in that they use no hazardous materials. Mercury is a byproduct of a significant number of HID lighting system components and disposal of those lamps and ballasts has become a significant environmental problem. Additional benefits of LED luminaires include the following.

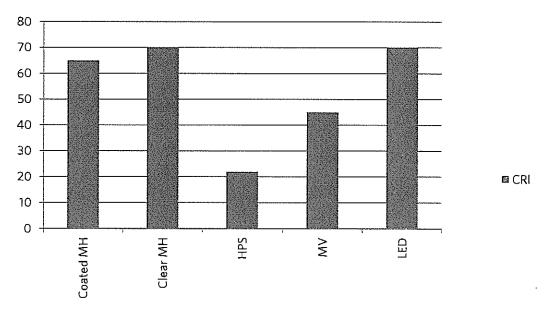
- Unlike conventional HID reflector systems, the optical system of an LED directs lumens to the target task only.
- Wasteful and neighbor-unfriendly backlight pollution is controlled through careful aiming and shielding. Costly, inconvenient, ineffective, and unsightly "house-side shield" accessories are unnecessary to provide backlight control.



- Uniformity of the lighting is significantly improved because the light is aimed toward distant points within the targeted task area, boosting minimum illumination levels. The maximum illumination levels are controlled because no LEDs are aimed straight down.
- Improved performance in cold applications.
- Instant on/off, ideal for lighting controls.
- Minimal maintenance: easy component replacement, if necessary.
- No hazardous or environmental concerns.

Another significant advantage of LED light sources is the improved color rendering, compared to other sources. The color rendering index (CRI) of a light source measures the ability of a light source to reproduce the colors of various objects faithfully in comparison with an ideal or natural light source. It is another key component in providing a safe and security environment. Color rendering describes how a light source makes the color of an object appear to human eyes and how well subtle variations in color shades are revealed. Figure 2 demonstrates the CRI values of LED compared with the other HID sources.

Figure 2: Color Rendering Index Comparison of LED to HID Sources



NORESCO will replace existing HID downlight, wall pack, and flood luminaires at each facility and install new like-kind LED luminaires. At Carrington School, we were told that the existing pole lights in the front courtyard poses a danger for many of the students, and they have requested we remove them. NORESCO has included in our scope for the removal of those luminaries. New building-mounted LED flood luminaires will be installed on the roof of the school in lieu of the pole lights. Existing parking lot and area pole luminaire heads will be replaced with like kind LED cobra, shoebox, and/or post top luminaires. Exiting poles will be reused.



Scope of Work

Table 2 summarizes the retrofits to the exterior lighting systems for the City of Waterbury.

Table 2: Exterior Retrofit Types and Quantities

Lighting Improvements	Fixture Count
Remove Existing Pole-Mounted Fixture, and Install New Building-Mounted Flood Fixtures at Carrington School in Front Courtyard	5
LED Flood Fixture with 89w LED Module and Driver, Trunion Mount, Photocell	2
New LED Surface-Mounted Canopy Fixture, with LED Module and Driver	61
New Flood Fixture with LED Module and Driver	197
New Pole-Mounted Box Fixture with LED Module and Driver	229
New Wall Pack Fixture with LED Module and Driver	236
Fixture with 4' T8 Fluorescent lamps, Relamp with 4' 12w LED T8 Linear Lamps, Reuse Existing Electronic Ballast	1,141
Fixtures with 4' T12 Fluorescent lamps, Retrofit with 4' 12w LED Linear T8 Lamps, with New Elec. Normal-Power High-Efficiency Ballast	14
Fixtures with Incandescent Screw-in Lamps, Relamp with LED Screw-in Lamp	95
Total	1,885

Table 3 summarizes the retrofits to be implemented at each facility. A comprehensive room-by-room detailed scope of work is included in *Appendix 1: Savings Calculations*.



Table 3: Summary of Interior Lighting Systems at Each Facility

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Fixture Types	LED Flood Fixture with 89w LED Module and Driver, Trunion Mount, Photocell	New LED Surface Mount Canopy Fixture, with LED Module and Driver	New Flood Fixture with LED Module and Driver	New Pole- Mounted Box Fixture with LED Module and Driver	New Wall Pack Fixture with LED Module and Driver	Relamp with 4 12w LED T8 Linear Lamps, Reuse Existing Electronic Ballast

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ESIVI Z: EXTERIOR LIB

ESM 2: Exterior Lighting Improvements Page | 10



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City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and Customer shall relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. otherwise interfere with the ESM implementation and installation process.

Hazardous Materials Abatement Allowance

The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this



warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW, NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or additional work through execution of a change order or remitted to the City.



Interface with Existing Systems & Operations

The majority of work performed under this ESM will be completed after normal business hours. The impact on building occupants should be nominal. NORESCO will coordinate all work with facility personnel to minimize the impact on the all occupants.

Maintenance Procedures

The project maintenance costs will be lowered by reducing the quantities of luminaires to be maintained over the term of the contract.

Special Operating Requirements

Beyond the normal end-of-life replacements, there are no special operating requirements associated with the lighting improvement measures.

Equipment Information

Manufacturer & Type

NORESCO is vendor neutral, and we will work with any lighting manufacturers to ensure competition and best option and value for the City of Waterbury. Installed equipment will be on the Design Lights Consortium-qualified products list to expedite incentive application reviews and approvals by Eversource. The new lighting equipment will be manufactured by one or more of the companies listed below, or by a suitable alternative.

Lamps

- Phillips Lighting Company, 200 Franklin Square Drive, Somerset, NJ 08875, 908-563-3000
- Green Creative, LLC, 1200 Bayhill Drive, Suite 220, San Bruno, CA 94066, 866-774-5433
- Osram-Sylvania, Inc., 100 Endicott Street, Danvers, MA 01923, 800-544-4828
- TCP, Inc., 325 Campus Drive, Aurora, OH, 44202, 800-324-1496

Ballast

- Osram-Sylvania, Inc., 100 Endicott Street, Danvers, MA 01923, 800-544-4828
- Philips Lighting Company, 200 Franklin Square Drive, Somerset, NJ 08875, 908-563-3000
- RemPhos Technologies, LLC, 90 Holten Street, Danvers, MA 01923, 877-997-3674
- Lithonia, PO Box A, Convers, GA 30012, 800-858-7764

Fixtures

- CREE, 4600 Silicon Drive, Durham, North Carolina 27703, 866-924-3645
- RAB, 170 Ludlow Ave, Northvale, NJ 07647, 888-RAB-1000
- Spectrum Lighting, Inc., 994 Jefferson Street Fall River, MA 02721, 508-678-2303

Savings Calculations

During the IGEA, a luminaire-by-luminaire audit was performed for the exterior lighting with the wattages and quantities of luminaries at each facility, which is provided following in the Appendix 1:



Savings Calculations. The existing luminaire types and quantities in the lighting audit are based on observations made during the walkthroughs of each facility.

To calculate the direct lighting savings, luminaries have been grouped with other luminaries sharing the same baseline Lamp, Ballast, Combination (LBC) group, post-installation LBC group, and hours of operation. For each group of LBC, energy savings during each time of use period are calculated as follows:

• $ES_{lighting} = (P_{base} \times N_{base} - P_{post} \times N_{post}) \times H_{base}$

Where:

ES_{lighting} = energy savings, in kWh, for the lighting retrofits

P_{base} = electrical power, in kW, per luminaire for appropriate baseline LBC group

P_{post} = electrical power, in kW, per luminaire for appropriate post-installation LBC group

 H_{base} = existing annual operating hours defined by luminaire's pre hours group

N_{base} = number of fixtures in representative baseline LBC group

N_{post} = number of fixtures in representative post-installation LBC group

Cost savings are determined by multiplying the energy and demand savings for each applicable LBC by the approved incremental energy costs. The results of these calculations are summed for total electric demand (kW) and energy (kWh) savings.

Table 4: Hours of Operation for Schools and City Buildings

Hours Group	Hours Des	cription Annual Hours	Hou	rs Group Hours Description	Annual Hours
COB - GAR	Garage	8,760	Χ	Exterior	4,380

Design Considerations

After an analysis of the existing lighting systems and in consideration of the IESNA guidelines presented in *The Lighting Handbook, 10th Edition*, NORESCO has identified a scope of work that will generate significant energy savings and reduce maintenance costs while providing appropriate light levels. NORESCO will follow the illuminance targets recommended by IESNA as the standards of comfort for The City of Waterbury facilities. Table 5 shows a sample of those recommended targets.

Table 5: IESNA-Recommended Maintained Illuminance Targets (Excerpt)

		Main	liained
Application and Tasks	Notes	- Illuminan	ice Targets
		Horizontal	Vertical
And the second of the second o	Parking Late		
Open Parking Spaces		3 fc	0.5 - 0.8 fc
	Public Errolistur		
General Parking & Walkways	Horizontal fc @ Floor. Vertical fc @ 5'	AFF 3 fc	0.5 - 0.8 fc

Footnotes: fc= foot-candle; AFF = above finished floor

Information an this page is proprietary and subject to confidentiality restrictions

City of Waterbury, Connecticut

ESM 2: Exterior Lighting Improvements



ESM 3:

VARIABLE SPEED CHILLERS & PUMPS



ESM 3: Variable Speed Chillers & Pumps

Benefits: This measure will replace the two aging chillers that use ozone-depleting refrigerant R-22, which is no longer manufactured, and will replace the chilled water and condenser water pumps, which are oversized. The new equipment will reduce the Crosby-Wallace Complex's electrical consumption and utility costs while improving performance, reliability, and comfort. The City of Waterbury will also benefit from reduced labor requirements, lower preventative maintenance and service costs, and reduced future equipment repair or replacement costs.

Buildings: Crosby-Wallace Complex

Summary: NORESCO will replace the two (2) existing water-cooled chillers with two (2) new 250-ton high efficiency units. The new integrated variable speed, water cooled, screw chillers will make use of the environmentally friendly refrigerant R-134A to reliably and efficiently cool the high school and middle school buildings. The existing chilled and condenser water pumps will be replaced with properly sized equipment, including premium efficiency motors, and the piping will be modified to optimize operational efficiencies. The new equipment will include new direct digital controls (DDC) that will be integrated to the newly upgraded energy management system (EMS).

Implementation Cost: \$1,205,930

Energy Cost Savings: \$43,149

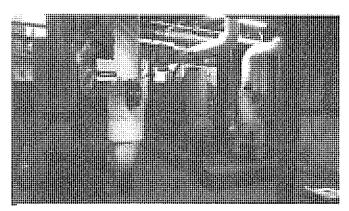
Annual Energy Reduction: 404 kVA · 116,829 kWh

M&V Protocol: Option A

Detailed Description

Existing Description

The existing chilled water system serves over twenty (20) air handling units that provide the cooling for the almost-400,000 square foot Crosby-Wallace Complex. There are also small areas of the buildings in the Complex that are air-conditioned by less efficient, stand-alone, air-cooled equipment.



Existing chillers to be replaced at Crosby-Wallace complex.

The existing chilled water system is

comprised of equipment of varying vintages, with chillers and pumps that are mis-matched in capacities. The original chilled and condenser water pumps are approximately twice the capacity they need to be, and the chillers lack variable frequency drives, contributing to equipment and operational



efficiencies that waste energy. NORESCO has confirmed with the chiller manufacturer that the existing equipment cannot be retrofitted with variable frequency drives (VFDs). The life expectancy of a water-cooled screw chiller is about 20 years. The current chillers were installed in 1999, have operated through 17 cooling seasons already, and are approaching the end of their life expectancies.

The existing screw chillers are Carrier models 23XL2O21EC60, each with a cooling capacity of 250 tons. Their rated full-load efficiency when new was 0.606 kW/ton, under standard chilled water and condenser water conditions. This capacity has degraded over the last 17 years, causing building cooling demand issues during the hottest summer days. The older chillers at the Complex also make use of the ozone-depleting refrigerant R-22, which is no longer manufactured and is strictly regulated. Not only does this pose an environmental concern, but it substantially increases the cost of service, repairs, and recharging because R-22 availability is becoming more and more limited.

Recommended Improvements

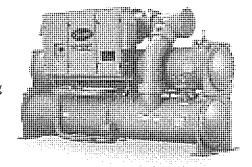
NORESCO will replace both aging water-cooled chillers with two new 250-ton variable speed chillers. The new units will operate with an efficiency of 0.404 kW/ton based on Integrated Part Load Value (IPLV). As the new chillers part-load efficiency is much higher than the existing chillers and as the chillers spend almost all of their time operating at less than full-load, substantial energy and utility cost savings will be achieved.

The new chillers will also make use of the more environmentally friendly and readily available refrigerant R-134A. The two existing chilled water pumps and two existing condenser (cooling tower) pumps will be replaced with new, properly sized units complete with premium efficiency motors. The existing chilled water and condenser water piping will be modified so the pumps can be operated independently for increased operational efficiencies. The existing VFD-equipped cooling towers will be reused, and all new equipment will have new DDC controls, including BACnet integration of the chiller manufacturer's local controls to the Complex's newly upgraded and expanded EMS.

Scope of Work

This chiller replacement at the Crosby-Wallace Complex will include the following.

- Removal of two (2) existing, 250-ton water-cooled chillers, including:
 - Reclamation of refrigerant from the existing chillers
 - Recycling and disposal of the chillers
- Removal of two (2) existing chilled water pumps, including:
 - Modifications of the chilled water supply and return piping
 - Recycling and disposal of the pumps



Carrier AquaEdge 23XRV Water-Cooled Variable-Speed Screw Chiller



- Removal of two (2) existing condenser water pumps, including:
 - Modifications of the condenser water supply and return piping
 - · Recycling and disposal of the pumps
- Installation of two (2) new 250-ton high-efficiency, variable-speed, water-cooled chillers, including:
 - Electrical connections
 - Chilled water piping connections
 - Condenser water piping connections
 - Control system connections and EMS integration
- Installation of two (2) new chilled water pumps, including:
 - Electrical connections
 - Chilled water piping connections and modifications
 - Pipe insulation
 - Control system connections and EMS integration
- Installation of two (2) new condenser (cooling tower) water pumps, including:
 - Electrical connections
 - Condenser water piping connections and modifications
 - Pipe insulation
 - Control system connections and EMS integration

Construction will be scheduled to minimize any required chilled water system outages. NORESCO will work closely with the Complex to schedule outages at times when they will not impact normal school operations.

City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. Customer shall relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or otherwise interfere with the ESM implementation and installation process.

Hazardous Materials Abatement Allowance

The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an



accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.

Interface with Existing Systems & Operations

Maintenance Procedures

The new chillers and pumps will be more reliable and require far less maintenance and repair than the aging units they are replacing. In addition to the age difference, the new chillers being proposed have a variety of features designed to improve operation, reliability and reduce maintenance. These include the following.

- No shaft seals
- No guide vanes or slide vanes
- No chlorine in the refrigerant
- No refrigerant pumps
- No pressurization systems
- No bearing capacitors to change
- No pumps, hoses, or clamps for the VFD
- No glycol cooling required for the VFD
- Compressor acoustical enclosure for sound reduction

Special Operating Requirements

Each new chiller will be equipped with web-based DDC system integrated with the Complex's upgraded energy management system. This will provide much better control and building comfort while also allowing remote monitoring, trouble-shooting, and adjustment.

Equipment Information

Manufacturer & Type

The two new chillers will be Carrier model 23XRV4041NRVAA50 or approved equal. Since the invention of modern air-conditioning in 1902, Carrier has had a long history of innovation and industry leading cooling equipment. This particular model won ASHRAE's Green Building Innovation Award when it was introduced at the Air-Conditioning, Heating, Refrigerating (AHR) Expo, and it has been efficiently cooling buildings ever since, with ongoing enhancements and increasing capacity options. The pumps will be Bell & Gossett, or approved equal.



Savings Calculations

The calculations for the savings from this chiller replacement ESM were based on calculations of building loads and cooling system usage at various outside air temperatures over the course of the cooling season. A simple approximation of the formulae used for this calculation is shown below.

 Cooling Savings (for each hour of the year) = Hours × Cooling Load × (1/Proposed Cooling Efficiency – 1/Existing Cooling Efficiency)

Where:

Cooling Savings = Energy Savings (kWh) for Cooling Improvements

Hours = Hours of Cooling Season Operation

Cooling Load = Building Cooling Demand for Cooling Season Hours

Existing Cooling Efficiency = Manufacturer-Rated Efficiency for Corresponding Load

Proposed Cooling Efficiency = Manufacturer-Rated Efficiency for Corresponding Load



ESM 4:

AIR HANDLER UNIT DAMPER REFURBISHMENT



ESM 4: Air Handling Unit Damper Refurbishments

Benefits: This measure will replace inoperable air handler dampers and refurbish the remaining dampers, reducing the ongoing maintenance burden on the HVAC shop and improving temperature control and air quality of the schools while reducing energy and maintenance costs.

Buildings: Crosby-Wallace Complex Kennedy High School

West Side Middle School Wilby-North End Complex

Summary: NORESCO will refurbish or replace the dampers for seventy-six (76) air handling units in the buildings listed above. The scope of work will include installing thirty-four (34) new outdoor/return/exhaust air dampers and refurbishing/rebuilding one hundred and forty-six (146) existing-to-remain outdoor/return/exhaust air dampers.

Implementation Cost: \$321,887

Energy Cost Savings: \$29,038

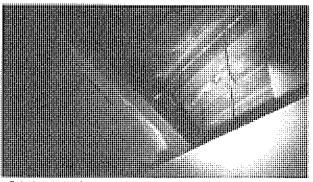
Annual Energy Reduction: 597 kVA, 153,414 kWh

M&V Protocol: Option A

Detailed Description

Existing Description

The existing air handling units (AHUs) in the buildings come in a variety of types and configurations, predominantly consisting of constant volume (single and multi-zone units) and variable volume systems, each providing heating, ventilation, and air conditioning (HVAC) to the occupied spaces.



Existing AHU damper with disconnected linkage and rusted and corroded blades that are permanently closed.

Based on our observations, Waterbury has

recently repaired some AHU components in these buildings including, but not limited to, new fan motor bearings at Crosby, vibration isolators at Crosby, new coils at Kennedy, and new condensate drain pans throughout the buildings.

Despite the repairs observed and the generally fair to good condition of most of the AHUs, there are still some key components of the existing systems that warrant some additional servicing, repairs, and replacement parts.



Recommended Improvements

Based on the existing condition of the equipment and the cost to restore the systems and improve their operational efficiency, NORESCO does not feel the capital expense of a complete AHU replacement is warranted at this time. However, the refurbishment or replacement of the AHU dampers in these buildings will provide more reliable and consistent comfort levels, improve indoor air quality, improve system performance under varying conditions and reduce current and future maintenance and service costs.

NORESCO will perform a thorough refurbishment of the key components and install new replacement parts on the existing AHU dampers to bring the units back to their original ventilation and air mixing capabilities. Extending the useful life of the equipment will avoid the need for a considerable capital investment in the dampers and will allow Waterbury the flexibility in prioritizing where to use scarce maintenance and capital funds elsewhere. The scope of this ESM was developed in close conjunction with the school department's facilities and HVAC shop. The HVAC shop foreman, Jason Porrini, and others felt that the AHUs were in good serviceable condition and a complete replacement was not necessary. The HVAC staff has done a good job keeping up with critical AHU component replacements, which NORESCO confirmed during the audit.

Damper replacement was identified as a critical need, and has been included in the scope for this ESM. Installation of new AHU dampers are included in this ESM, while the new electronic damper actuators, AHU steam and chilled water valve assemblies (valves and electronic actuators), and associated controls will be installed as part of ESM 5: Energy Management System Upgrades & Expansion, allowing NORESCO to replace maintenance-intensive pneumatic controls and seamlessly integrate monitoring and control of the newly refurbished equipment with the newly upgraded and expanded direct digital control (DDC) energy management system (EMS).

Scope of Work

The scope of work will include:

- See the table below for the damper schedule included in the scope of work. New damper actuators with electronic actuation and associated controls are included in ESM 5: Energy Management System Upgrades & Expansion.
- Damper refurbishment includes:
 - Clean dirt and debris from damper blades.
 - Install new silicone damper seals on blades.
 - Each damper shall be adjusted for free movement and the damper blade bearings lubricated.
 - Each damper linkage shall be adjusted for free movement and all adjustments nuts tightened and secured. Subcontractor shall lubricate damper blade bearings and each linkage pivot point.
 - Subcontractor shall test and adjust each actuator for full stroking without any binding prior to being put back in service.



Damper replacement includes:

- Remove existing outside air, return air, and exhaust air dampers.
- Furnish and install new low leakage outside air, return air, and exhaust air dampers. The new dampers will be sized to match the existing equipment.
- Control dampers shall be Greenheck model VCD-33, ultra-low leakage airfoil dampers or approved equal. Leakage rating at four (4) inches of water column (in. w.g.), pressure differential across damper shall be six (6) cubic feet per minute by feet squared (cfm/ft²). Modulating dampers shall have linear flow output characteristics.
- Outdoor and return air mixing dampers shall be parallel-blade and shall direct airstreams toward each other.
- Other modulating dampers shall be opposed-blade.
- Frame shall be galvanized steel, minimum 3/32-inch thick, channel shaped for adequate strength.
- Damper construction shall be sixteen (16) gauge galvanized steel, or 304 stainless steel depending on the application as specified in the scope of work. Blade seals shall be silicone.
- Damper blades shall be airfoil type not exceeding an 8-inch width or 48-inch length and shall be suitable for medium velocity performance.
- After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.
- Each damper linkage shall be adjusted for free movement and adjustments nuts tightened and secured. Subcontractor shall lubricate damper blade bearings and each linkage pivot point.
- Test and adjust each actuator for full stroking without any binding prior to it being put back in service.

City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. Customer shall relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or otherwise interfere with the ESM implementation and installation process.

Hazardous Materials Abatement Allowance

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accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.

Table 1: AHU Damper Schedule

Air Handling Unit Ide	entification (Outside Air Damper	Return Air Damper	Exhaust Air Damp
AHU-1 (Multizone)	3 4	8'x4'	Refurbish	6'x6'
AHU-2 (Multizone)		8'x4'	Refurbish	6'x6'
AHU-3 (Multizone)	el adres de la transmité descriment de la francia a vita de describió de del del describo de la cultura Acedon	8'x4'	Refurbish	Refurbish
AHU-4 (Multizone)		8'x4'	Refurbish	6'x6'
AHU-5 (Multizone)		8'x4'	Refurbish	6'x6'
AHU-6 (Multizone)		8'x4'	Refurbish	Refurbish
AHU-7 (Multizone)	na mana-aram-alaharamananaki na asassarkat da karm-mara shinanasararandanara 2 sa mana i k	8'x4'	Refurbish	Refurbish
AHU-8 (Multizone)		8'x4'	Refurbish	Refurbish
AHU-9 (Multizone)	enerenen av enerenovok kralina kran, enerene a derekter de serverenen men akteur kriz, a skilmer.	8'x4'	Refurbish	Refurbish
AHU-10 Multi-Purpose	Room	Refurbish	Refurbish	
AHU-11 Pool	enement in promise consump you gar you can it angue on y can a fan annaying a commission of the construction of the constructi	Refurbish	Refurbish	_
AHU-12 (Multizone) MS	Music Area	Refurbish	Refurbish	Refurbish
AHU-13 (Multizone) Au	ditorium	Refurbish	Refurbish	Refurbish
AHU-14 (Multizone) HS	Music Area	Refurbish	Refurbish	Refurbish
AHU-10 Multi-Purpose AHU-11 Pool AHU-12 (Multizone) MS AHU-13 (Multizone) Au AHU-14 (Multizone) HS AHU-15 Cafeteria AHU-16 Gym		10'x38"	Refurbish	<u>-</u>
AHU-16 Gym		Refurbish	Refurbish	
AHU-17 Gym	net met der de litter et de die deue de mit inne et demonstra en mit en de en et de met de membre de membre de	Refurbish	Refurbish	—
AHU-18 Gym		Refurbish	Refurbish	
AHU-19 Gym	mi manh milinanni)am tao an aman ta pantan an manera mailinn a in an	Refurbish	Refurbish	Not 1 Mill at the Astronomics in committee and accommission of a survey of the survey
AHU-20 Gym Lobby		Refurbish	Refurbish	Refurbish
AHU-21 Locker Rooms	-1	Refurbish	Refurbish	Refurbish
AHU-22 Locker Rooms		Refurbish	Refurbish	Refurbish
AHU-23 Auditorium Lob	bby	Refurbish	Refurbish	Refurbish
AHU-24 Student Kitche	n Area "D"	Refurbish		-
AHU-25 (Multizone)	ikanan mirik di dinambun mendukan di didinama piri di menangi bedi manusun melilim 14 susan sa	Refurbish	_	The second secon
H-1 North Perimeter		Refurbish	Refurbish	Refurbish
H-2 West Perimeter		Refurbish	Refurbish	Refurbish
H-3 3rd Floor Core (VA) H-4 2nd Floor Core (VA) H-5 East Perimeter H-6 South Perimeter	Ŋ	Refurbish	Refurbish	Refurbish
H-4 2пd Floor Core (VA	V)	Refurbish	Refurbish	Refurbish
H-5 East Perimeter		Refurbish	Refurbish	Refurbish
H-6 South Perimeter	or reference control of the control	Refurbish	Refurbish	Refurbish
H-11 Home Economics		Refurbish	Refurbish	



Air Handling Unit Identification	Outside Air Damper	Return Air Damper	Exhaust Air Damp
H-12 Home Economics	Refurbish	Refurbish	-
H-13 Graphics Shop	Refurbish	Refurbish	
M-1 North Perimeter	Refurbish	Refurbish	Refurbish
M-2 East Perimeter	Refurbish	Refurbish	Refurbish
M-3 2nd Floor Core (VAV)		Refurbish	Refurbish
M-4 3rd Floor Core (VAV)		Refurbish	Refurbish
M-5 West Perimeter	Refurbish	Refurbish	Refurbish
M-6 South Perimeter	Refurbish	Refurbish	Refurbish
M-10 Graphics Shop	Refurbish	Refurbish	Refurbish
C-1 Theatre Arts			
C-2 Auditorium	Refurbish		_
C-3 MS Cafeteria	Refurbish	-	Refurbish
C-4 MS Arts & Music (MultiZone)	Refurbish	Refurbish	en programment in the second s
C-5 Lobby & Faculty (MultiZone)	Refurbish	Refurbish	
C-6 HS Arts & Music (MultiZone)	Refurbish	Refurbish	et (re-t-etime) (Ver-e-t-tire et estre tre tremovier vierne et en en en et
C-7 HS Cafeteria	Refurbish	Refurbish	
C-8 Stage	Refurbish	Refurbish	**************************************
C-9 Gym West	3'x6'	Refurbish	
C-10 Kitchen Hood MUA	Refurbish	Refurbish	<u> </u>
C-11 Voc. Food Lab Hood MUA	Refurbish	Refurbish	
C-12 MS Locker Rooms	Refurbish	Refurbish	Refurbish
C-13 Gym Center	Refurbish	Refurbish	Refurbish
C-14 Auxiliary Gym West	<u></u>		-
C-15 Auxiliary Gym East	2	-	
C-16 HS Locker Rooms	Refurbish	Refurbish	Refurbish
C-17 Gym East	Refurbish	Refurbish	Refurbish
C-18 Pool	Refurbish	Refurbish	
1 (Multizone) Classrooms	3'x10'	Refurbish	Refurbish
2 (Multizone) New Unit	3'x8'	Refurbish	Refurbish
3 (Multizone) Classrooms	3'x10'	Refurbish	3'x6'
4 (VAV) Classrooms	3'x10'	Refurbish	3'x6'
5 (Multizone) Classrooms	4'x6'	Refurbish	2'x5'
6 Cafeteria	Refurbish	Refurbish	
7 (Multizone) Admin.	2'x6'	Refurbish	Refurbish
8 Tech. Arts	2'x3'	Refurbish	Refurbish
9 Aux. Gym	Refurbish	Refurbish	÷ .
10 Lobby	Refurbish	Refurbish	na a semantana menerakan kanan dari kemana kemana kemana dari kema



Air Handling Unit Identification	Outside Air Damper	Return Air Damper	Exhaust Air Damper
11 Gym	2'x4.5'	Refurbish	Refurbish
12 Gym	2'x5'	Refurbish	Refurbish
13 Locker Room	Refurbish	Refurbish	Refurbish
14 Pool	3'x6'	1.5'x7'	1.5'x7'
HV-1 (Cafeteria)	Refurbish	•	
HV-2 (Boy's Locker Room)	17" x 36"	Refurbish	
HV-4 (Pool)	Refurbish	Refurbish	
HV-5 (Visitor's Locker Room)	Refurbish	Refurbish	-
HV-6 (Music Room RTU)	Refurbish	Refurbish	CONTRACTOR AND
HV-9 (Girl's Locker Room) New			- Come to determine the second state of the second state of the second s
AHU-8 (RTU)	24"x54"	Refurbish	
AHU-9 (RTU)	24"x54"	Refurbish	
AC-1 (RTU)			
AC-2 (RTU)	24"x60"	Refurbish	_

Interface with Existing Systems & Operations

Maintenance Procedures

The maintenance for the replaced and refurbished AHU dampers will be less than the existing equipment, as the existing equipment was past due for refurbishment and required repairs or replacements in addition to typical preventative maintenance. The HVAC shop currently spends considerable time servicing and maintaining the dampers. This ESM will allow them to get caught up on some of the past due deferred maintenance, and more time for proactive, regularly scheduled maintenance on this equipment going forward to ensure its continued efficient operation.

Special Operating Requirements

There are no special operating requirements for the new or refurbished dampers other than it will be operated by the new direct digital controls installed under ESM S: Energy Management System Upgrades & Expansion.

Equipment Information

Manufacturer & Type

The new AHU dampers will meet or exceed the original specifications. Equipment will be manufactured by Greenheck, or approved equals.



Savings Calculations

Pre-retrofit energy consumption is calculated using the systems' CFM, cooling loads, and operational parameters such as economizer hours of operation. Pre- and post-installation end use energy consumptions are calculated in a spread sheet model using the following formulae as its basis:

q = 1.08 · CFM · △T

Where:

q = AHU Heating/Cooling (Latent only) Load (Btu/hr)

1.08 = Conversion Constant (Btu/CFM*hr*°F)
CFM = AHU Air Flow (Cubic Feet per Minute)

 ΔT = Temperature Differential (°F)

q = 4.5 · CFM · △h

Where:

q = AHU Total Cooling Load (Btu/hr)

4.5 = Conversion Constant (#*min/CFM*hr)
CFM = AHU Air Flow (Cubic Feet per Minute)

 Δh = Enthalpy Differential (But/#)



ESM 5:

ENERGY MANAGEMENT SYSTEM UPGRADES & EXPANSION



ESM 5: Energy Management System Upgrades & Expansion

Benefits: This measure will improve building occupant comfort, reduce energy costs, reduce maintenance costs, and provide increased monitoring, control, and troubleshooting of building heating ventilating and air conditioning (HVAC) systems. The new systems will be open protocol systems with a web-accessible user interface to provide password-protected access to City and school personnel. These new automatic controls will provide temperature set point and occupancy schedules as well as other control strategies, saving electricity and fuel energy. Retro-commissioning (RCx) the existing-to-remain energy management system (EMS) will restore proper and efficient operation of controlled HVAC equipment and systems.

Buildings: Barnard Adult Education Bucks Hill School

Bunker Hill School Carrington School

Chase Building Chase School

Crosby-Wallace Complex Department of Public Health

Driggs School Generali School

Hopeville School Kennedy High School

Kingsbury School Regan School
Sprague School Tinker School

Walsh School Washington School

Waterbury Arts Magnet School Wendell Cross School

West Side School Wilby-North End Complex

Wilson School

Summary: NORESCO will install new, comprehensive web-accessible direct digital control (DDC) energy management systems and/or retro-commission (RCx) the existing-to-remain control systems in twenty-three (23) buildings. The Crosby-Wallace Complex, Wilby-North End Complex, Kennedy High School, and West Side Middle School will have old pneumatic control systems removed and will be converted to electronic DDC systems. The new electronic controls will automatically enable HVAC systems and modulate heating, cooling, and ventilation to maintain space temperature setpoints. Schedules will be set up in accordance with occupancy to reduce energy use during off hours. For retro-commissioning, we will evaluate the existing-to-remain HVAC controls systems at the appropriate facilities and identify and correct existing deficiencies with the controls and sequences of operation.



Implementation Cost: \$5,346,414

Energy Cost Savings: \$621,167

Annual Energy Reduction: 215,990 CCF · 2,603,237 kWh

M&V Protocol: Option B

Detailed Description

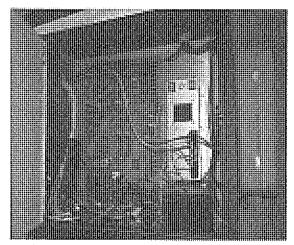
Existing Description

In the Chase Building, there is no existing DDC or EMS. The manual and pneumatic controls that are intended to provide control of the boiler and steam radiators are not sufficient to regulate the space temperatures properly. Numerous uneven temperature complaints were noted from the building occupants during our walkthroughs.

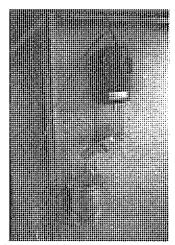
At Barnard, Bucks Hill, Bunker Hill, Carrington, Chase, Driggs, Generali, Hopeville, Kingsbury, Regan, Sprague, Tinker, Walsh, Washington, Wendell Cross, West Side, and Wilson schools and the Department of Public Health, there are some older proprietary direct digital control (DDC) from Honeywell, TAC, and pneumatic systems that control HVAC equipment in the buildings. These systems are not easily monitored and are increasingly difficult to maintain and upgrade.

At Waterbury Arts Magnet, the existing full DDC system is capable of turning off equipment during unoccupied hours, but these scheduled operations and other energy savings strategies could be better programmed and implemented.

The Crosby-Wallace Complex, Wilby-North End Complex, and Kennedy High School have existing legacy DDC systems overlaying obsolete and cost-intensive pneumatic controls that have no direct monitoring and limited control capability. Some critical components of these legacy systems are no longer supported by the manufacturers.



Legacy DDC panel at the Department of Health.



A disconnected pneumatic actuator at Crosby.



Table 1: EMS Points Summary

Building	Existing EMS	Analog Inputs	Analog Outputs	Digital Inputs	Digital Outputs	Total Points
Barnard	Honeywell 5000	6	2	6	4	18
Bucks Hill	Honeywell 5000	6	2	6	4	18
Bunker Hill	. Honeywell 5000	6	2	6	4	18
Carrington	Honeywell 5000	6	0	6	10	22
Chase	Honeywell 5000	9	4	8	6	27
Driggs	Honeywell 5000	19	10	9	4	42
Generali	Honeywell 5000	8	2	11	7	27
Hopeville	Honeywell 5000	6	2	6	4	18
Kingsbury	Honeywell 5000	6	2	6	4	18
Regan	Honeywell 5000	6	0	7	5	18
Sprague	Honeywell 5000	6	2	6	5	19
Tinker	Honeywell 5000	6	2	6	4	18
Walsh	Honeywell 5000	6	2	6	4	18
Washington	Honeywell 5000	6	0	7	5	18
Wendell Cross	Honeywell 5000	6	2	6	4	18
West Side Middle	Honeywell 5000	187	174	58	38	457
Wilson	Honeywell 5000	6	2	6	4	18
Chase Building	None	7	J	2	1	11
Dept. of Health/Wachovia	TAC Vista	171	6	7	420	604
Crosby-Wallace	TAC/Barber-Colman	503	398	128	151	1180
Wilby-North End	TAC/Barber-Colman	386	257	169	198	1010
Kennedy	TAC/Barber-Colman	67	33	42	37	179
Waterbury Art Magnet	Siemens	263	142	172	197	774
	alatoT	1,698	1,047	686	1,120	4,251

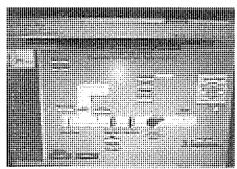
Recommended Improvements

NORESCO will install or RCx twenty-three (23) HVAC control systems totaling four thousand five hundred fifty-one (4,551) hardware points that will save Waterbury energy and provide significantly increased monitoring, control, and building comfort while reducing the maintenance burden on the HVAC shop. Building HVAC equipment, including air handling units, pumps, boilers, and chillers will be enabled by automatic controls programmed to turn on/off equipment and maintain space temperature set-points during both occupied and unoccupied periods. The old and obsolete pneumatic controls will be replaced with new DDC. An additional central workstation will be provided to monitor and control points via interactive graphic displays. The DDC is web-accessible to allow for EMS monitoring and



control via home laptops, smart phones and tablets. Data will be trended and reports generated to provide up-to-date data for analytics of building operations. This high level of increased DDC monitoring and control, along with comprehensive training of facilities staff will serve the City well and provide features that will markedly improve building operations, maintenance, troubleshooting, and inhouse customer service.

At Crosby-Wallace, Wilby-North End, and West Side, in addition to upgrading the legacy EMS and replacing the old pneumatic valves and damper actuators with new, modern DDC components; additional controls are proposed to optimize the volume of air delivered for the heating and cooling needs of the spaces served by the majority of the air handlers. Matching the volume of air provided to the space heating and cooling loads reduces energy and allows more precise temperature control of the space. The controls included to do this include seventy (70) new variable frequency drives (VFDs) on over one thousand, two hundred and ninety-five (1,295) total HP of air handler fan motors; three hundred and



New DDC will be installed in eleven of Waterbury's buildings. A central workstation will be provided to monitor mechanical equipment control points in a graphical format. An existing Crosby High School air handling unit graphic is shown here.

sixty-five (365) HP from forty-one (41) new premium-efficiency fan motors; static pressure and space temperature/CO₂ sensors. When the space temperature conditions are satisfied, the volume of air delivered by the air handler will be incrementally reduced while still maintaining the set-point. Under ESM 12: Hot Water Boilers & Pool Heating Systems, the new boilers, pumps, and other included equipment will be interfaced and integrated with the EMS. At Crosby-Wallace, under ESM 3: Variable Speed Chillers & Pumps, the new chillers, pumps, and other included equipment will be interfaced and integrated with the EMS.

At Kennedy, the old legacy DDC and pneumatic controls on the air handling units will be replaced with all new DDC and scheduling and other energy savings strategies will be programmed and implemented. Under ESM 12: Hot Water Boilers and Pool Heating Systems, the new boiler, pool heater, pumps, and other included equipment will be interfaced and integrated with the EMS. Individual radiators and convectors will have the old, inoperable pneumatic control valves removed, and thermostatic radiator valves (TRVs) installed under ESM 8: Steam Traps & Thermostatic Radiator Valves.

For Kennedy, Crosby-Wallace, and Wilby-North End, the existing building level network engine controllers (JACEs) will be upgraded to the most current revisions (8000) available, which will also allow the head end platform to be upgraded to the Niagara 4 configuration. These upgrades allow for fully supported hardware/software revisions and expansion in the future.

At the Department of Public Health and Barnard, Bucks Hill, Bunker Hill, Carrington, Chase, Driggs, Generali, Hopeville, Kingsbury, Regan, Sprague, Tinker, Walsh, Washington, Wendell Cross, and Wilson schools, the legacy and proprietary EMS will be replaced in its entirety with a modern DDC system. For Barnard, Bunker Hill, Chase, Generali, Sprague, and Wilson, the new boilers and other included equipment under ESM 11: Steam Boilers will be interfaced and integrated with the EMS.



Individual radiators and convectors will have the old, inoperable pneumatic control valves removed, and thermostatic radiator valves (TRVs) installed under ESM 8: Steam Traps & Thermostatic Radiator Valves.

The Chase Building will have a new DDC EMS installed controlling the new steam boiler and individual floor zone temperature sensors for space conditions control during occupied and unoccupied hours. Individual radiators and convectors will have the old, inoperable pneumatic control valves removed, and thermostatic radiator valves (TRVs) installed under ESM 8: Steam Traps & Thermostatic Radiator Valves.

At Waterbury Arts, the existing modern EMS will be retro-commissioned (RCx) exclusively. At the Crosby-Wallace and Wilby-North End Complexes, existing-to-remain EMS will be retro-commissioned in addition to the new DDC to be installed. While these energy management systems are functional, some of the control logic and functionality of the control systems have been intentionally "worked around" as a result of expediency or stop gap solutions to various problems. The RCx scope of this ESM will ensure the functionality of control equipment and systems and also optimize how they operate together in order to reduce energy waste and improve building operation and comfort. Thus, the goal of ensuring comfort and productivity of the building occupants accompanies the goal of cost savings. The process includes investigating and documenting the condition of the systems, identifying existing problems with the controls, and optimizing control of energy systems and formalizing operational procedures. This will include a thorough point-to-point review of the existing hardware and software control points and sequences of operation to ensure that the buildings' systems are operating properly and using the most efficient control strategies available. DDC end devices, such as damper and valve actuators, will be tested and calibrated to ensure that they are functioning as designed. The graphics will be revised and updated, and the updated application software will be installed in the controllers.

Additional Scope of Work

Valves and Dampers

New AHU outside/return/exhaust air dampers will be installed under ESM 4: Air Handling Unit Damper Refurbishment. New DDC points will be installed to monitor and control the new steam and chilled water valve assemblies, and new damper actuators will be provided for the air handlers at Crosby-Wallace, Wilby-North End, West Side, and Kennedy.



Table 2: EMS Upgrades and Expansion Scope of Work Matrix

Building	New/ Upgraded	Rex	New Points	New VFDs &	DDC Valves	DDC Zone	ESM 3	ESM (15	ESM TT	ESM!
Barnard	SME			Morors		Controls			\	
Bucks Hill								**************************************		
Bunker Hill	>								>	
Carrington	>									
Chase	>	The second section is a second section of the second section of the second section is a second section of the second section is a second section of the second section section section is a second section of the second sec		The state of the s					>	300
Driggs	>									
Generali	`>								>	
Hopeville										
Kingsbury	>		***************************************	A. B. A.				eran anuana transmin		
Regan	>									
Sprague	>								>	
Tinker	>									
Walsh	>									
Washington	>									
Wendell Cross	`>					-				
West Side	>									`
Wilson	>								>	
Chase Building								>	>	
Dept. of Health	>							3		
Crosby-Wallace			>	>	`	>	>			`
Wilby-North End	>		>	>	>	>			***************************************	>
Kennedy	>		>		>					>
Waterbury Art Magnet		>				and the same of	69-1- access (A)	## FOO VORTEROOFS.	METORISCAN.	

Informotion on this page is proprietary and subject to confidentiality restrictions

City of Waterbury, Connecticut Investment Grade Energy Audit · May 13, 2016 (rev. June 29, 2016)



Table 3: EMS Upgrades and Expansion Control Sequences Summary

Steam Boiler Water Lemman Actuators Actuators Control		(a) sequential 15.		(Weden)	Mestry Verline			@filled	I	
Hill con wilding chools	Building	Unoccupied Schedules	Steam Boiler Control	Water Boiler Control	New Valves and Actuators	AHU Fan VFD Control	DHW Heat Exchanger	Water System Control	Ferminal Equipment Control	Ketro - Commission DDC
Hill con con control con control con control con control con control c	Barnard	>	>							
uniding chool Wallace Public Health in walking chool Wallace walking chool walking	Bucks Hill	and the second s	>		the control of the first of the control of the cont	announcement of the state of th	edel prod Choolive Production of the broken and delicated	The second secon	and the Street of the Street o	en Anne addear mandear of an energy summable from the first to
uniding	Bunker Hill	>	>							
wulding chool choo	Carrington	>	>						Control of the Contro	
Wallace Public Health	Chase Building	>	>						>	
Wallace * </th <th>Chase School</th> <th>></th> <th></th> <th>the second secon</th> <th>and the second s</th> <th>e dan mil dan mendebugan pada engin pipak</th> <th>and continued to the control of the</th> <th></th> <th>Conduction of Asserting Conduction Conduction</th> <th></th>	Chase School	>		the second secon	and the second s	e dan mil dan mendebugan pada engin pipak	and continued to the control of the		Conduction of Asserting Conduction	
Public Health Y Is a second of the second o	Crosby-Wallace		>	>	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	\			`	
gton ry ry ry ry ry ry ry ry ry r	Dept. of Public Health					>				The state of the s
	Driggs	>	`							
ry ry cy ry ston gron wry Arts	General		American Control Con	A Company of the Comp	A to the book agreement and the second and the seco		de la companya de la	The state of the s	Part of the second seco	
ry	Hopeville	\	\						STATE OF THE STATE	
ry	Kennedy		and the second s	memory (1) and the state of the						and the first for the first for the first statement and the many of the first for the first statement and the first statement
gton wry Arts Cross de de v v v v v v v v v v v v v	Kingsbury	>	\ \						S Programme S Annual	CONTROL TO VALUE
gton	Regan	And the state of t	Special Control of the Control of th	resided Activation and was a fact of the Activation as a second second	and it is the control of the control	The state of the s				
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gron V V V ury Arts V V V I Cross V V V de V V V v orth End V V V	Walsh	>	>							
Cross	Washington			The second secon	manuformation (manuformation of manuformation of the manuformation of th	The second section of the sect				
de	Waterbury Arts	`>		. \		>		>	>	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
de	Wendell Cross	\ \ \ !	>				elevis Villam (Miller) vol. II. a. a. i. a.			en e
lorth End	West Side	>	. >	>	>	>	>	>		
Wilson	Wilby-North End	>		>		>		>	>	>
	Wilson	>	` ` `							

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ESM 5: EMS Upgrades & Expansion Page | 7



Table 4: New VFDs, Motors, and VFD Points for AHUs

Building	Air Handling Unit Identification	SAF HP	SAF Replace	RAE HP	RAF Replace	SAF VFD	RAF VIZD
	AHU-1 (Multizone)	30	etr	7 . 5	x	X	X
	AHU-2 (Multizone)	30	etr	7.5	X	X	X
	AHU-3 (Multizone)	30	etr	7 . 5	X	X	х
	AHU-4 (Multizone)	30	etr	7.5	X	X	X
	AHU-5 (Multizone)	30	etr	7.5	x	X	X
	AHU-6 (Multizone)	30	etr	7.5	x	X	X
	AHU-7 (Multizone)	30	etr	7.5	X	х	х
	AHU-8 (Multizone)	30	etr	7.5	х	х	Х
	AHU-9 (Multizone)	30	etr	7.5	x	Х	х
Crosby- Wallace	AHU-10 Multi-Purpose Rm	10	×	-	-	X	-
,,,,,,,,,	AHU-12 (Multizone) MS Music Area	15	etr	1.5	х	X	х
	AHU-13 (Multizone) Auditorium	7.5	x	5	x	X	Х
	AHU-14 (Multizone) HS Music Area	15	etr	5	etr	X	Х
	AHU-16 Gym	7.5	X	-	-	х	-
	AHU-17 Gym	7.5	x	-	-	X	-
	AHU-18 Gym	7.5	Х	-	-	X	-
	AHU-19 Gym	7.5	X	-	-	х	-
	AHU-23 Auditorium Lobby	7.5	X	-	-	X	_
Y	AHU-25 (Multizone)	15	etr	-	-	х	-
	H-1 North Perimeter	15	etr	5	x	X	X
	H-2 West Perimeter	15	etr	5	-:: x	X	x
	H-3 3 rd Floor Core (VAV)	40	x	20	etr	etr	etr
	H-4 2 nd Floor Core (VAV)	40	x	25	etr	etr	etr
	H-5 East Perimeter	15	etr	5	X	χ	X
	H-6 South Perimeter	15	etr	5		X	X
	M-1 North Perimeter	15	etr	7.5	X	X	
Wilby-North	M-2 East Perimeter	15	X	15	etr	X	X
End	M-3 2 nd Floor Core (VAV)	25	etr	10	X	etr	etr
	M-43 rd Floor Core (VAV)	25	etr	10	X	etr	etr
	M-5 West Perimeter	15	etr	10	x	x	x
	M-6 South Perimeter	15	etr	7.5	X	X	×
	C-2 Auditorium	15	etr	15	etr	X	X
	C-4 MS Arts & Music (MultiZone)	10	×	7.5	x	X	X .
	C-5 Lobby & Faculty (MultiZone)	10	X	3	x	X	X
**************************************	C-6 HS Arts & Music (MultiZone)	15	etr	10	X	X	X



Building	Air Handling Unit Identification	SAF HP	SAF Replace	RAF HP	RAF Replace	SAF VFD	RAF VFD
	C-9 Gym West	15	etr	5	etr	X	
	C-12 MS Locker Rooms	7.5	X	5	x	X	X
	C-13 Gym Center	10	X	5	etr	X	
	C-16 HS Locker Rooms	7.5	X	5	X	X	X
	C-17 Gym East	15	etr	5	etr	X	
	1 (Multizone) Classrooms	30	etr	15	etr	etr	etr
	2 (Multizone) – New Unit	25	etr	10	etr	X	X
	3 (Multizone) Classrooms	30	etr	15	etr	X	etr
	4 (VAV) Classrooms	20	etr	7.5	etr	X	etr
	5 (Multizone) Classrooms	25	etr	10	etr	etr	etr
	7 (Multizone) Auditorium	20	etr	10	etr	etr	etr
West Side	8 Tech. Arts	7.5	etr	_		etr	
	9 Aux. gym	7.5	etr	***************************************		etr	·
	10 Lobby	10	etr	***		X	<i></i>
	11 Gym	10	etr	-		etr	
	12 Gym	10	etr			X	- *************************************
	13 Locker Room	7.5	etr	7.5	etr	etr	etr
	14 Pool	20	etr	7.5	etr	х	X

^{*} ETR = existing to remain

Table 5: New Valves, Dampers, and Points for AHUs

Building	Air Handling Unit ID	Steam Coil Valve	Chilled Water Coil Valve	Damper Actuators
	AHU-1 (Multizone)	2 - 3"		X
	AHU-2 (Multizone)	2 - 3"		X
	AHU-3 (Multizone)	2 - 3"		X
	AHU-4 (Multizone)	2 - 3"		X
	AHU-5 (Multizone)	2 - 3"		X
Crosby- Wallace	AHU-6 (Multizone)	1-3"	WINDOWS AT the state of the sta	X
*** dilacc	AHU-7 (Multizone)	1-3"	THE PROPERTY OF THE PROPERTY O	Χ
	AHU-8 (Multizone)	1 - 3"		X
	AHU-9 (Multizone)	1 - 2"	***************************************	Х
	AHU-10 Multi-Purpose Rm	2 - 2"		X
	AHU-11 Pool	2 - 2"	TW-9991714; 1988944466; 144 \$1.00044666444464164646464644646446	X



Building	Air Handling Unit ID	Steam Coil Valve	Chilled Water Coil Valve	Damper Actuators
	AHU-12 (Multizone) MS Music Area	1 - 2"		Х
	AHŲ-13 (Multizone) Auditorium	1-3"		Χ
•	AHU-14 (Multizone) HS Music Area	1 - 2"	1 - 3"	X
t t	AHU-15 Cafeteria	1 - 3"	1 - 3"	X
1	AHU-16 Gym	1-3"	COMPANY TO SERVICE A VICTOR OF THE SERVICE SER	Χ
	AHU-17 Gym	1-3"		Χ
	AHU-18 Gym	1-3"		Χ
	AHU-19 Gym	1 - 3"	h	X
ì	AHU-20 Gym Lobby	1 - 1"		X
	AHU-21 Locker Rooms	1 - 2"		X
	AHU-22 Locker Rooms	1 - 3"		X
	AHU-23 Auditorium Lobby	1 - 2"		X
•	AHU-24 Student Kitchen Area "D"	1 - 2"		X
	AHU-25 (Multizone)	1-2"		X
	H-1 North Perimeter	1-3"	1-3"	X
	H-2 West Perimeter	1-3"	1-3"	Χ
	H-3 3 rd Fl Core (VAV)	**************************************	1-4"	X
	H-4 2 nd fl Core (VAV)		1-4"	X
	H-5 East Perimeter	1-3"	1-3"	X
	H-6 South Perimeter	1-3"	1-3"	X
	H-11 Home Econ.	1-1.5"	1-2"	X
	H-12 Home Econ.	1 - 1.5"	1-2"	X
	H-13 Graphics	1-1.5"	1 - 2"	X
	M-1 North Perimeter	1-3"	1-3"	X
Wilby-North End	M-2 East Perimeter	1-3"	1-3"	X
Lilu	M-3 2 nd Fl Core (VAV)	1-4"	1-4"	X
	M-4 3 rd Fl Core (VAV)	1-4"	1-4"	X
	M-5 West Perimeter	1-3"	1-2"	X
	M-6 South Perimeter	1-2"	1-2.5"	X
	M-10 Graphics	1-1.5"	1-2"	X
	C-1 Theatre Arts	1 - 1.5"	1 - 1.5"	X
	C-2 Auditorium	1-2"	1-2.5"	Χ
	C-3 MS Cafeteria	1-2"	1-2.5"	X
	C-4 MS Arts & Music (MultiZone)	1 – 1.5"	1-2.5"	· X
	C-5 Lobby & Faculty (MultiZone)	1-1.5"	1-2.5"	X .
\$41-10-10-10-10-10-10-10-10-10-10-10-10-10				



Building	Air Handling Unit ID	Steam Coil Valve	Chilled Water Coil Valve	Damper Actuators
	C-6 HS Arts & Music (MultiZone)	1 - 1.5"	1 - 2.5"	X
	C-7 HS Cafeteria	1-2"	1 - 2.5"	X
	C-8 Stage	1-2"	1-25"	Х
	C-9 Gym west	1-3"		X
	C-10 Kitchen Hood MUA (MeLink)	1 - 2"		X
	C-11 Voc. Food Lab Hood MUA (MeLink)	1-2"		X
	C-12 MS Locker Rooms	1-2"		X
	C-13 Gym center	1-2.5"		Χ
	C-14 Aux. gym west			X
	C-15 Aux. gym east			X
	C-16 HS Locker Rooms	1 - 2"		X
	C-17 Gym East	1 - 2.5		X
	C-18 Pool	2 - 3"		X
TO THE REST OF THE PROPERTY OF	1 (Multizone) Classrooms (PH)	1 - 4"	1 - 4"	X
	2 (Multizone) New Unit (PH)	1 - 3"	1 - 4"	Χ
	3 (Multizone) Classrooms (PH)	1 - 3"	1 - 4"	X
	4 (VAV) Classrooms (PH)	от не в неменя в неменя в неменя на положения в неменя в	1 - 4"	X
	5 (Multizone) Classrooms (BSMT)	1-3"	1 - 4"	X
	6 Cafeteria (above gym)	1 - 3"	1 - 4"	X
14((6))	7 (Multizone) Admin.	1 - 3 "	1 - 4"	X
West Side	8 Tech. Arts	1 - 1.5"	1 - 1.5"	X
	9 Aux. gym (above gym)	1-3"	1-3"	X
	10 Lobby (above gym)	1 - 1.5"	1 - 1.5"	X
	11 Gym (above gym)	1 - 3"		Χ
	12 Gym (above gym)	1 - 2"		Χ
	13 Locker Room (above gym)	1 - 2"	HINNEL	Χ
	14 Pool	3"		X
	HV-1 (Cafeteria)	2-2"		X
	HV-2 (Boy's Locker Room)	1 - 1.5"		X
	HV-4 (Pool)	2 - 2"		X
	HV-5 (Visitor's Locker Room)	1 - 1.5"	Andrew An	X
Kennedy	HV-6 (Music Rm RTU)	1 - 1.5"		X
	HV-9 (Girl'S Locker Room) New	1-1.75"		X
	AHU-8 (RTU)	1 - 1.5"	and a state of the	X
	AHU-9 (RTU)	1 - 1.5"	**************************************	X



Building	Air Handling Unit ID	Steam Coil Valve	Chilled Water Coil Valve	Damper Actuators
AC-1 (RTU)		1-1.5"		Χ
AC-2 (RTU)		2 - 2"		X

City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. Customer shall relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or otherwise interfere with the ESM implementation and installation process.

Hazardous Materials Abatement Allowance

The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.

Interface with Existing Systems & Operations

Maintenance Procedures

The removal of pneumatic controls should significantly reduce the current operational and maintenance costs for the energy management systems. The installation of new equipment and the ability of the system to troubleshoot issues remotely should also reduce time spent maintaining the newly installed equipment.

Special Operating Requirements

There are no special operating requirements.

Equipment Information

Manufacturer & Type

New DDC and associated devices will be manufactured by Schneider Electric (TAC I/A) and Automated Logic Controls, and the front end to the TAC system will be licensed by Tridium.



- Schneider Electric United States, North American Divisio, Boston One Campus, 800 Federal Street, Andover MA 01810, 877-342-5173, www.schneider-electric.us
- Automated Logic Controls, Inc. 1150 Roberts Blvd., Kennesaw, Georgia 30144, 770-429-3000, www.automatedlogic.com

Savings Calculations

Pre-retrofit energy consumption is calculated using the systems' fan motor horsepower, heating system and cooling system efficiencies, as well as operational parameters such as hours of operation. Pre- and post-installation end use electrical energy consumptions are calculated in a spread sheet model using the following formulae as its basis:

q = 1.08 · CFM · △T

Where:

q = AHU Cooling (sensible only) load (Btu/hr)
 1.08 = conversion constant (Btu/CFM*hr*°F)
 CFM = AHU air flow (cubic feet per minute)
 ΔT = temperature differential (°F)

q = 4.5 · CFM · △h

Where:

q = AHU total cooling load (Btu/hr)
 4.5 = conversion constant (#*min/CFM*hr)
 CFM = AHU air flow (cubic feet per minute)
 Δh = enthalpy differential (But/#)

• $kW = Hp \cdot 0.746 \cdot LF \cdot VFD \div Eff$

Where:

kW = motor power (kW) Hp = motor Hp (HP)

0.746 = conversion constant (kW/HP)

LF = motor load factor Eff = motor efficiency (%)

VFD = % motor speed based on the fan law



ESM 5: POINTS LIST

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# **ESM 6:**BUILDING WEATHERIZATION



# **ESM 6: Building Weatherization**

Benefits: This measure will reduce infiltration of unconditioned air, save energy, and improve occupant comfort. All buildings, regardless of type and age, experience infiltration losses through cracks in the building. In addition to providing energy and cost savings, the sealing of the buildings' envelopes will help preserve each building's construction over time.

Buildings: Barnard Adult Education Bucks Hill School

Chase Building Chase School

City Hall Crosby-Wallace Complex

Department of Public Health Driggs School

Duggan School Enlightenment School

Generali School Gilmartin School

Hopeville School Kennedy High School

Kingsbury School Maloney School

Police Headquarters Reed School

Regan School Rotella School

Silas Bronson Library Sprague School

Tinker School Walsh School

Washington School Waterbury Career Academy School

Wilby-North End Complex Wilson School

**Summary:** NORESCO will reduce infiltration by sealing cracks with foam or beads of caulk as needed, improving door seals, replacing worn sweeps and weatherization strips on doors, making roof-to-wall joint gaps airtight and sealing exterior envelope penetrations.

Implementation Cost: \$584,745

Energy Cost Savings: \$47,528

Annual Energy Reduction: 40,828 CCF · 13,417 kWh

M&V Protocol: Option A



# **Detailed Description**

# **Existing Description**

The buildings were inspected visually and using smoke tracer tests in accordance with ASTM E-1186 – 03. A smoke puffer was used to identify the location and severity of air leakage paths. These air leakage paths are detailed in the scope of work below. Areas inspected include roof-wall joints, elevation changes, soffit areas, roofs, walls, windows, doors, and other penetrations.

Building envelope inspections were performed on thirty-three (33) buildings located in the City of Waterbury. Overall, the buildings are in good to fair condition and well maintained by facility staff. During our inspection we found that the buildings were fairly to moderately leaky.

Many of the buildings were built in the 1920s to the 1940s, with the oldest built in 1898. A few of the buildings are newer structures, built within the last 10-15 years. Five of the buildings are municipal buildings, while the remaining twenty-eight are school buildings. Several of the buildings have had significant renovation projects performed, addressing several key building systems (e.g., doors, windows, roof surfaces, remodeled interior surfaces). The structures represented a cross-section of construction styles, which include:

- Masonry and brick walls with steel-framed pitched and/or flat concrete roofing
- Steel-frame and CMU walls with flat and/or pitched concrete roofing systems
- Masonry and brick walls with steel-framed pitched and/or flat roofing
- Steel-frame with masonry wall and glass curtain-wall systems, with flat and/or pitched concrete and metal roofing systems
- One-, two-, three-, and four-story structures
- Stand-alone structures, structures with multiple wings, bump-out sections and/or portable sections directly attached and/or connected via enclosed or open corridors



Tracer smoke testing indicating leaky seals on Police Headquarter roll-up garage doors.

Our building envelope assessments identified several significant air leakage paths in a majority of the buildings we inspected, with the key leakage areas being:

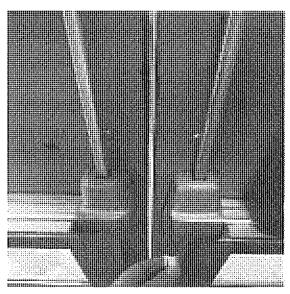
- Exterior, mechanical/boiler room and roof-access doors
- Window systems
- Roof-wall junctures and building joints
- Exterior walls open to vented soffit systems
- Attic/cockloft floor systems with significant chases, penetrations and bypasses allowing significant communication to conditioned spaces,



 Older, passive ventilation systems that allow significant, ongoing air-leakage and that should not be sealed without newer, dedicated building Make-Up-Air systems in place

Ventilation must be hard ducted or blocked in combination with installation of mechanical venting for insulation to be feasible. Continuing to dump building air into the cockloft after insulating these areas would cause condensation and building deterioration issues. Roof fans that connect conditioned spaces within the building envelopes to unconditioned building sections and directly to the outdoors.

The majority of the air leakage paths identified during our building assessments are a direct result of misalignment of the building's thermal and air barriers that resulted from design issues, implementation/framing issues during construction and/or deterioration of materials over time or voids in maintenance activities (contracted vs. in-house).



A gap (5/-inch) between double door entrance to Maloney School.

Discussions with staff revealed the following issues:

- Significant hot/cold sections of the buildings, lending to ongoing occupant comfort complaints stemming from significant air-leakage and poorly insulated building sections
- Ongoing moisture intrusion through leaky door and window systems, leading to higher maintenance, repair and replacement issues associated with the door and window systems and adjoining building systems (e.g., floor, wall, and ceiling surfaces).

Sealing these air leakage pathways can considerably reduce the energy usage of these buildings, improve structural integrity (by stopping the intrusion of moisture, which can cause a significant amount of deterioration to the various construction materials/systems) and can greatly improve the comfort and indoor air quality of the building occupants.

### Recommended Improvements

After completing the audit, our assessment is that we can cost-effectively address weatherization deficiencies in twenty-eight of the buildings studied, that will provide a significant impact on future energy consumption with a reasonable payback. Weatherization in this ESM will include both air sealing and some insulating. Air sealing will include weatherstripping, sealing around exterior penetrations, and roof wall joints. Insulation includes batt insulation on knee-walls, and Thermaxx rigid insulation.



# Scope of Work

#### Barnard

#### Windows

The window systems are metal-framed, double-pane units with fixed and double-hung sections. The window systems tested tight along the sashes, but leaky along the frame-wall junctures of each system. The frame-wall junctures need to be sealed, 1-line, using appropriate non-foam sealant materials.

 Seal along the frame-to-wall junctures of each window system (#1, #2, #3 with appropriate non-foam sealant, total 2,560 lineal feet

#### Attic Air-Sealing

The attic area in the original section has wood-framing and wood flooring with old, deteriorated blown insulation (4"-6") installed within the floored framing. The pitched wood-framed roof deck is uninsulated. There are multiple chases and bypasses that connect the attic to the conditioned spaces below which need to be air-sealed using appropriate materials (2 crew days). Access to the attic space is via an access door and narrow staircase. Much of the old, large disavowed passive ventilation system is still in place. There is ample working height clearance throughout attic section.

 Air-seal chases and penetrations along attic floor system, total 2 crew days, total 8.0 square feet

#### Bucks Hill

#### Windows

The window systems are metal-framed, double-pane units with fixed, slider and hopper-type sections. The windows tested tight along the sashes. The framing details above the window systems in the attached modular tested leaky and these seams need to be air-sealed along 2 seams, using appropriate non-foam sealants. One seam is along the bottom of beam-to-framing. The second seam is along the top of window framing-to-trim. The max working height is 12', with access to the seams above the suspended ceiling system.

- Seal seam along bottom of beam, 1-line (at beam-framing) using appropriate non-foam sealant, total 172 lineal feet
- Seal seam along top of window frame-to-trim, 1-line, using appropriate non-foam sealant, total
   172 lineal feet

# Chase Building

#### Doors

The exterior, attic access, and key interior doors tested leaky and need new weatherstripping installed.

- Weatherstrip standard-sized attic and garage access doors, total 2 doors
- Weatherstrip non-standard doors (3'6" W x 7' H), total 3 doors
- Weatherstrip non-standard door (3'6" W x 8' H), total 1 door



- Weatherstrip non-standard doors (3'6" W x 8' H, copper-clad), total 3 doors
- Weatherstrip non-standard doors (2'6" W x 9' H, copper-clad), total 2 doors
- Weatherstrip the (2' W x 2' H) attic hatch, total 1 hatch

#### Overhead Doors

There is one (1) sectional overhead door installed. The door (10' W x 10' H), tested leaky and should be weatherstripped.

Weatherstrip the sectional overhead door (10' W x 10' H), total 1 door

# Seal Fireplace Damper

The fireplace installed (2nd floor, SW) is leaky at the flue damper (1' W  $\times$  5' L) and the damper needs to be sealed.

Seal the fireplace flue damper, 1-line (½" gap max.), using appropriate sealant materials, total
 13 lineal feet

#### Chase School

#### Doors

The exterior, mechanical room and boiler room door systems tested leaky and need new weatherstrip materials installed.

- Weatherstrip standard exterior, and roof access doors, total 21 doors
- Weatherstrip non-standard roof/attic access door (3' W x 7'6" H), total 1 door
- Weatherstrip non-standard exterior doors (3'6" W x 7'6" H), total 2 doors
- Weatherstrip standard mechanical and boiler room doors, using fire-rated materials, total 2 doors

#### City Hall

#### Doors

The exterior and roof-access doors tested leaky and need new weatherstrip materials installed.

- Weatherstrip standard-sized roof-access and exterior doors, total 15 doors
- Weatherstrip non-standard exterior door (3'6" W x 7'6" H), total 1 door
- Weatherstrip non-standard exterior "auto" doors (3' W x 8'6" H), total 8 doors

#### Crosby-Wallace

#### Roof-Wall

The roof-wall junctures throughout the original middle school and high school wings tested leaky and need to be sealed with 2-component, closed-cell polyurethane spray foam. All flutes on steel decking must be punched and sealed. The 1-story entry and building joints (3rd floor H5 wings-to-library) need to be sealed with 1-line of two-component closed-cell polyurethane spray foam. There are 286 lineal feet of roof-wall and 176 lineal feet of building joints, above the suspended ceilings, at a working height of 13 feet. There are 3,020 lineal feet of roof-wall junctures along the M5 (1,390 LF) and H5 (1,630 LF)



wings, which need 2-lines (1 at roof-wall joint, 1 at bottom of I-beam). Access is above the suspended ceilings, at a working height of 13 feet.

- Seal the roof-wall joint and any framing penetrations, per floor plans, 1-line, at 13' working height, total 286 lineal feet
- Seal the building joints and any framing penetrations, per floor plans, 1-line, at 13' working height, total 176 lineal feet
- Seal the roof-wall joints and any framing penetrations, per floor plans, 2-lines, at 13' working height, total 3,020 lineal feet

# Department of Public Health

#### Doors

The exterior, roof access, boiler room and fire stairwell doors tested leaky. New, effective weatherstrip materials need to be installed.

- Weatherstrip exterior doors, total 9 doors
- Weatherstrip boiler room and stairwell doors, using appropriate fire-rated materials, total 17 doors

# Driggs

#### Attic Hatches

The attic access doors in the building tested leaky and need to be weatherstripped.

Weatherstrip standard-sized attic access and pump room doors, total 2 doors

#### Duggan

#### Doors

The exterior and boiler room doors tested leaky and need new, effective weatherstrip materials installed.

- Weatherstrip standard-sized exterior doors, total 15 doors
- Weatherstrip non-standard exterior doors (3'6" W x 7' H), total 6 doors
- Weatherstrip non-standard exterior doors (4' W x 7' H), total 4 doors
- Weatherstrip standard-sized boiler room doors, using appropriate fire-rated materials, total 2 doors

#### Miscellaneous Sealing

There is a dryer vent penetration along the NE elevation that is leaky and needs to be sealed, using appropriate materials. The vent is 5" in diameter with 3/4" to 1" gap. The vent is directly accessible and the max work height is 8 feet.

 Air-seal dryer vent penetration (5" diam. vent, ¾" to 1" gap), using appropriate sealant materials, total 1 dryer vent



# Enlightenment

#### Doors

The exterior, boiler and fan room doors tested leaky and need new, effective weatherstrip materials installed.

- Weatherstrip standard-sized exterior and fan room doors, total 16 doors
- Weatherstrip non-standard sized boiler room door 4' W x 7' H), total 1 door

### Generali

#### Windows

The window systems are metal-framed, double-pane units with fixed, slider, panel, and double-hung sections. One of the three double-hung systems (W-4) tested leaky along the sashes and need new weatherstrip materials installed.

Weatherstrip the four (4) double-hung window units (W-4), total 44 lineal feet

# Roof-Wall

The roof-wall junctures tested leaky along sections of the portable. the junctures need to be sealed, 1-line, with 2-component, closed-cell polyurethane spray foam. Access to the junctures is above the suspended ceiling system, at a working height of 12 feet.

• Seal the roof-wall joint and any framing penetrations, at 12' working height, total 134 lineal feet

#### Wall-Ceiling Junctures

The wall-to-ceiling panel seams along sections of the gym/stage are leaky and need to be sealed, 1-line, using appropriate sealant materials. There is direct access to the seams, at a working height of 22 feet. A lift may be an option.

Seal the wall-ceiling panel seams and any framing penetrations, 1-line, at 22' working height,
 total 328 lineal feet

### Gilmartin

#### Windows

The metal-frame, double-pane window systems have fixed and casement-type units. The windows tested tight along the sashes, glazing and top/left/right framing seams. The units (Wsys-1, 2, 3, 4, 5, 7, and 8) tested leaky along the bottom frame-sill junctures which need to be sealed using appropriate non-foam sealants. There are 259 window units that need to be sealed along the frame-sill junctures.

 Seal along the frame-to-sill juncture only, (Wsys-1, 2, 3, 4, 5, 7, and 8), 1-line, using appropriate non-foam sealant, total 942 lineal feet

#### Hopeville

# Doors

The exterior and boiler room doors tested leaky and need new weatherstrip materials installed.



- Weatherstrip standard-sized exterior doors, total 15 doors
- Weatherstrip non-standard doors (3' W x 7'6" H), total 4 doors
- Weatherstrip standard-sized boiler room doors, using appropriate fire-rated materials, total 2 doors

#### Windows

The windows are metal-frame, double-pane systems with fixed, panel, slider and double-hung units. The slider and double-hung units tested leaky along the sashes and need to have new, effective weatherstrip materials installed. The meeting rails on the double-hung units tested leaky as well. new sash locks need to be installed. The slider-type units in the gymnasium (W-5) need to have some seals reset and the sash locks replaced. The maximum working height for the gym windows is 18' - 20 feet.

- Weatherstrip the slider-type window units in the main sections (W-1, W-2), total 835 lineal feet
- Weatherstrip the double-hung window units (W-3, W-4), total 2,009 lineal feet
- Replace top-mount sash locks on ninety-seven (97) double-hung window units (W-3, W-4) (2 per unit), total 194 sash locks
- Weatherstrip the seventeen (17) slider-type window units in the gym (W-5), with a max working height of 18 – 20 feet, total 170 lineal feet
- Replace sash locks on seventeen (17) slider-type window units in gym (W-5) (2 per unit), total
   34 sash locks
- Reset window seals in the corners (as needed), on slider-type window units in the gym (W-5) (approx. 5 to 7 of 17 units), total 28 corners

# Kennedy

#### Doors

The exterior doors tested leaky and new weatherstrip materials need to be installed.

- Weatherstrip standard-sized exterior doors, total 55 doors
- Weatherstrip non-standard door, (3'6" W x 7' H), total 1 door

#### Kingsbury

# Doors

The exterior and boiler room doors tested leaky and need new, effective weatherstrip materials installed. The cockloft/roof access hatch needs to be weatherstripped and insulated.

- Weatherstrip standard-sized exterior doors, total 16 doors
- Weatherstrip standard-sized boiler room doors, using appropriate fire-rated materials, total 2 doors
- Weatherstrip and insulate with 4" Thermax the (2'6" W x 2'6" L) roof/cockloft hatch, total 1
   hatch



# Penetrations (Boiler Room Pipe)

There are numerous pipe penetrations in the boiler room which allow ongoing communication with conditioned spaces. the penetrations need to be air-sealed using appropriate fire-rated sealant materials. There are (4) 3" diameter pipes with (1"-2" gaps). There are six (6) 6" diameter pipes with (2" to 4" gaps/holes). There are two (2) bundled 2" pipe penetrations with (2"-3" gaps). The max working height is 16'.

- Air seal pipe penetrations (3" diam., 1"-2" gaps), total 4 penetrations
- Air seal pipe penetrations (6" diam., 2"-4" gaps), total 6 penetrations
- Air seal 2 bundled pipe penetrations (3, 2" pipes within 1 penetration) (2" -" gaps), total 2 bundled penetrations

#### Attic Sealing

Two of the main building sections have an uninsulated plaster/metal lath ceiling surface, with an accessible cockloft section above. The old, passive ventilation ducts vent into the cockloft section, allowing ongoing communication between the conditioned spaces below, the attic and outdoors. The attic side of the plaster/lath ceiling should be air-sealed. Onsite staff noted the existing metal lath framing has supported workers previously using walk-boards. The working height is approximately 4' to 4'6" from plaster/lath surface to underside of the ribs of the concrete roof deck. Access to the cockloft is via access hatch in corridor ceiling, which provides access to the roof hatch as well.

 Air-seal penetrations along plaster/lath ceiling surface, using appropriate sealant materials, total 1 crew day

# Maloney

#### Doors

The exterior, boiler room and mechanical room doors tested leaky and need new, effective weatherstrip materials installed. The boiler and mechanical room doors need fire-rated weatherstrip materials installed. The doors in the building are blue/mill-finished, and beige. Beige and mill-finished door kits will be fine. Weatherstrip the doors, per the floor plan.

- Weatherstrip standard exterior doors, total 16 doors
- Weatherstrip non-standard exterior doors, (3'6" W x 7' H), total 2 doors
- Weatherstrip non-standard exterior doors, (4' W x 7' H), total 9 doors
- Weatherstrip standard boiler/mechanical room doors, using fire-rated materials, total 3 doors

#### Police

# Doors

The exterior doors are leaky and need new weatherstrip materials installed.

- Weatherstrip exterior doors, total 9 doors
- Weatherstrip non-standard doors, (3'6" W x 7' H), total 6 doors
- Weatherstrip non-standard doors, (3' W x 7'6" H), total 2 doors
- Weatherstrip non-standard door, (3' W x 8' H), total 1 door



Weatherstrip non-standard door, (4' W x 7' H), total 1 door

#### Overhead Doors

There are four (4) roll-up overhead doors installed. Three of the doors each measure (11'6" W X 10' H). The remaining door measures (12' W x 10' H). The doors tested leaky and should be weatherstripped.

- Weatherstrip the roll-up overhead doors, (11'6" W x 10' H), total 3 doors
- Weatherstrip the roll-up overhead door, (12' W x 10' H), total 1 door

# Windows

The window systems are metal-frame, double-pane systems, with fixed and casement sections. The casement units (Wsys-2, 2'6" W x 5' H ea.) are leaky along the sashes and need new weatherstrip materials installed.

• Weatherstrip the casement windows, (Wsys-2), total 450 lineal feet

#### Compactor Chute

The old compactor is no longer used. the large (2'6" diameter) compactor chute is very leaky and connects to each floor of the building. The bottom of the chute needs to be sealed, using appropriate sealants.

 Seal bottom opening of compactor chute (2'6" diam.), using appropriate sealant materials, total 1 chute

#### Reed

#### Roof-Wall

The roof-wall junctures in areas of the 2-story and 1-story sections tested leaky and need to be air-sealed, 1-line, using 2-component, closed-cell polyurethane spray foam. All flutes on steel decking must be punched and sealed. Access to the junctures is above the suspended ceiling, a radiant heating panel is installed above the 1st section of suspended ceiling (3' in from exterior walls) and some piping runs parallel to the exterior walls. There are 627 lineal feet of roof-wall junctures along sections of the 2nd floor, at a working height of 16 feet. There are 152 lineal feet of roof-wall junctures along the 1-story section, at a working height of 16 feet.

- Seal the roof-wall joint and any framing penetrations (2nd floor), 1-line, at 16' working height, total 627 lineal feet
- Seal the roof-wall joint and any framing penetrations (1st floor), 1-line, at 16' working height, total 152 lineal feet

#### Regan

#### Doors

The exterior doors tested leaky. New, effective weatherstrip materials need to be installed. The Bilco roof hatch is in poor condition, showing signs of deterioration and damaged framing. We noted considerable air-leakage and significant signs of ongoing water intrusion. We recommend consideration be given toward replacing the hatch with a new energy efficient unit (by others).



- Weatherstrip standard-sized exterior doors, total 17 doors
- Weatherstrip the roof-access hatch (2' W x 3' L), total 1 hatch

#### Rotella

#### Batt Insulated Kneewall

There is an insulated kneewall-type wall section (behind I-beam, in the framing detail beneath the slanted window system in the central corridor, lobby and library) which needs to be covered/sealed, using Thermax (or similar). The kneewall-type detail measures 294 lineal feet by 2' high.

 Cover/seal the batt insulated kneewall (294 LF x 2' H), with Thermax (or similar), and seal all seams using appropriate sealant materials, total 588 square feet

# Silas Bronson Library

#### Doors

The exterior and mechanical room doors tested leaky and need new weatherstrip materials installed. The louver/grille (1'6" W x 1'H) on the mechanical room door should be sealed, using appropriate sealants (e.g., Thermax and flashing, with seams sealed with fire-rated sealant).

- Weatherstrip standard-sized exterior doors, total 3 doors
- Weatherstrip non-standard doors (3'6" W x 7' H), total 2 doors
- Weatherstrip non-standard doors (3'6" W x 7'6" H), total 8 doors
- Weatherstrip non-standard doors ornate metal/brass (3' W x 9' H), total 4 doors
- Weatherstrip standard-sized mechanical room door, using fire-rated materials, total 1 door
- Seal louver/grille (1'6" W x 1' H) on mechanical room door, using appropriate sealants, total 1
   grill

## Windows

The window systems are metal-framed, double-pane fixed units. The windows tested leaky along the frame-wall junctures and the bottom sections of each of the snap trim sections. The frame-wall junctures need to be sealed, 1-line, using appropriate non-foam sealant. The max work height is 15 feet. The bottom gaps, of each snap trim section (4" W x ¾" deep) needs to be sealed using appropriate non-foam sealant materials. The max work height is 15 feet.

- Seal the window systems along the frame-to-wall junctures, 1-line, with appropriate non-foam sealant, total 218 lineal feet
- Seal the bottom gaps of each snap trim section (4" W x ¾" deep ea.), total 86 snap trim sections

#### Roof-Wall

The roof-wall junctures tested leaky in several locations throughout the building. The building joints along 2 sections tested leaky as well. The roof-wall junctures and building joints need to be sealed with 2-component, closed-cell polyurethane spray foam. All flutes on steel decking must be punched and sealed. Access to the junctures and building joints is above the suspended ceiling systems. There are 38 lineal feet of roof-wall junctures and 70 lineal feet of building joints to be sealed, 1-line, at 10' work



height. There are 54 lineal feet of roof-wall junctures and 54 lineal feet of building joints to be sealed, 1-line, at 16' work height. There are 280 lineal feet of roof-wall junctures to be sealed, 3-lines, at 14' work height (1-line at top of beam with 3" gap, 2-lines at bottom of beam with 6" gap). Seal the roof-wall junctures and building joints.

- Seal the roof-wall junctures and building joints, and any framing penetrations, 1-line, at 10'
  working height, total 108 lineal feet
- Seal the roof-wall junctures and building joints, and any framing penetrations, 1-line, at 16'
  working height, total 108 lineal feet
- Seal the roof-wall junctures and any framing penetrations, 3-lines, at 14' working height, total
   280 lineal feet

#### Roof-top Fans

There are two (2) fans on the roof that need to be sealed. Fans should be serviced annually. Inspect fan for proper operation. Inspect and clean dampers.

Inspect and seal the roof-top fans, total 2 roof fans

#### Sprague

#### Windows

The window systems installed are metal-frame, double-pane systems. The window A/C units (1'6" W x 1'6" H each) installed within a number of the window systems are leaky and need to be sealed along the unit-to-window junctures, using appropriate sealant materials.

 Seal the window A/C units, (1'6" W x 1'6" H), along the unit--to-frame junctures, with appropriate sealant materials, (e.g., non-foam sealants/Thermax), total 204 lineal feet

#### Tinker

#### Doors

The exterior and boiler room doors in the building are leaky and need to be weatherstripped. One newer standard-sized exterior door tested tight along door-frame seams but leaky along the framewall junctures. These junctures need to be sealed, 1-line, using appropriate non-foam sealant materials.

- Weatherstrip standard-sized exterior doors, total 21 doors
- Weatherstrip standard-sized boiler doors, using appropriate fire-rated materials, total 2 doors
- Seal along the frame-wall junctures of standard exterior door (1-line at left and top, 2-lines at right) with appropriate non-foam sealant, total 24 lineal feet

#### Penetrations (Boiler Room Pipe)

There are (10) pipe penetrations in the boiler room which allow ongoing communication with conditioned spaces. the penetrations need to be air-sealed using appropriate fire-rated sealant materials. There are (7) 2" diameter pipes with (3/4"-1") gaps). There are 3 bundled pipe penetrations (three 2" pipes thru 1 hole) with (1' x 1' hole to be sealed). The max working height is 16 feet.



- Air-seal pipe penetrations using appropriate fire-rated sealant materials (2" diam., 3/4"-1" gaps), total 7 penetrations
- Air-seal (3) bundled pipe penetrations using appropriate fire-rated sealant materials (1' x 1' holes), total 3 bundled penetrations

#### Air-Seal Cockloft Floor Surface

Three (3) of the main building sections have an uninsulated plaster/metal lath ceiling surface with an accessible cockloft section above. The old, passive ventilation ducts/chases vent into the cockloft section then directly outdoors. The attic side of the plaster/lath ceiling should be air-sealed. Onsite staff noted the existing metal lath framing has supported workers previously using walk-boards, with some walk-boards still present in cockloft. The working height is approximately 3' to 3'6" from plaster/lath surface to underside of the ribs of the concrete roof deck. Access to the cockloft is via access hatch, with fixed steel ladder. The fixed ladder continues through cockloft to underside of the roof-access hatch.

 Air-seal penetrations along plaster/lath ceiling surface, using appropriate sealant materials, total 1.5 crew days

#### Walsh

#### **Building Joints**

The building joints tested leaky at two building junctures. The junctures need to be sealed with 2-lines of two-component, closed-cell polyurethane spray foam. Access to the junctures is above the suspended ceiling. There are 180 lineal feet of building joints, at 16' working height.

Seal the building joints and any framing penetrations, 2-lines, at 16' working height, total 180 lineal feet

#### Wall-Ceiling Joint

A small section of wall-ceiling juncture tested leaky along a 2nd floor landing. The air-leakage path needs to be sealed, 1-line, using appropriate sealant material. Access to the juncture is above the window and drop ceiling at the beam/framing. The working height is 12 feet.

Air-seal leakage path at wall-ceiling juncture, 1-line, using appropriate sealant material, total
 14 lineal feet

# Washington

Attic Insulation and Air Sealing

The air barrier between the conditioned and unconditioned spaces is leaky. All penetrations (e.g., chimney, pipe, and wiring) need to be sealed using appropriate sealant materials. Access to the attic is

Air-seal all penetrations along attic floor, total 1 crew day



### Waterbury Career

#### Doors

The exterior, roof-access and mechanical/chiller room doors tested leaky and need new, effective weatherstrip materials installed.

- Weatherstrip standard-sized exterior and roof-access doors, total 17 doors
- Weatherstrip non-standard doors (3'6" W x 7' H), total 6 doors
- Weatherstrip non-standard doors (3'6" W x 7'6" H), total 10 doors
- Weatherstrip non-standard doors (3'6" W x 10' H), total 2 doors
- Weatherstrip standard-sized mechanical room doors, using appropriate fire-rated materials, total 4 doors

# Wilby-North End

#### Doors

The exterior and boiler room doors tested leaky and new weatherstrip materials need to be installed. One roof hatch (Bilco, 2' W x 5' L) has deteriorated weatherstrip materials. New, appropriate weatherstrip materials need to be installed.

- Weatherstrip standard-sized exterior doors, total 118 doors
- Weatherstrip standard boiler room doors, using fire-rated materials, total 4 doors
- Weatherstrip non-standard doors, (3'6" W x 7' H), total 3 doors
- Weatherstrip non-standard doors, (4' W x 7' H), total 7 doors
- Weatherstrip non-standard doors, (4' W x 8' H), total 2 doors
- Weatherstrip roof access hatch, (2' W x 5' L), total 1 hatch

#### Wilson

#### Air-Seal Cockloft Floor Surface

The main building section has an uninsulated plaster/metal lath ceiling surface, with an accessible cockloft section above. The old, passive ventilation ducts/chases vent into the cockloft section then directly outdoors. The attic side of the plaster/lath ceiling should be air-sealed. Onsite staff noted the existing metal lath framing has supported workers previously, using walk-boards, with some walkboards still present in cockloft. The working height is approximately 3' to 3'6" from plaster/lath surface to underside of the ribs of the concrete roof deck. Access to the cockloft is via access hatch, with fixed steel ladder. The fixed ladder continues through cockloft to underside of the roof-access hatch.

Air-seal penetrations along plaster/lath ceiling surface, using appropriate sealant materials. total 1.5 crew days

#### City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. Customer shall



relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or otherwise interfere with the ESM implementation and installation process.

#### Hazardous Materials Abatement Allowance

The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.

# Interface with Existing Systems & Operations

#### Maintenance Procedures

Worn weather-stripping will need to be inspected and repaired if damaged. Maintenance procedures will be similar to existing requirements.

# Special Operating Requirements

There are no special operating requirements.

# **Equipment Information**

# Manufacturer & Type

NORESCO will install weatherization products as shown below, or approved equal:

- Dow Building Solutions, 200 Larkin Center, Midland, MI 48674, 800-583-BLUE, www.dowbuildingsolutions.com
- Todol Products, 25 Washington Avenue, Natick, MA 01760, 508-651-3818, www.todol.com
- Schlegal Systems, Inc., 1555 Jefferson Road, Rochester, NY 14692, 800-586-0354

# Savings Calculations

To quantify energy savings associated with this measure, NORESCO has developed a spreadsheet model using the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) formulas that calculates air leakage through door and roof-to-wall intersections as a function of gap widths and wind pressure. The savings are calculated by finding the energy cost of this infiltration due to the additional winter heating and summer cooling loads associated from unconditioned air entering the building. Savings were calculated based on the following key assumptions:

- Building construction characteristics
- Infiltration rates for sealable gaps at each building



HVAC system efficiency

Local weather data including average temperature difference and wind speed are also used to calculate the air volume in cubic feet per minute. The energy required to condition this volume was then calculated using the following equations:

- Energy Usage (Btu) = 1.08 × Volume (cfm) × Temperature Difference (°F) × Heating Hours
- CFM = Area (sq.in.) × ((Stack Coeff. × Avg. Temp. Diff) × (Wind Coeff. × Wind Speed^2))1/2



# ESM 7:

# PIPE & FITTING INSULATION



## **ESM 7: Pipe & Fitting Insulation**

**Benefits:** This measure will reduce the amount of heat lost in ventilated mechanical spaces and reduce overheating in nearby occupied areas such as classrooms and administrative spaces. Reduced heat loss will decrease boiler fuel consumption and the City's utility costs. Insulating bare piping will also make it safer for staff and other building occupants by preventing burns on hot steam piping.

Buildings: Barnard Adult Education Bucks Hill School

Bunker Hill School Chase Building

Chase School City Hall

Crosby-Wallace Complex Department of Public Health

Driggs School Enlightenment School

Generali School Hopeville School

Kennedy High School Kingsbury School

Police Headquarters Reed School

Silas Bronson Library Sprague School

Tinker School Walsh School

Wendell Cross School West Side Middle School

Wilby-North End Complex

**Summary:** NORESCO will install new fiberglass pipe insulation with all service jackets, and removable insulating jackets on exposed metal steam and hot water pipe, fittings, valves, and associated equipment in twenty-three (23) City buildings and schools.

Implementation Cost: \$804,567

Energy Cost Savings: \$79,239

Annual Energy Reduction: 76,824 CCF

M&V Protocol: Option A

### Detailed Description

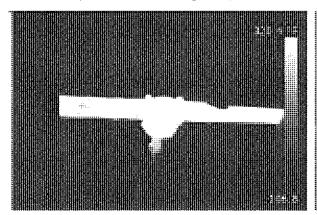
### Existing Description

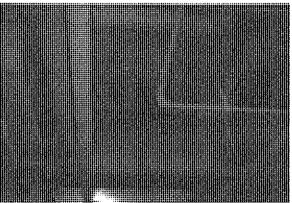
During the IGEA, NORESCO documented un-insulated lengths of heating and domestic hot water (DHW), steam, and condensate piping, fittings, flange pairs, bonnets, and equipment such as steam traps, isolation valves, and vessels such as heat exchangers, condensate receivers, and expansion

Information on this page is proprietary and subject to confidentiality restrictions



tanks. Steam leaks as well as bare steam pipe and equipment pose a significant safety concern to anyone with access to these conditions. Exposed piping results in significant energy losses and in the cases of building mechanical rooms, can also result in overheating and uncomfortable conditions in adjacent spaces. By installing new insulation on this piping and equipment, comfort conditions in these facilities will be improved and thermal savings will be achieved. Uninsulated piping can also pose a safety hazard for building occupants and maintenance workers.





Infrared photo of bare valve and pipe (left) and camera photo of bare valve and pipe (right).

### Recommended Improvements

NORESCO will insulate exposed steam and hot water heating system pipe in the boiler and mechanical rooms of the selected City's buildings and schools. We completed a comprehensive audit of all HVAC and related piping and equipment in the boiler and other mechanical rooms and penthouses.

The new insulation will greatly reduce the thermal losses associated with the steam and hot water piping systems. A reduction in thermal losses will lower the demand on the heating systems in the associated buildings, reducing fuel consumption and utility costs. Insulating bare steam pipe will also make these buildings safer for students and staff.

### Scope of Work

The scope of work includes insulating boiler and mechanical room bare piping and fittings in twenty-three of the City's buildings and schools.

- Remove and properly dispose of damaged insulation, pipe jacketing or other materials as
  necessary prior to the installation of blanket insulation. Pipe hangers, rollers and threaded rod
  shall remain in place and insulation shall be installed around these materials.
- Verify surfaces are clean and dry prior to installation. Examine the thermal valves, tanks, strainers, pumps, and fittings for signs of excessive wear or corrosion and notify the Owner of any defects in writing prior to the installation of thermal blankets.
- Field-verify IGEA measurements to ensure that the material inventory is accurate.
- Install the thermal blanket and removable jacket insulation for the specified equipment in accordance with the manufacturer's specifications.

Information on this page is proprietory and subject to confidentiality restrictions



- Install steam blankets snug and fasten with Velcro straps or 20 gauge stainless steel wire ties, with no portions left dangling or creating a hazard.
- Blanket will extend beyond mating flanges onto existing insulation for a minimum of 2". Where blanket cannot fit over existing insulation, blanket will butt up to existing insulation with friction fit closing seam.
- Type A pipe insulation includes a foil and paper jacket: Laminated glass-fiber-reinforced, flame retardant Kraft paper and aluminum foil – white exterior, Kraft reinforce foil vapor barrier with self-sealing adhesive joints.
- Type A pipe insulation terminations will be neatly finished with Childers Vi-Cryl CP-11 Mastic, or equal.
- Jacket pieces which match mating seams include an extended 2" flap constructed from the
  exterior fabric and shall be secured using hook & loop closure (i.e., Velcro TM) parallel to the
  seam.
- Insulation will be sewn as integral part of the jacket to prevent shifting of the insulation. Insulation pins are not an allowable method of preventing the insulation from shifting and will not be used.

### City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. Customer shall relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or otherwise interfere with the ESM implementation and installation process.

### Hazardous Materials Abatement Allowance

The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.

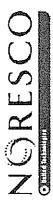
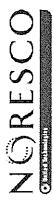


Table 1: Insulation Audit Schedule

ltem	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
31.001	Barnard	t t	Low Water Cut-Off - 31,001	n/a	n/a	n/a	2.00	ŧ
31.002	Barnard		Low Water Cut-Off - 31.002	n/a	п/а	n/a	2.00	-
31.003	Barnard	1	6 Gate Valve 125/150 (0-299°F) 1" - 31.003	n/a	125/150	6.00	5.04	-
31.004	Barnard		6 Flange 125/150 (0-299°F) 1" - 31.004	n/a	125/150	6.00	1.92	-
31.005	Barnard	1	Condensate Receiver - 31.005	e/u	n/a	n/a	15.55	-
31.006	Barnard		1.25 FT steam trap (0°-299°F) 10mm Exterior - 31.006	n/a	NPT	1.25	1.88	10mm
31.007	Barnard		1.25" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 31.007	n/a	LAN	1.25	2.61	-
31.008	Barnard		1.25" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 31.008	n/a	TdN	1.25	2.61	# T
31.009	Barnard	1	2 Wye Strainer NPT (0-299°F) 10mm - 31.009	n/a	PPN	2.00	1.62	10mm
31.01	Barnard		2.5 Flange 125/150 (0-299°F) 1" - 31.01	n/a	125/150	2.50	1.22	To the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of th
31.011	Barnard	1	Low Water Cut-Off - 31.011	n/a	n/a	n/a	2.00	-
31.012	Barnard	1	Low Water Cut-Off - 31.012	n/a	n/a	n/a	2.00	-
31.013	Barnard	1	Low Water Cut-Off - 31.013	n/a	n/a	n/a	2.00	-
31.014	Barnard	1	4 Flange 125/150 (0-299°F) 1" - 31.014	n/a	125/150	4.00	1.57	<u> </u>
31.015	Barnard	1	4 Flange 125/150 (0-299°F) 1" - 31.015	n/a	125/150	4.00	1.57	-
31.016	Barnard		3 Bonnet - Gate 125/150 (0-299ºF) 1" - 31.016	n/a	125/150	3.00	1,34	-
31.017	Barnard		3 Bonnet - Gate 125/150 (0-299°F) 1" - 31.017	n/a	125/150	3.00	1.34	-
31.018	Barnard		8 Bonnet - Gate 125/150 (0-299ºF) 1" - 31.018	n/a	125/150	8.00	3.39	-
31.019	Barnard		4 Flange 125/150 (0-299°F) 1" - 31.019	n/a	125/150	4.00	1.57	=
31.02	Barnard		1.25" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 31.02	n/a	NPT	1.25	2.61	



'V Insulation m Thickness	1	38 10mm	10 1	20	14.00 1.5"	00		1.1	4 1"	54 mm	: :	4		1	11 10mm		 	000	: : : :	7 10mm	
Nom. SqFt/ Pipe Item Size	1.25 2.61	1.25 1.88	5.00 4.40	2.00 31.00		1,25 17,00	4.00 3.45	6.00 5.04	danaman morana	2.50 0.54	2.50 1.11	2.50 2.14	4.00 3.45	6.00 5.04	2.00 3.11	2.00 3.50	2.00 3.53	2,00 39,00	1.50 14.00	0.75 1.67	0.75 1.96
Flange P Class S	NPT	NPT	125/150 5	N/A 2		N/A	125/150 4	125/150 6	125/150 2	N/A	125/150 2	125/150 2	125/150 4	125/150 6	NPT 2.	NPT 2	NPT 2	N/A	***************************************	NPT	O LAN
LF of Piping	п/а	n/a	n/a	09	35	50	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1/a	n/a	75	35	n/a	n/a
Description	1.25" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 31.021	1.25 FT steam trap (0°-299°F) 10mm Exterior - 31.021	5 Gate Valve 125/150 (0-299°F) 1" - 31.023	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 31.024	1.5" Hard Pipe Insulation x1' 1.5" - 31.025	1.25" Hard Pipe Insulation x1'1" (0°-299°F) - 31.026	4 Gate Valve 125/150 (0-299°F) 1" - 7001	6 Gate Valve 125/150 (0-299°F) 1" - 7002	2.5 Gate Valve 125/150 (0-299°F) 1" - 7003	2.5 Elbows 90°1" (0-299°F) - 7004	2.5 Control Valve 125/150 (0-299°F) 1" - 7005	2.5 Gate Valve 125/150 (0-299°F) 1" - 7006	4 Gate Valve 125/150 (0-299°F) 1" - 7007	6 Gate Valve 125/150 (0-299°F) 1" - 7008	2 FT Steam Trap (0°-299°F) 10mm Exterior - 7009	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 7010	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 7011	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 7012	1.5" Hard Pipe Insulation x1' 1" (0°-299°F) - 7013	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 7014	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 7015
Location 2	1					•							t		t		i				
Location 1	Barnard	Barnard	Barnard	Barnard	Barnard	Barnard	Bucks Hill	Bucks Hill	Bucks Hill	Bucks Hill	Bucks Hill	Bucks Hill	Bucks Hill	Bucks Hill	Bucks Hill	Bucks Hill	Bucks Hill	Bucks Hill	Bucks Hill	Bucks Hill	Bucks Hill
ltem	31.021	31.022	31.023	31,024	31.025	31,026	7001	7002	7003	7004	7005	7006	7007	7008	7009	7010	7011	7012	7013	7014	7015



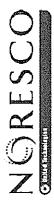
Item	Location 1	Location 2	Description	LFof	Flange Class	Nom, Pipe Size	SqFt/ Item	Insulation Thickness
7016	Bucks Hill	1	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 7016	n/a	NPT	0.75	1.96	<u> </u>
7017	Bucks Hill	1	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 7017	n/a	NPT	0,75	1.67	10mm
7018	Bucks Hill		0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 7018	n/a	LAN	0.75	1.96	=
7019	Bucks Hill		0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 7019	n/a	NPT	0.75	1.96	<del>[</del>
7020	Bucks Hill	•	4" Hard Pipe Insulation x1' 1" (0°-299°F) - 7020	10	N/A	4.00	11.00	<b>.</b>
7021	Bucks Hill	F	4 Flange 125/150 (0-299°F) 1" - 7021	n/a	125/150	4.00	1.57	-
7022	Bucks Hill	\$	6 Flange 125/150 (0-299°F) 1" - 7022	n/a	125/150	6.00	1.92	
7023	Bucks Hill	1	6 Flange 125/150 (0-299°F) 1" - 7023	n/a	125/150	6.00	1.92	
7024	Bucks Hill		6 Flange 125/150 (0-299°F) 1" - 7024	n/a	125/150	6.00	1,92	
7025	Bucks Hill	ţ	6 Flange 125/150 (0-299°F) 1" - 7025	n/a	125/150	6.00	1.92	
7026	Bucks Hill		6 Flange 125/150 (0-299°F) 1" - 7026	п/а	125/150	6.00	1.92	# T
7027	Bucks Hill	B	6 Flange 125/150 (0-299°F) 1" - 7027	n/a	125/150	6.00	1.92	
7028	Bucks Hill		6 Gate Valve 125/150 (0-299°F) 1" - 7028	n/a	125/150	6.00	5.04	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
7029	Bucks Hill	t	Boiler Drum - 7029	n/a	n/a	n/a	13.40	-
7030	Bucks Hill		Boiler Drum - 7030	п/а	n/a	n/a	13,40	
7031	Bucks Hill	t	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 7031	п/а	LM	0.75	1.67	10mm
7032	Bucks Hill		0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 7032	1/a	NPT	0,75	1.96	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
7033	Bucks Hill	L	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 7033	n/a	NPT	0.75	1.96	. <b>E</b>
7034	Bucks Hill		Condensate Receiver - 7034	n/a	n/a	n/a	15.55	TI -
13.001	Bunker Hill	10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 miles (10 mil	6 Crane Gate Valve 125/150 (0-299°F) 1" - 13.001	n/a	125/150	6.00	5.04	-
13.002	Bunker Hill		8" Blind Flange 125/150 (0-299°F) 1" -13,002	n/a	125/150	8:00	3.28	



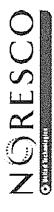
ltein	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
13.003	Bunker Hill		5 Bonnet - Gate 125/150 (0-299°F) 1" - 13.003	n/a	125/150	5.00	2.20	
13.004	Bunker Hill	1	2 FT Steam Trap (0°-299°F) 10mm Exterior - 13,004	n/a	TAN	2.00	3.11	10mm
13.005	Bunker Hill	1	Low Water Cut-Off - 13.005	n/a	n/a	n/a	2.00	*
13.006	Bunker Hill		Back Boiler Door - 13.006	n/a	n/a	n/a	50.00	
13.007	Bunker Hill		5 Flange 125/150 (0-299°F) 1" - 13.007	n/a	125/150	5.00	1.75	£
13.008	Bunker Hill	•	Low Water Cut-Off -13.008	n/a	n/a	n/a	2.00	1
13.009	Bunker Hill		4 Gate Valve 125/150 (0-299°F) 1" - 13.009	n/a	125/150	4.00	3,45	William Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Con
13.01	Bunker Hill		4 Gate Valve 125/150 (0-299°F) 1" -13.01	n/a	125/150	4,00	3,45	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
13.011	Bunker Hill		10 Flange 125/150 (0-299°F) 1" - 13.011	n/a	125/150	10.00	2.79	-
13.012	Bunker Hill		6 Gate Valve 125/150 (0-299ºF) 1" - 13,012	n/a	125/150	6.00	5.04	Ţ
13.013	Bunker Hill		5 Flange 125/150 (0-299°F) 1" - 13.013	n/a	125/150	5.00	1.75	
13.014	Bunker Hill		0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 13.014	n/a	TdN	0.75	1.96	The second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of th
13.015	Bunker Hill	. 1	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 13.014	n/a	T A N	0.75	1.96	=_
13.016	Bunker Hill	•	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F)	n/a	LdN	0.75	1,96	Production del Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control of Control
13.017	Bunker Hill	-	0.75" Hard Pipe Insulation x1' 1" (0°-299°F) - 13.017	46	N/A	0.75	9.00	
13.018	Bunker Hill		4" Hard Pipe Insulation x111" (0°-299°F) - 13,018	င္ထ	N/A	4.00	87,00	THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE S
13.019	Bunker Hill	ı	4 Flange 125/150 (0-299°F) 1" - 13.019	n/a	125/150	4.00	1.57	=
13.02	Bunker Hill	***	4 Flange 125/150 (0-299°F) 1" - 13.02	n/a	125/150	4.00	1.57	-
13.021	Bunker Hill	ı	Condensate Tank - 13,021	n/a	n/a	n/a	19.25	-
13.022	Bunker Hill		2" Hard Pipe Insulation x1'1" (0°-299°F) - 13.022	28	N/A	2.00	15.00	-
13.023	Bunker Hill	An additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and additional data and add	4" Hard Pipe Insulation x1'1" (0°-299°F) - 13.023	2	N/A	4.00	2.00	-
13.024	Bunker Hill		Low Water Cut-Off-13.024	72	n/a	n/a	2.00	



		Location 2	Description	Piping	Class	Size	llem	Thickness
13.025 Bun	Bunker Hill	ŧ	4 Flange 125/150 (0-299°F) 1" - 13.024	n/a	125/150	4.00	1.57	-
13.026 Bun	Bunker Hill	•	4 Flange 125/150 (0-299°F) 1" - 13.026	n/a	125/150	4.00	1.57	=-
13.027 Bun	Bunker Hill		Low Water Cut-Off - 13.027	n/a	n/a	n/a	2.00	-
13.028 Bun	Bunker Hill		Back Boiler Door - 13.028	e/u	n/a	n/a	50.00	A Laboratory of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the C
13.029 Bun	Bunker Hill	<b>I</b>	5 Flange 125/150 (0-299°F) 1" - 13.029	n/a	125/150	5.00	1.75	<b>=</b>
13,03 Bun	Bunker Hill		2 FT Steam Trap (0°-299°F) 10mm Exterior - 13,03	n/a	TaN	2.00	3.11	10mm
13.031 Bun	Bunker Hill	i i i i i i i i i i i i i i i i i i i	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 13.024	2	N/A	2.00	5.00	<u>.</u>
13.032 Bun	Bunker Hill		2" Hard Pipe Insulation x1' 1" (0°-299°F) - 13.032	355	N/A	2.00	18.00	•
13.033 Bun	Bunker Hill		2 FT Steam Trap (0°-299°F) 10mm Exterior - 13.033	n/a	NPT	2.00	3.11	10mm
13.034 Bun	Bunker Hill		2.5 Gate Valve 125/150 (0-299°F) 1" - 13.034	η/a	125/150	2.50	2.14	
13.035 Bun	Bunker Hill	1	2.5 Gate Valve 125/150 (0-299°F) 1" - 13.035	n/a	125/150	2,50	2.14	-
13.036 Bun	Bunker Hill		1.25" Hard Pipe Insulation x1' 1" (0°-299°F) - 13.036	25	N/A	1.25	8.00	
3001 Cha	Chase Building	Boiler room	4" Hard Pipe Insulation x1'1" (0°-299°F) - 3001	6	N/A	4.00	9.00	*
3002 Cha	Chase Building	Boiler room	4 Flange 125/150 (0-299°F) 1" - 3002	n/a	125/150	4.00	157	1
3003 Cha	Chase Building	Boiler room	3 Flange 125/150 (0-299°F) 1" - 3003	n/a	125/150	3.00	131	-
3004 Cha	Chase Building	Boiler room	3 Flange 125/150 (0-299°F) 1" - 3004	n/a	125/150	3.00	13	Marie Street Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control
3005 Cha	Chase Building	Boiler room	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 3005	9	N/A	2.00	31.00	F
3006 Cha	Chase Building	Boiler room	4 Flange 125/150 (0-299°F) 1" - 3006	n/a	125/150	4.00	1.57	=
3007 Cha	Chase Building	Boiler room	4 Flange 125/150 (0-299°F) 1" - 3007	n/a	125/150	4.00	1.57	=
3008 Cha	Chase Building	Boiler room	4 Flange 125/150 (0-299°F) 1" - 3008	n/a	125/150	4.00	1.57	11
3009 Cha	Chase Building	Boiler room	Low Water Cut-Off - 3009	n/a	n/a	n/a	2.00	
3010 Cha	Chase Building	Boiler room	Low Water Cut-Off - 3010	n/a	/a	n/a	2.00	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
3011 Cha	Chase Building	Boiler room	4 Basket Strainer 125/150 1" (0-299°F)	n/a	125/150	4.00	18.92	<u> </u>
3012 Cha	Chase Building	Boiler room	2 Gate Valve 250/300 (0-299°F) 1" - 3012	n/a	250/300	2.00	1,98	11
3013 Cha	Chase Building	Boiler room	3 Check Valve 125/150 (0-299°F) 1"	n/a	125/150	3.00	2.45	-



ltem	Location	Location 2	Description	LF of Piping	Flange Class	Nom, Pipe Size	SqFt/ Item	Insulation Thickness
3014	Chase Building	Boiler room	4 Bonnet - Gate 125/150 (0-299°F) 1" - 3014	n/a	125/150	4.00	1.73	μĻ
21.001	Chase	Boiler room	5 Gate Valve 125/150 (0-299°F) 1" - 21.001	n/a	125/150	5.00	4.40	ŧ-
21.002	Chase	Boller room	5" Hard Pipe Insulation x1' 1" (0°-299°F) - 21.002	2	N/A	5.00	3:00	£
21.003	Chase	Boiler room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 21.003	n/a	NPT	0.75	1.67	10mm
21.004	Chase	Boiler room	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 21.004	n/a	LAN	0.75	1.96	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
21.005	Chase	Boiler room	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 21.005	n/a	LAN	0.75	1.96	-
21.006	Chase	Boller room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 21.006	n/a	TAN	0.75	1.67	10mm
21.007	Chase	Boiler room	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 21.007	n/a	NPT	0.75	1,96	F. Control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the con
21.008	Chase	Boiler room	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 21.008	n/a	LMN	0.75	1,96	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
21.009	Chase	Boiler room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 9036	n/a	NPT	0.75	1.67	10mm
21.01	Chase	Boiler room	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 21.01	n/a	LMN	0.75	1,96	
21.011	Chase	Boiler room	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 21.011	n/a	TAN	0.75	1,96	<u></u>
21.012	Chase	Boiler room	2.5 Flange 125/150 (0-299°F) 1" - 21.012	n/a	125/150	2.50	1.22	
21.013	Chase	Boiler room	2.5 Flange 125/150 (0-299°F) 1" - 21.013	n/a	125/150	2.50	1.22	<b>F</b>
21.014	Chase	Boiler room	2 FT Steam Trap (0°-299°F) 10mm Exterior - 21.014	e/u	LAN	2.00	3.11	10mm
21.015	Chase	Boiler room	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 21.015	n/a	NPT	2.00	3.50	<del>-</del>
21.016	Chase	Boiler room	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 21.016	n/a	NPT	2.00	3.53	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
21.017	Chase	Boiler room	Condensate Receiver - 21.017	n/a	n/a	n/a	15.55	: : : :
21.018	Chase	Boiler room	2.5" Hard Pipe Insulation x1'1" (0°-299°F) - 21.018	38	N/A	2.50	25.00	1



(tem	Location 1	Location 2	Description	LEof	Flange Class	Nom, Pipe Size	SqFt/. Item	Insulation Thickness
21.019	Chase	Boiler room	2.5 Gate Valve 125/150 (0-299°F) 1" - 21.019	n/a	125/150	2.50	2.14	=
21.02	Chase	Boiler room	2.5 Gate Valve 125/150 (0-299°F) 1" - 21.02	n/a	125/150	2.50	2.14	•
21.021	Chase	Boiler room	2.5 Gate Valve 125/150 (0-299°F) 1" - 21.021	r∕a	125/150	2.50	2.14	
21.022	Chase	Boiler room	2.5 Ball Valves 125/150 (0-299°F) 1" - 21.022	n/a	125/150	2.50	1,13	
21.023	Chase	Boiler room	2.5 Ball Valves 125/150 (0-299°F) 1" - 21.023	n/a	125/150	2.50	1.13	} } } } }
21.024	Chase	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 21.024	n/a	125/150	4.00	3.45	
21.025	Chase	Boiler room	4 Tee 125/150 1" (0-299°F) - 21.025	n/a	125/150	4.00	1.13	<b>.</b>
21.026	Chase	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 21.026	n/a	125/150	4.00	3,45	eranound three error and data boson to Communic
21.027	Chase	Boiler room	5 Gate Valve 125/150 (0-299°F) 1" - 21.027	n/a	125/150	5.00	4.40	-
21.028	Chase	Boiler room	8 Gate Valve 125/150 (0-299ºF) 1" - 21.028	n/a	125/150	8.00	6.77	<b>.</b>
21.029	Chase	Boiler room	5" Blind Flange 125/150 (0-299°F) 1" - 21,029	n/a	125/150	5.00	2.29	**************************************
21.03	Chase	Boiler room	5" Blind Flange 125/150 (0-299°F) 1" - 21,03	n/a	125/150	5.00	2.29	TIL
21.031	Chase	Boiler room	Low Water Cut-Off - 21.031	n/a	n/a	п/а	2.00	
21.032	Chase	Boiler room	Low Water Cut-Off - 21:032	n/a	n/a	e 2	2.00	-
21.033	Chase	Boiler room	Low Water Cut-Off - 21.033	n/a	n/a	n/a	2.00	=
21.034	Chase	Boiler room	0.75" Hard Pipe Insulation x1'1" (0°-299°F) - 21.034	24	N/A	0.75	5.00	A Commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of the commence of
21.035	Chase	Boiler room	Low Water Cut-Off - 21.035	n/a	п/а	n/a	2.00	# # # # # # # # # # # # # # # # # # #
21.036	Chase	Boiler room	Low Water Cut-Off - 21.036	n/a	n/a	n/a	2.00	#
21.037	Chase	Boiler room	5 Flange 125/150 (0-299°F) 1" - 21.037	n/a	125/150	5.00	1.75	-
21.038	Chase	Boiler room	5 Flange 125/150 (0-299°F) 1" - 21.038	n/a	125/150	5.00	1.75	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
21.039	Chase	Boiler room	2 Gate Valve NPT (0-299°F) 10mm - 9036	n/a	NPT	2.00	1.80	10mm
21.04	Chase	Boiler room	3 Flange 125/150 (0-299°F) 1" - 21.04	n/a	125/150	3.00	131	į.
21.041	Chase	Boiler room	5 Gate Valve 125/150 (0-299°F) 1" - 9036	п/а	125/150	5.00	4.40	<u> </u>
4001	City Hall	Воіїег гоот	- 4" Pump Jacket = 4001	n/a	N/A	4.00	9.33	Processor to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the second to the
4002	City Hall	Boiler room	4" Pump Jacket - 4002	n/a	N/A	4.00	9.33	=

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lfem	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom, Pipe Size	SqFt/ Item	Insulation Thickness
4003	City Hall	Boiler room	4" Pump Jacket - 4003	n/a	N/A	4.00	9.33	
4004	City Hall	Boiler room	4 Flange 125/150 (0-299°F) 1" - 4004	n/a	125/150	4.00	1.57	-
4005	City Hall	Boiler room	4" Pump Jacket - 4005	n/a	N/A	4,00	9.33	
4006	City Hall	Boiler room	4" Pump Jacket - 4006	n/a	N/A	4.00	9.33	
4007	City Hall	Boiler room	4" 3-Way Valve 125/150 (0-299°F) 1" - 4007	n/a	125/150	4.00	6.28	
4008	City Hall	Boiler room	4" 3-Way Valve 125/150 (0-299°F) 1" - 4008	n/a	125/150	4.00	6.28	<b>-</b>
4009	City Hall	Boiler room	4" 3-Way Valve 125/150 (0-299°F) 1" - 4009	n/a	125/150	4.00	6.28	=
4010	City Hall	Boiler room	4 Wye Cap 125/150 (0-299°F) 1" - 4010	n/a	125/150	4.00	1.56	Total Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control
4011	City Hall	Boiler room	4 Wye Cap 125/150 (0-299°F) 1" - 4011	- - -	125/150	4.00	1.56	
4012	City Hall	Boiler room	4 Wye Cap 125/150 (0-299°F) 1" - 4012	n/a	125/150	4.00	1.56	-
24,001	Crosby-Wallace	Boiler room c157	18 Flange 125/150 1" (0-299°F) - 24.001	n/a	125/150	18.00	8.00	
24.002	Crosby-Wallace	Boiler room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 24.002	n/a	LGN	0.75	1.67	10mm
24.003	Crosby-Wallace	Boiler room	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24.003	n/a	LdN	0.75	961	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
24.004	Crosby-Wallace	Boiler room	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.004	n/a	TAN	0.75	1.96	<b>-</b>
24,005	Crosby-Wallace	Boiler room	0.75" Hard Pipe Insulation x1" (0°-299°F) - 24.005	38	N/A	0.75	8.00	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
24.006	Crosby-Wallace	Boiler room	8 Bonnet - Gate 125/150 (0-299°F) 1" - 9036	n/a	125/150	8.00	3.39	-
24,007	Crosby-Wallace	Boiler room	18 Flange 125/150 1" (0-299°F) - 24,007	n/a	125/150	18,00	8.00	=
24.008	Crosby-Wallace	Boiler room	8 Bonnet - Gate 125/150 (0-299°F) 1" - 24.008	n/a	125/150	8.00	3.39	-
24.009	Crosby-Wallace	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 24,009	n/a	125/150	6.00	2.52	Amount of the little of the lateral Artificial Artificial Artificial Community of the lateral Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artificial Artif
24.01	Crosby-Wallace	Boiler room	4 Bonnet - Gate 125/150 (0-299°F) 1" - 24.01	e/u	125/150	4.00	1.73	<u>-</u>
24,011	Crosby-Wallace	Boiler room	8 Bonnet - Gate 125/150 (0-2999F) 1" - 24.011	n/a	125/150	8.00	3.39	
24.012	Crosby-Wallace	Boiler room	18 Flange 125/150 1" (0-299°F) - 24.012	n/a	125/150	18.00	8.00	ŧ-
24.013	Crosby-Wallace	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 24.013	n/a	125/150	6.00	2.52	11

ESM 7: Pipe & Fitting Insulation Page | 11



ltem	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
24.014	Crosby-Wallace	Boiler room	8 Bonnet - Gate 125/150 (0-299°F) 1" - 24.014	n/a	125/150	8.00	3,39	=-
24.015	Crosby-Wallace	Boller room	* 4 Bonnet - Gate 125/150 (0-299°F) 1" - 24.015	e/⊔	125/150	4.00	1.73	-
24.016	Crosby-Wallace	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 24.016	n/a	125/150	6.00	2.52	<b>=</b>
24.017	Crosby-Wallace	Boiler room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 24.017	n/a	NPT	0.75	1.67	10mm
24.018	Crosby-Wallace	Boiler room	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24.018	n/a	FGZ	0.75	1.96	ž
24.019	Crosby-Wallace	Boiler room	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.019	n/a	LdN	0.75	1.96	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
24.02	Crosby-Wallace	Boiler room	1.25 McDonald Miller Low Water Cut-Off - 24.02	n/a	N/A	1.25	2.00	2 <b>L</b>
24.021	Crosby-Wallace	Boller room	1.25 McDonald Miller Low Water Cut-Off - 24.021	n/a	N/A	1.25	2.00	
24.022	Crosby-Wallace	Boiler room	1.25 McDonald Miller Low Water Cut-Off - 24.022	n/a	N/A	1.25	2.00	=
24.023	Crosby-Wallace	Boiler room	1.25" Hard Pipe Insulation x1'1" (0°-299°F) - 24.023	25	NA	1.25	8,00	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
24.024	Crosby-Wallace	Boiler room	3" Hard Pipe Insulation x 1' 1" (0°-299°F) - 9036	09	N/A	3.00	48.00	=
24.025	Crosby-Wallace	Boiler room	3 Flange 125/150 (0-299°F) 1" - 24.025	n/a	125/150	3.00	1.3	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
24.026	Crosby-Wallace	Boiler room	3 Flange 125/150 (0-299°F) 1" - 24.026	n/a	125/150	3.00	<u>ب</u>	<b>F</b>
24,027	Crosby-Wallace	Boller room	1FT Steam Trap (0°-299°F) 10mm Exterior - 9036	n/a	LAN	1.00	1.83	10mm
24.028	Crosby-Wallace	Boiler room	1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24.028	n/a	LAN	1.00	2.25	= = = = = = = = = = = = = = = = = = =
24.029	Crosby-Wallace	Boiler room	1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.029	n/a	LAN	1.00	2.25	H C C C C C C C C C C C C C C C C C C C
24.03	Crosby-Wallace	Boiler room	1" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.03	10	N/A	1.00	3.00	**************************************
24,031	Crosby-Wallace	Boiler room	Back Boiler Door - 24.031		n/a	_/a	50.00	3
24,032	Crosby-Wallace	Boiler room	Back Boiler Door - 24.032	n/a	n/a	n/a	50.00	-
24.033	Crosby-Wallace	Boiler room	Back Boiler Door - 24.033	n/a	n/a	n/a	50.00	
24.034	Crosby-Wallace	Boiler room	4 Bonnet - Gate 125/150 (0-299°F) 1" - 24.034	n/a	125/150	4.00	1.73	_
24.035	Crosby-Wallace Boller room	Boller room	Condensate Tank 24.035	n/a	n/a	n/a	19.25	4
			Information on this name is proprietory and subject to confidentiality restriction	•				

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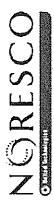
Rem	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom, Pipe Size	SqFt/ Item	Insulation Thickness
24.036	Crosby-Wallace	Boiler room	Condensate Tank - 24.036	n/a	n/a	n/a	19.25	=
24.037	Crosby-Wallace	Boiler room	2.5 Control Valve 125/150 (0-299°F) 1" - 24.037	n/a	125/150	2.50	H.	-
24.038	Crosby-Wallace	Boiler room	2.5 Control Valve 125/150 (0-299°F) 1" - 9036	n/a	125/150	2.50	1.1	<b>2</b>
24.039	Crosby-Wallace	Boiler room	2.5" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.039	40	N/A	2.50	26.00	A artem for restainty of trend And Dad astronochasters
24.04	Crosby-Wallace	Boiler room	4 Control Valve 125/150 (0-299°F) 1" - 24.04	n/a	125/150	4.00	2.06	=
24.041	Crosby-Wallace	Boiler room	4 Butterfly Valve 125/150 (0-299°F) 1" - 24.041	n/a	125/150	4,00	1,47	
24.042	Crosby-Wallace	Boiler room	4 Control Valve 125/150 (0-299°F) 1" - 24.042	n/a	125/150	4.00	2.06	<b>E</b>
24.043	Crosby-Wallace	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 24.043	n/a	125/150	4.00	3,45	The same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the sa
24.044	Crosby-Wallace	Boiler room	0.75" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.044	5	N/A	0.75	1.00	<b>2</b>
24.045	Crosby-Wallace	Boiler room	4 Flange 125/150 (0-299°F) 1" - 24.045	n/a	125/150	4.00	1.57	# <b>.</b>
24.046	Crosby-Wallace	Boiler room	Heat Exchanger Head - 24.046	n/a	n/a	n/a	14.50	
24.047	Crosby-Wallace	Boiler room	Heat Exchanger Head - 24.047	n/a	n/a	n/a	14,50	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
24.048	Crosby-Wallace	Boiler room	Condensate Tank	n/a	n/a	п/а	19.25	
24.049	Crosby-Wallace	Boiler room	2.5 Butterfly Valve 250/300 (0-299°F) 1" - 24.049	n/a	250/300	2.50	1.10	
24.05	Crosby-Wallace	Boiler room	1.5" Inline Pump - 24.05	n/a	N/A	1.50	3.00	į.
24.051	Crosby-Wallace	Boiler room	1.5" Inline Pump - 24.051	п/а	N/A	1.50	3.00	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
24.052	Crosby-Wallace	Boiler room	Heat Exchanger Head - 24.052	n/a	n/a	n/a	14.50	-
24.053	Crosby-Wallace	Boiler room	2.5 Bell and Gossett 3D-2.55 Triple Duty Valve 1 - 24.053	n/a	N/A	2.50	1.83	=
24.054	Crosby-Wallace	Boiler room	2.5 Bell and Gossett 3D-2.55 Triple Duty Valve 1 - 24.054	n/a	N/A	2.50	1,83	-
24.055	Crosby-Wallace	Boiler room	2.5 Bell and Gossett 3D-2.55 Triple Duty Valve 1-24,054	n/a	N/A	2,50	1.83	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
24.056	Crosby-Wallace	Boiler room	2.5 Gate Valve 125/150 (0-299°F) 1" - 24.056	n/a	125/150	2.50	2.14	-
24,057	Crosby-Wallace	Boiler room	2.5 Gate Valve 125/150 (0-299°F) 1" - 24.057	n/a	125/150	2.50	2.14	
24.058	Crosby-Wallace	Boiler room	Condensate Tank	n/a	n/a	n/a	19,25	-
24,059	Crosby-Wallace	Boiler room	4 Flange 125/150 (0-299°F) 1" - 24.059	n/a	125/150	4,00	1.57	
24.06	Crosby-Wallace	Boiler room	2.5 Flange 125/150 (0-299°F) 1" - 24.06	п/а	125/150	2.50	1.22	±

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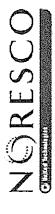
Location 1	Location 2	Description	LF of Piping	Flange Class	North Pipe Size	SqFt/ Item	Insulation Thickness
33 C 33	Boiler room	Air Separator - 24:061	n/a	n/a	n/a	5.00	#1
	Boiler room	2.5" Spool 125/150 (0-299°F) 1" - 24.063	n/a	125/150	2.50	1.83	-
	Boiler room	2.5 Butterfly Valve 125/150 (0-299°F) 1" - 24.063	n/a	125/150	2.50	1.10	-
ജ്	Boiler room	2.5" Centrifugal Pump - 24.064	n/a	N/A	2.50	11,06	**************************************
മ്	Boiler room	4" 3-Way Valve 125/150 (0-299°F) 1"	15	125/150	4,00	6.28	•
ĕ	Boiler room	4" Hard Pipe Insulation x1'1" (0°-299°F) - 24.065	n/a	N/A	4.00	16.00	÷
ĕ	Boiler room	6" Hard Pipe Insulation x1'11/2" - 24.066	20	N/A	6.00	79.00	1.5
Σ	Mech d104	2 FT Steam Trap (0°-299°F) 10mm Exterior - 24.067	n/a	LAN	2.00	3.11	10mm
Σ	Mech d104	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 9036	n/a	LdN	2.00	3.50	<b>e</b>
Σ	Mech d104	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.069	n/a	NPT	2.00	3.53	
Σ	Mech d104	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.07	9	N/A	2.00	3.00	and the same states and the
Σ	Mech d104	Condensate Receiver - 24.071	n/a	n/a	n/a	15.55	=======================================
∡	ROTC Mechanical	Condensate Receiver - 24,072	n/a	n/a	_ 	15.55	
∝	ROTC Mechanical	3 Bonnet - Gate 250/300 (0-299°F) 1" - 24.073	n/a	250/300	3.00	2.06	-
∡	ROTC Mechanical	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 24.074	n/a	TAN	0.75	1.67	10mm
~~	ROTC Mechanical	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24.075	n/a	NPT	0.75	1.96	Ţ.
Crosby-Wallace RC	ROTC Mechanical	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.076	n/a	ΔPT	0.75	1.96	
쪼	ROTC Mechanical	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 24.074	n/a	LAPT	0.75	1.67	10тт
¥	ROTC Mechanical	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24.078	n/a	LdN	0.75	1,96	i i
Crosby-Wallace RC	ROTC Mechanical	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 4.079	n/a	NPT	0,75	1.96	-

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Insulation	Thickness	II.	ŧ_	1	-	Hardward of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the st	=	10mm	10mm		**************************************	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s	<del>-</del>	10mm	<b>:</b>	Total profits of manufactures from the control	2		Ę	10mm	10mm	# T	-
Sha	Item	29'9	6.67	6,67	6.67	5.00	2.06	76.0	1.83	2.25	2.25	16.00	16.00	1.01	5.00	5.00	6.00	2.00	8.00	1.01	3.11	3.50	3.53
Nom.	Pipe Size	2,00	2.00	2,00	2.00	n/a	3.00	1,50	1.00	1.00	1.00	2.00	2.00	2.00	0.75	100	1.00	0.75	2.00	2.00	2.00	2.00	2.00
Flange	Class	N/A	N/A	N/A	N/A	n/a	250/300	МРŢ	NPT	LdN	LAPT	N.A	N/A	ᇤ	N/A	N/A	N/A	N/A	N/A	NPT	NPT	LMN	FGZ
IFOF	Piping	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30	30	n/a	25	20	24	13	15	n/a	n/a	n/a	п/а
	Description	2" Pump Jacket - 24.08	2" Pump Jacket - 24.081	2" Pump Jacket - 24.082	2" Pump Jacket - 24.083	Air Separator - 24.084	3 Bonnet - Gate 250/300 (0-299°F) 1" - 24,085	1.5 Control Valve NPT (0-299°F) 10mm - 24.0883	1 FT Steam Trap (0°-299°F) 10mm Exterior - 24.087	1" Steam Trap Station Sleeve Incoming (300°-425°F) 0.5" - 24.088	1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.089	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.09	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.1	2 Control Valve NPT (0-299°F) 10mm - 24.101	0.75" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.102	1" Hard Pipe Insulation x1'1" (0°-299°F) - 24,103	1" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.104	0.75" Hard Pipe Insulation x1'1" (0°-299°F) - 9036	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.106	2 Control Valve NPT (0-299°F) 10mm - 24.107	2 FT Steam Trap (0°-299°F) 10mm Exterior - 24.108	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24:109	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.11
	[(0)e514[0]f).Z	ROTC Mechanical	ROTC Mechanical	ROTC Mechanical	ROTC Mechanical	ROTC Mechanical	ROTC Mechanical	ROTC Mechanical	<b>Crosby</b> penthouse	Crosby penthouse	Crosby penthouse	Crosby penthouse	Crosby penthouse	Crosby penthouse	Crosby penthouse	Crosby penthouse	Crosby penthouse	Crosby penthouse	Crosby penthouse	Crosby penthouse	Crosby penthouse	Crosby penthouse	Crosby-Wallace Crosby penthouse
	Lecrition	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace
	IIIeIIII	24.08	24.081	24.082	24.083	24.084	24.085	24,086	24.087	24.088	24,089	24.09	24.1	24.101	24.102	24.103	24.104	24.105	24.106	24.107	24.108	24,109	24.11

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litem	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom, Pipe Síze	SqFt/ Item	Insulation Thickness
24.112	Crosby-Wallace	Crosby penthouse	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.112	36	N/A	2.00	19.00	1
24.113	Crosby-Wallace	Crosby penthouse	2 Control Valve NPT (0-299°F) 10mm - 24.113	n/a	NPT	2.00	1.01	10mm
24,114	Crosby-Wallace	Crosby penthouse	2" Hard Pipe Insulation x1'1" (0°-299°F) - 24.114	20	N/A	2.00	11.00	=
24.115	Crosby-Wallace	Crosby penthouse	2 Control Valve NPT (0-299°F) 10mm - 24.115	n/a	NPT	2.00	1.9	10mm
24.116	Crosby-Wallace	Crosby penthouse	2" Hard Pipe Insulation x1'1" (0°-299°F) - 24.116	35	N/A	2.00	18.00	11
24.116	Crosby-Wallace	Crosby penthouse	3 Gate Valve 125/150 (0-299°F) 1" - 24.116	n/a	125/150	3.00	2.67	=
24.117	Crosby-Wallace	Crosby penthouse	2 Control Valve NPT (0-299°F) 10mm - 24.117	n/a	LdN	2,00	1.01	10mm
24.118	Crosby-Wallace	Crosby penthouse	2" Hard Pipe Insulation x1'1" (0°-299°F) - 24.118	5	N/A	2.00	8.00	1
24.119	Crosby-Wallace	Crosby penthouse	3 Control Valve 125/150 (0-299ºF) 1" - 24,114	n/a	125/150	3.00	1.47	•
24.12	Crosby-Wallace	Crosby penthouse	2" Hard Pipe Insulation x1" 1" (0°-299°F) - 24.12	4	N/A	2.00	21.00	=
24.121	Crosby-Wallace	Crosby penthouse	3" Hard Pipe Insulation x 1' 1" (0°-299°F) - 24.12	30	N/A	3,00	24.00	-
24.122	Crosby-Wallace	Crosby penthouse	1.25 FT steam trap (0°-299°F) 10mm Exterior - 24.122	n/a	LAN	1.25	1.88	10mm
24.123	Crosby-Wallace	Crosby penthouse	1.25" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24.123	n/a	TAN	1.25	2.61	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
24.124	Crosby-Wallace	Crosby penthouse	2 Control Valve NPT (0-299°F) 10mm - 24.124	n/a	LAN	2.00	1.01	10mm
24.124	Crosby-Wallace	Crosby penthouse	1.25" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.124	n/a	LdN	1,25	2.61	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
24.125	Crosby-Wallace	Crosby penthouse	1" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.125	12	N/A	1.00	3.00	=
24.126	Crosby-Wallace	Crosby penthouse	3 Gate Valve 125/150 (0-299°F) 1" - 24.126	n/a	125/150	3.00	2.67	•
24.127	Crosby-Wallace	Crosby penthouse	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.127	25	N/A	2.00	13.00	-
24.128	Crosby-Wallace	Crosby penthouse	2.5" Hard Pipe Insulation x1' 1" (0°-299°F) - 24,128	9	M/A	2.50	4,00	THE STREET
24,129	Crosby-Wallace	Crosby penthouse	2 Control Valve 250/300 (0-299°F) 1" - 24.129	n/a	250/300	2.00	1.01	-
24.13	Crosby-Wallace	Crosby penthouse	2.5 Gate Valve 125/150 (0-299°F) 1" - 24.13	n/a	125/150	2.50	2.14	
24.131	Crosby-Wallace	Crosby penthouse	2.5 Control Valve 125/150 (0-299°F) 1" - 24.131	n/a	125/150	2.50	E	-
24.132	Crosby-Wallace	Crosby penthouse	4" Hard Pipe Insulation x1"1" (0°-299°F) - 24.132	10	N/A	4.00	11.00	The contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract o

City of Waterbury, Connecticut Investment Grade Energy Audit · May 13, 2016 (rev. June 29, 2016)



Insulation Thickness		10mm	10mm	=	± -		10mm			=	10mm	A Description of April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 1 and April 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SqFt/  ltem	1.57	0.82	1.67	1,96	1.96	39,00	1.88	2,61	2.61	4.00	1.83	2,25	2.25	1,67	1.96	1.96	1.67	2.25
Nom, Pipe Size	4,00	1,00	0.75	0.75	0.75	2.00	1.25	1.25	1,25	1,00	1.00	1,00	1.00	0.75	0.75	0.75	0.75	1,00
Flange Class	125/150	NPT	NPT	NPT	NPT	N/A	NPT	NPT	NPT	N/A	NPT	NPT	NPT	TAN	NPT	LdN	NPT	LdN
LF of Piping	n/a	n/a	_/a	n/a	n/a	75	n/a	n/a	n/a	15	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Description	4 Flange 125/150 (0-299°F) 1" - 24.133	1 Control Valve NPT (0-299°F) 10mm - 24.134	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 24.135	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24.136	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.137	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.138	1.25 FT steam trap (0°-299°F) 10mm Exterior - 24.139	1.25" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24.14	1.25" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.141	1" Hard Pipe Insulation x1 1" (0°-299°F) - 24.142	1 FT Steam Trap (0°-299°F) 10mm Exterior - 24.143	1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24,144	1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.145	0.75 FT Steam Trap (0%-299%F) 10mm Exterior - 24.146	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24.147	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24;148	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 24.149	1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24:15
Location 2	Crosby penthouse	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 2
Location 1	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace
Iteim	24.133	24.134	24.135	24.136	24.137	24.138	24.139	24.14	24.141	24.142	24.143	24,144	24.145	24.146	24.147	24,148	24.149	24.15

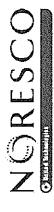


Insulation Thickness	1		10mm	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s	-	10mm	<b>.</b>	<b>.</b>	F	10mm	2	= -		10mm		=	-	<b>=</b>	=	10mm
SqFt/ Item	1.31	10.00	1.67	4.00	29.00	1.88	2.61	2.61	1.31	1.88	2.61	2.61	4.00	1,67	1.96	1.96	3.00	1.91	6.67	4.14
Nom, Pipe Size	3.00	3.00	0,75	1.25	2.00	1,25	1.25	1.25	3.00	1.25	1.25	1.25	1.25	0.75	0.75	0.75	0.75	2.00	2.00	2.00
Hange	125/150	N/A	NPT	N/A	N/A	LAN	TGN	TdN	125/150	LAN	TAN	LdN	N/A	LGN	LAN	TdN	N/A	125/150	N/A	125/150
LF of Piping	п/а	13	n/a	13	55	n/a	n/a	n/a	n/a	n/a	п/а	n/a	<b>-</b>	e/u	n/a	n/a	15	n/a	n/a	n/a
Description	3 Flange 125/150 (0-299°F) 1" - 24.151	3" Hard Pipe Insulation x 1' 1" (0°-299°F) - 24,152	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 24.153	1.25" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.154	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.155	1.25 FT steam trap (0°-299°F) 10mm Exterior - 24.156	1.25" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24.155	1.25" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.158	3 Flange 125/150 (0-299°F) 1" - 24.159	1.25 FT steam trap (0°-299°F) 10mm Exterior - 24.16	1.25" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24.161	1.25" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24,162	1.25" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.163	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 24.164	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 24.165	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 24.166	0.75" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.167	2 Control Valve 125/150 (0-299°F) 1" - 24,168	2" Pump Jacket - 24.169	2 Expansion Joint 125/150 (0°-299°F) 10mm - 24.17
Location 2	Mech mezzanine 2	Mech mezzanine 2	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	Mech mezzanine 1	1104 Mech. Room	1104 Mech. Room
Location 1	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace
Item	24.151	24.152	24.153	24,154	24.155	24.156	24.157	24.158	24,159	24.16	24.161	24.162	24.163	24.164	24.165	24.166	24,167	24,168	24.169	24.17



Insulation Thickness	10mm	ı		10mm	10mm		-	well about 1990 and the last life is a consequent to the	-	10mm	=	10mm	10mm			± ± ±	<del>-</del>	•	<u>-</u>	10mm
SqEV/ Item	4.14	11:11	6.67	4.14	4.14	Ę	1.01	1.01	2.85	06:0	2.67	1.67	1.67	15.55	9.00	1.01	60.00	2.67	1.47	1.67
Nom. Pipe Size	2.00	n/a	2.00	2.00	2.00	n/a	2.00	2.00	1.25	1.25	3.00	0.75	0.75	n/a	2.00	2.00	2.00	3.00	3.00	0.75
Flange Class	125/150	e/u	N/A	125/150	125/150	n/a	125/150	125/150	N/A	FM	125/150	TdN	LAN	n/a	N/A	250/300	N/A	125/150	125/150	LdN
LF of Piping	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	18	n/a	115	n/a	n/a	n/a
Description	2 Expansion Joint 125/150 (0°-299°F) 10mm - 24.171	Suction Diffusor - 24.172	2" Pump Jacket - 24.173	2 Expansion Joint 125/150 (0°-299°F) 10mm - 24.174	2 Expansion Joint 125/150 (0°-299°F) 10mm - 24.175	Suction Diffusor - 9036	2 Control Valve 125/150 (0-299°F) 1" - 24.177	2 Control Valve 125/150 (0-299°F) 1" - 24.178	1.25" Inline Pump - 24.179	1.25 Control Valve NPT (0-299°F) 10mm - 24.18	3 Gate Valve 125/150 (0-299°F) 1" - 24.181	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 24.182	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 24.183	Condensate Receiver - 24.184	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.185	2 Control Valve 250/300 (0-299°F) 1" - 24.186	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.187	3 Crane Gate Valve 125/150 (0-299°F) 1" - 24.188	3 Control Valve 125/150 (0-299°F) 1" - 24.189	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 24.19
Location 2	1104 Mech. Room	1104 Mech. Room	1104 Mech. Room	1104 Mech. Room	1104 Mech. Room	1104 Mech. Room	1104 Mech. Room	1104 Mech. Room	1104 Mech. Room	1104 Mech. Room	1104 Mech. Room	1104 Mech. Room	1104 Mech. Room	1104 Mech. Room	McCarthy house penthouse	McCarthy house penthouse	McCarthy house penthouse	McCarthy house penthouse	McCarthy house penthouse	McCarthy house penthouse
Location 1	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Crosby-Wallace	Grosby-Wallace
llem	24.171	24.172	24.173	24.174	24.175	24.176	24.177	24.178	24.179	24.18	24.181	24.182	24.183	24.184	24.185	24.186	24.187	24.188	24.189	24.19





Item	Location 1	Location 2	Description	LF of Piping	Flange	Nom. Pipe Size	maj) Ajibs	Insulation Thickness
24.207	Crosby-Wallace	Middle school roof	0.75" Hard Pipe Insulation x1'1" (0°-299°F) - 24:207	10	N/A	0.75	2.00	1.
24.208	Crosby-Wallace	Middle school roof	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 924.208	85	N/A	2.00	44.00	-
24.209	Crosby-Wallace	Middle school roof	2 Control Valve NPT (0-299°F) 10mm - 24.209	n/a	NPT	2.00	1.01	10mm
24.21	Crosby-Wallace	Middle school roof	2 Control Valve NPT (0-299°F) 10mm - 24.21	n/a	PA	2.00	1.0	10mm
24.211	Crosby-Wallace	Middle school roof	2" Hard Pipe Insulation x1'1" (0°-299°F) - 24:211	- 65	N/A	2.00	34.00	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
24.212	Crosby-Wallace	Middle school roof	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 24.204	75	N/A	2.00	39.00	-
2001	Dept. of PH	Boiler room	2" Centrifugal Pump - 2001	n/a	N/A	2.00	10.25	ŧ
2002	Dept. of PH	Boiler room	Suction Diffusor - 2002	_/a	n/a	n/a	=======================================	1
2003	Dept. of PH	Boiler room	2 Bonnet - Check 125/150 (0-299ºF) 1" - 2003	n/a	125/150	2.00	0.98	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
2004	Dept. of PH	Boiler room	2" Centrifugal Pump - 2004	п/а	N/A	2.00	10.25	-
2005	Dept. of PH	Boiler room	Suction Diffusor = 2005	n/a	n/a	n/a	1	
2006	Dept. of PH	Boiler room	2 Bonnet - Check 125/150 (0-299°F) 1" - 2006	_/a	125/150	2.00	0.98	<b>F</b>
2002	Dept. of PH	Boiler Room	Air Separator - 2007	n/a	n/a	n/a	5.00	The second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of th
5028	Dept. of PH	Boiler room	Suction Diffusor - 5028	n/a	n/a	n/a	11.11	
11.053	Driggs	Boiler room	2.5 Butterfly Valve 125/150 (0-299°F) 1" - 11.053	n/a	125/150	2.50	1.10	<b>.</b>
11.054	Driggs	Boiler room	2.5 Butterfly Valve 125/150 (0-299°F) 1" - 11.054	n/a	125/150	2.50	1.10	ŧ
14.001	Driggs	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 14,001	n/a	125/150	6.00	2.52	
14.002	Driggs	Boiler room	8 Flange 125/150 (0-299°F) 1" - 14.002	n/a	125/150	8.00	2.36	-
14.003	Driggs	Boiler room	4 Flange 125/150 (0-299°F) 1" - 14.003	n/a	125/150	4.00	1.57	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
14.004	Driggs	Boiler room	4 Flange 125/150 (0-299°F) 1" - 14.004	n/a	125/150	4.00	1.57	÷
14.005	Driggs	Boiler room	8 Flange 125/150 (0-299°F) 1" - 9037	n/a	125/150	8.00	2.36	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
14.006	Driggs	Boiler room	6 Gate Valve 125/150 (0-299°F) 1" - 14.006	n/a	125/150	6.00	5.04	-
14,007	Driggs	Boiler room	6 Gate Valve 125/150 (0-299°F) 1" - 14.007	n/a	125/150	6.00	5.04	-
14.008	Driggs	Boiler room	Low Water Cut-Off - 14,008	n/a	n/a	n/a	2.00	-
14.009	Driggs	Boiler room	Low Water Cut-Off - 14,009	n/a	n/a	n/a	2.00	
-			Information on this sees is exempletony and subject to confidentiality readistic	. ;				

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Insulation Thickness	-	-	-	11	10mm	### ### ### ### ### ### ### ### ### ##	=	10mm	=	## 1	**************************************		10mm	J. C. Constant			10mm	#	**************************************	Company of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the common of the c
SqFt/ Item	2.00	16,00	2.72	2.72	1.67	1.96	1.96	1.67	1.96	1,96	5.43	5,43	1.01	6.00	2.72	12.00	1.67	1,96	1.96	
Pipe Size	n/a	1.00	4.00	4.00	0.75	0.75	0.75	0.75	0.75	0,75	4.00	4,00	2.00	4.00	4.00	0.75	0.75	0.75	0.75	1 C 0
Flange Class	n/a	ΝΆ	250/300	250/300	NPT	TAN	NPT	NPT	NPT	LdN	250/300	250/300	NPT	ΝΆ	250/300	N/A	NPT	Laz	NPT	LUI
LF of Piping	n/a	63	n/a	n/a	n/a	n/a	n/a	n/a	п/а	n/a	n/a	n/a	n/a	9	n/a	09	n/a	n/a	e/u	ero and reduction is retrieved and ending
Description	Low Water Cut-Off - 14.01	1" Hard Pipe Insulation x1'1" (0°-299°F) - 14.011	4 Bonnet - Gate 250/300 (0-299°F) 1" - 14.012	4 Bonnet - Gate 250/300 (0-299°F) 1" - 14.013	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 14.014	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 14.015	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 14.016	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 14.017	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 14.018	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 14,019	4 Gate Valve 250/300 (0-299°F) 1" - 14.02	4 Gate Valve 250/300 (0-299°F) 1" - 14.021	2 Control Valve NPT (0-299°F) 10mm - 14.023	4" Hard Pipe Insulation x1' 1" (0°-299°F) - 14.023	4 Bonnet - Gate 250/300 (0-299°F) 1" - 14.024	0.75" Hard Pipe Insulation x1'1" (0°-299°F) - 14.025	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 14.026	0.75" Steam Trap Station Sleeve Incoming (0°-299°F)	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 14,028	The distribution of the anti-department of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of t
Location 2	Boiler room	Boiler room	Boiler room	Boller room	Boiler room	Boiler room	8oiler room	Boiler room	Boiler room	Boiler room	Boiler room	Boiler room	Boiler room	Boiler room	Boiler room	Boiler room	Boiler room	Boiler room	Boiler room	make a country of the same of the same tradestate and construction of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same
Location1	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	Driggs	and the state of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of t
llem	14.01	14,011	14,012	14.013	14.014	14.015	14.016	14.017	14.018	14.019	14.02	14.021	14.022	14,023	14.024	14.025	14.026	14,027	14.028	07071

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ltem	Location 1	Eccetion 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
14.03	Driggs	Boiler room	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 14.03	n/a	NPT	0.75	1.96	<del>-</del>
14.031	Driggs	Boiler room	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 14,031	n/a	NPT	0.75	1.96	<b>II</b>
14.032	Driggs	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 14.032	n/a	125/150	6.00	2.52	
14.033	Driggs	Boller room	8 Flange 125/150 (0-299°F) 1" - 14.033	n/a	125/150	8.00	2.36	
14.034	Driggs	Boiler room	4 Flange 125/150 (0-299°F) 1" - 9037	n/a	125/150	4.00	1.57	_
14.035	Driggs	Boiler room	4 Flange 125/150 (0-299°F) 1" - 14,035	n/a	125/150	4.00	1.57	1
14.036	Driggs	Boiler room	Low Water Cut-Off - 14.036	n/a	n/a	_/a	2.00	=
14,037	Driggs	Boiler room	Low Water Cut-Off - 14.037	n/a	n/a	n/a	2.00	11
14.038	Driggs	Boiler room	Low Water Cut-Off - 14.038	n/a	n/a	n/a	2.00	_
14.039	Driggs	Boiler room	1FT Steam Trap (0"-299"F) 10mm Exterior - 14.039	n/a	NPT	1.00	1.83	10mm
14.04	Driggs	Boiler room	1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 14.04	n/a	NPT	1.00	2.25	W. C. C. C. C. C. C. C. C. C. C. C. C. C.
14.041	Driggs	Boiler room	1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 14.041	n/a	LdN	1.00	2.25	
14.042	Driggs	Boiler room	Condensate Receiver - 14.042	n/a	n/a	n/a	15.55	#
14,043	Driggs	Boiler room	Condensate Tank - 14,043	n/a	n/a	⊓/a	19.25	1
14.044	Driggs	Boiler room	2" Hard Pipe Insulation x1' 1" (0°-299ºF) - 14.044	25	N/A	2.00	13.00	-
14.045	Driggs	Boiler room	1FT Steam Trap (0°-299°F) 10mm Exterior - 14,045	n/a	LGN LGN	1.00	1.83	10mm
14.046	Driggs	Boiler room	1" Steam Trap Station Sleeve Incoming (0°-299°F) 0,5" - 14.046	n/a	NPT	1,00	2.25	<b>!</b> -
14.047	Driggs	Boiler room	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 14.047	n/a	LdN	0.75	1.96	
14.048	Driggs	Boiler room	2" Centrifugal Pump - 14.048	п/а	N/A	2.00	10.25	
14.049	Driggs	Boiler room	2.5 Butterfly Valve 125/150 (0-299°F) 1" - 14,048	n/a	125/150	2.50	1.10	•



Item	Lacation:1	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
14.05	Driggs	Boiler room	2.5 Butterfly Valve 125/150 (0-299°F) 1" - 14.05	n/a	125/150	2.50	1.10	1
14.051	Driggs	Boiler room	2.5 Butterfly Valve 125/150 (0-299°F) 1" - 14.051	n/a	125/150	2.50	1.10	=
14.052	Driggs	Boiler room	Air Separator - 14.052	n/a	e/u	n/a	5.00	÷
14,053	Driggs	Boiler room	2.5 Butterfly Valve 125/150 (0-299°F) 1" - 14.053	n/a	125/150	2.50	1.10	and the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of t
14.054	Driggs	Boiler room	2" Centrifugal Pump - 14.054	n/a	N/A	2.00	10.25	
16.001	Enlightenment	Basement boiler room	2 Angle Stop Check Valve 125/150 (0-299°F) 1" - 16.001	n/a	125/150	2.00	2.43	<b>±</b>
16.002	Enlightenment	Basement boiler room	2 Hyspan Expansion Joints 125/150 (0°-299°F) 1" - 16.002	n/a	125/150	2.00	4.14	ŧ-
16.003	Enlightenment	Basement boiler room	2 Hyspan Expansion Joints 125/150 (0°-299°F) 1" - 16.003	n/a	125/150	2.00	4.14	=
16.004	Enlightenment	Basement boiler room	2 Hyspan Expansion Joints 125/150 (0°-299°F) 1" - 16.004	n/a	125/150	2.00	4,14	<b>.</b>
16.005	Enlightenment	Basement boiler room	Suction Diffusor	n/a	n/a	n/a	1:11	# <b>.</b>
16.006	Enlightenment	Basement boiler room	2" Pump Jacket - 16.003	п/а	N/A	2.00	6.67	<b>E</b>
16.007	Enlightenment	Basement boiler room	2" Pump Jacket - 16.007	n/a	N/A	2.00	79'9	Transport Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Con
16.008	Enlightenment	Basement boiler room	2 Hyspan Expansion Joints 125/150 (0°-299°F) 1" - 16.008	п/а	125/150	2.00	4.14	<del>-</del>
16.009	Enlightenment	Basement boller room	2 Hyspan Expansion Joints 125/150 (0°-299°F) 1" - 16.009	n/a	125/150	2.00	4.14	and the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second s
16.01	Enlightenment	Basement boiler room	4" Spool 125/150 (0-299°F) 1"	e/u	125/150	4.00	2.36	<u>‡</u>
16.011	Enlightenment	Basement boiler room	2 Angle Stop Check Valve 125/150 (0-299°F) 1" - 16.011	n/a	125/150	2.00	2,43	

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ltem	Location 1	Location 2	Description	LF of Piping	Flange	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
16.012	Enlightenment	Basement boiler room	2" Pump Jacket - 16.012	n/a	N/A	2.00	79'9	-
16.013	Enlightenment	Basement boiler room	2 Angle Stop Check Valve 125/150 (0-299°F) 1" - 16.013	n/a	125/150	2.00	2.43	Ę
16.014	Enlightenment	Basement boiler room	2" Pump Jacket - 9036	n/a	N/A	2.00	6.67	de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la
16.015	Enlightenment	Basement boiler room	2 Angle Stop Check Valve 125/150 (0-299°F) 1" - 16.015	n/a	125/150	2.00	2.43	
22.001	Generali	Boiler room	Low Water Cut-Off - 22.001	n/a	n/a	n/a	2.00	
22.002	Generali	Boller room	Low Water Cut-Off - 22,002	n/a	n/a	n/a	2.00	1
22.003	Generali	Boiler room	Low Water Cut-Off - 22.003	n/a	n/a	n/a	2.00	-
22,004	Generali	Boiler room	4 Flange 125/150 (0-299°F) 1" - 22.004	n/a	125/150	4.00	1.57	
22.005	Generali	Boiler room	4 Flange 125/150 (0-299°F) 1" - 22.005	n/a	125/150	4.00	1.57	=
22.006	Generali	Boiler room	5 Bonnet - Gate 125/150 (0-299°F) 1" - 22.006	n/a	125/150	5.00	2.20	<b>II</b>
22.007	Generali	Boiler room	6 Bonnet - Gate 125/150 (0-299ºF) 1" - 22.007	n/a	125/150	6.00	2.52	# F
22.008	Generali	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 22,008	n/a	125/150	3.00	2.67	#
22.009	Generali	Boiler room	Condensate Receiver - 22.009	n/a	n/a	n/a	15.55	-
22.01	Generali	Boiler room	6 Bonnet - Gate 125/150 (0-299ºF) 1" - 22.01	n/a	125/150	6.00	2.52	
22.011	Generali	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 22.011	n/a	125/150	6.00	2.52	<b>t</b>
22.012	Generall	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 22,012	n/a	125/150	6.00	2.52	-
22.013	Generali	Boiler room	5 Bonnet - Gate 125/150 (0-299°F) 1" - 22.013	n/a	125/150	5.00	2.20	-
22.014	Generali	Boiler room	Low, Water Cut-Off - 22.014	n/a	n/a	n/a	2.00	
22.015	Generali	Boiler room	Low Water Cut-Off - 22.015	n/a	n/a	n/a	2.00	-
22.016	Generali	Boiler room	Low Water Cut-Off - 22.016	n/a	n/a	n/a	2,00	
22.017	Generali	Boiler room	4 Flange 125/150 (0-299°F) 1" - 22.017	n/a	125/150	4.00	1.57	Ę.
22.018	Generali	Boiler room	4 Flange 125/150 (0-299°F) 1" - 22.018	n/a	125/150	4.00	1.57	Project (rev

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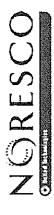
lltem	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
22.039	Generali	Mechanical room	2" Centrifugal Pump - 22.039	n/a	N/A	2.00	10.25	=_
22.04	Generali	Boiler room	4 Flange 125/150 (0-299°F) 1" - 22.04	n/a	125/150	4.00	1.57	-
22.041	Generali	Boiler room	0.75" Hard Pipe Insulation x1' 1" (0°-299°F) - 22.041	30	N/A	0.75	6.00	F
27.001	Hopeville	Boiler room	Low Water Cut-Off - 27.001	n/a	n/a	n/a	2,00	-
27.002	Hopeville	Boiler room	Low Water Cut-Off - 27.002	n/a	n/a	n/a	2.00	<b>E</b>
27.003	Hopeville	Boiler room	Low Water Cut-Off - 27.003	n/a	n/a	n/a	2.00	
27.004	Hopeville	Boiler room	4 Flange 125/150 (0-299°F) 1" - 27.004	п/а	125/150	4.00	1.57	<b>-</b>
27.005	Hopeville	Boiler room	4 Flange 125/150 (0-299°F) 1" - 27.005	n/a	125/150	4,00	1.57	II.
27.006	Hopeville	Boiler room	6 Nibco Gate Valve 125/150 (0-299°F) 1" - 27.006	n/a	125/150	6.00	5.04	Į.
27.007	Hopeville	Boiler room	10" Blind Flange 125/150 (0-299°F) 1" - 27.007	n/a	125/150	10.00	4,19	
27.008	Hopeville	Boiler room	10 Flange 125/150 (0-299°F) 1" - 27.008	n/a	125/150	10,00	2.79	=
27.009	Hopeville	Boiler room	10 Flange 125/150 (0-299°F) 1" - 27.009	n/a	125/150	10.00	2.79	-
27.01	Hopeville	Boiler room	10 Flange 125/150 (0-299°F) 1" - 27.01	n/a	125/150	10.00	2.79	<b>E</b>
27.011	Hopeville	Boiler room	10 Flange 125/150 (0-299°F) 1" - 27.011	n/a	125/150	10.00	2.79	-
27.012	Hopeville	Boiler room	8" Blind Flange 125/150 (0-299°F) 1" - 27.012	n/a	125/150	8.00	3.28	<b>-</b>
27.013	Hopeville	Boiler room	8 Gate Valve 125/150 (0-299°F) 1" - 27,013	n/a	125/150	8,00	6.77	
27.014	Hopeville	Boiler room	6 Nibco Gate Valve 125/150 (0-299°F) 1" - 27.014	n/a	125/150	6.00	5.04	1
27.015	Hopeville	Boller room	Low Water Cut-Off - 27,015	n/a	n/a	n/a	2.00	-
27.016	Hopeville	Boiler room	Low Water Cut-Off - 27.106	n/a	n/a	n/a	2.00	-
27.016	Hopeville	Boiler room	Low Water Cut-Off - 27.106	n/a	n/a	n/a	2.00	
27.017	Hopeville	Boiler room	6" Blind Flange 125/150 (0-299°F) 1" - 27.017	n/a	125/150	6.00	2.58	
27.018	Hopeville	Boiler room	4 Flange 125/150 (0-299°F) 1" - 27.018	n/a	125/150	4.00	1.57	3
27.019	Hopeville	Boiler room	4 Flange 125/150 (0-299°F) 1" - 27.019	n/a	125/150	4.00	1.57	÷
27.02	Hopeville	Boiler room	4 Flange 125/150 (0-299ºF) 1" - 27.019	n/a	125/150	4.00	1.57	
27.021	Hopeville	Boiler room	2" Pipe Sleeve x 1' (0-299°F) 10mm - 27.021	-	N/A	4.00	1.18	10mm
			Information on this page is proprietary and subject to confidentiality restrictions	ns.				-

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27.022         Hopeville         Boiler room         27 Pipe Sleeve x1 (0.29947) Tomm - 27.022         1         N/A         4.00         1.18         10mm           27.023         Hopeville         Boiler room         27 Pipe Sleeve x1 (0.29947) To 27.023         1         N/A         4.00         1.18         10mm           27.025         Hopeville         Boiler room         3 Bonnet - Gate 125/150 (0.29947) T- 27.025         n/A         125/150         3.00         1.34         T           27.026         Hopeville         Boiler room         3 Bonnet - Gate 125/150 (0.29947) T- 27.025         n/A         125/150         3.00         1.31         T           27.027         Hopeville         Boiler room         4 Hard Pipe Insulation x1 (0.29947) T- 27.025         6         N/A         4.00         3.00         1.7           27.027         Hopeville         Boiler room         4 Control Valve 125/150 (0.29947) T- 27.033         n/A         1.25/150         1.00         1.00         1.7           27.031         Hopeville         Boiler room         4 Gate Valve 125/150 (0.29947) T- 27.033         n/A         1.25/150         1.00         1.7           27.032         Hopeville         Boiler room         4 Gate Valve 125/150 (0.29947) T- 27.033         n/A         1.25/150	ltem	kocation 1	Location 2	Description	LF of Plping	Flange Class	Pipe Size	SqFt/ Item	Insulation Thickness
Hopewille         Boiler room         2' Pipe Sleeve x 1' (0-299°F) 10mm - 27.023         1         N/A         4.00         1.18           Hopewille         Boiler room         3 Bonnet - Gate 125/150 (0-299°F) 1" - 27.023         π/a         125/150         3.00         1.34           Hopewille         Boiler room         3 Hange 125/150 (0-299°F) 1" - 27.023         π/a         125/150         3.00         1.31           Hopewille         Boiler room         4" Had Pipe Insulation xi1" (0°-299°F) - 27.029         6         N/A         4.00         1.03           Hopewille         Boiler room         6" Hard Pipe Insulation xi1" (0°-299°F) - 27.029         6         N/A         4.00         9.00           Hopewille         Boiler room         6" Hard Pipe Insulation xi1" (0°-299°F) - 27.029         6         N/A         6.00         9.00           Hopewille         Boiler room         6" Hard Pipe Insulation xi1" (0°-299°F) - 27.039         7/a         125/150         4.00         3.45           Hopewille         Boiler room         4" Gate Valve 125/150 (0-299°F) 1" - 27.033         π/a         125/150         4.00         3.05           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27.033         π/a         125/150         4.00         3.05 <t< td=""><td>27.022</td><td>Hopeville</td><td>Boiler room</td><td>2" Pipe. Sleeve x 1' (0-299°F) 10mm - 27.022</td><td>1</td><td>N/A</td><td>4,00</td><td>1.18</td><td>10mm</td></t<>	27.022	Hopeville	Boiler room	2" Pipe. Sleeve x 1' (0-299°F) 10mm - 27.022	1	N/A	4,00	1.18	10mm
Hopewille         Boiler room         3 Bonnet - Gate 125/150 (0-299°F) 1" - 27,025         n/a         125/150         3.00         134           Hopewille         Boiler room         3 Hange 125/150 (0-299°F) 1" - 27,025         n/a         125/150         3.00         134           Hopewille         Boiler room         3 Hange 125/150 (0-299°F) 1" - 27,025         n/a         125/150         3.00         131           Hopewille         Boiler room         4 Hange 125/150 (0-299°F) 1" - 27,025         6         N/A         4.00         6.00           Hopewille         Boiler room         6 Hange 125/150 (0-299°F) 1" - 27,023         6         N/A         4.00         6.00           Hopewille         Boiler room         6 Hange 125/150 (0-299°F) 1" - 27,033         n/a         125/150         4.00         3.05           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27,033         n/a         125/150         4.00         3.05           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27,033         n/a         125/150         4.00         3.05           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27,033         n/a         125/150         4.00         3.05           Hopewille         Boiler r	27.023	Hopeville	Boiler room	2" Pipe Sleeve x 1' (0-299°F) 10mm - 27.023	_	N/A	4.00	1.18	10mm
Hopewille         Boiler room         3 Bonnet - Gate 125/150 (0-299°F) 1" - 27,025         π/a         125/150         3.00         1.34           Hopewille         Boiler room         3 Flange 125/150 (0-299°F) 1" - 27,025         π/a         125/150         3.00         1.31           Hopewille         Boiler room         4" Hard Pipe Insulation x1" (0-299°F) - 27,023         6         N/A         4.00         6.00           Hopewille         Boiler room         6" Hard Pipe Insulation x1" (0-299°F) - 27,033         35         N/A         4.00         6.00           Hopewille         Boiler room         6" Hard Pipe Insulation x1" (0-299°F) - 27,033         π/A         125/150         4.00         3.45           Hopewille         Boiler room         4" Control Valve 125/150 (0-299°F) 1" - 27,033         π/A         125/150         4.00         3.00         1.47           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27,033         π/A         125/150         4.00         3.45           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27,033         π/A         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27,033         π/A         125/150         3.00         2.67	27.024	Hopeville	Boiler room	3 Bonnet - Gate 125/150 (0-299°F) 1" - 27.024	n/a	125/150	3.00	1.34	
Hopewille         Boiler room         3 Flange 125/150 (0-299°F) 1" - 27,027         π/a         125/150         3.00         1.31           Hopewille         Boiler room         3 Flange 125/150 (0-299°F) 1" - 27,027         π/a         125/150         3.00         1.31           Hopewille         Boiler room         6" Hard Pipe Insulation x1" (0°-299°F) - 27,028         6         N/A         4.00         6.00           Hopewille         Boiler room         6" Hard Pipe Insulation x1" (0°-299°F) - 27,033         6         N/A         4.00         5.00           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) " - 27,033         π/a         125/150         4.00         3.05           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) " - 27,033         π/a         125/150         4.00         3.05           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) " - 27,033         π/a         125/150         4.00         3.45           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) " - 27,033         π/a         125/150         4.00         3.45           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) " - 27,033         π/a         125/150         3.00         2.67           Hopewille <td>27.025</td> <td>Hopeville</td> <td>Boiler room</td> <td>3 Bonnet - Gate 125/150 (0-299°F) 1" - 27.025</td> <td>n/a</td> <td>125/150</td> <td>3.00</td> <td>1.34</td> <td>-</td>	27.025	Hopeville	Boiler room	3 Bonnet - Gate 125/150 (0-299°F) 1" - 27.025	n/a	125/150	3.00	1.34	-
Hopewille         Boiler room         3 Flange 125/150 (0-299°F) 1" - 27.027         n/s         125/150         3.00         1.31           Hopewille         Boiler room         4" Hard Pipe Insulation x1" (0°-299°F) - 27.029         6         N/A         4.00         6.00           Hopewille         Boiler room         6" Hard Pipe Insulation x1" (0°-299°F) - 27.029         6         N/A         6.07         9.00           Hopewille         Boiler room         4" Hard Pipe Insulation x1" (0°-299°F) - 27.033         3/A         1.05         7.00           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) " - 27.033         n/a         125/150         4.00         3.45           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) " - 27.033         n/a         125/150         4.00         3.45           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) " - 27.033         n/a         125/150         4.00         3.45           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) " - 27.034         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) " - 27.034         n/a         125/150         3.00         2.67           Hopewille         Bo	27.026	Hopeville	Boller room	3 Flange 125/150 (0-299°F) 1" - 27.026	n/a	125/150	3.00	131	-
Hopewille         Boiler room         4" Hard Pipe Insulation X1" (0°-299°F) - 27.028         6         N/A         4.00         6.00           Hopewille         Boiler room         6" Hard Pipe Insulation X1" (0°-299°F) - 27.029         35         N/A         6.00         9.00           Hopewille         Boiler room         0.75" Hard Pipe Insulation X1" (0°-299°F) " - 27.033         n/a         125/150         4.00         3.45           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) " - 27.033         n/a         125/150         4.00         3.45           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) " - 27.033         n/a         125/150         4.00         3.45           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) " - 27.034         n/a         125/150         4.00         3.45           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) " - 27.034         n/a         125/150         3.00         1.47           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) " - 27.034         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) " - 27.034         n/a         125/150         3.00         2.67	27.027	Hopeville	Boiler room	3 Flange 125/150 (0-299°F) 1" - 27.027	n/a	125/150	3.00	1.31	-
Hopewille         Boiler room         6" Hard Pipe Insulation x11" (0°-299°F) - 27.029         6         N/A         6.00         9.00           Hopewille         Boiler room         0.5" Hard Pipe Insulation x11" (0°-299°F) - 27.031         π/a         125/150         4.00         3.45           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27.033         π/a         125/150         4.00         3.45           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27.033         π/a         125/150         4.00         3.45           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27.033         π/a         125/150         4.00         3.45           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.034         π/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.035         π/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.036         π/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.036         π/a         125/150         3.00         2.67	27.028	Hopeville	Boiler room	4" Hard Pipe Insulation x1' 1" (0°-299°F) - 27.028	9	N/A	4.00	6.00	* *-
Hopeville         Boiler room         0.75" Hard Pipe Insulation x11" (0°-299°F) - 27.033         3.5         N/A         0.75         7.00           Hopeville         Boiler room         4 Cate Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         4.00         3.45           Hopeville         Boiler room         4 Cantrol Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         4.00         3.06           Hopeville         Boiler room         4 Cate Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         4.00         3.45           Hopeville         Boiler room         3 Cate Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Cate Valve 125/150 (0-299°F) 1" - 27.034         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Cate Valve 125/150 (0-299°F) 1" - 27.035         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Cate Valve 125/150 (0-299°F) 1" - 27.034         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Cate Valve 125/150 (0-299°F) 1" - 27.035         n/a         125/150         3.00         2.67	27.029	Hopeville	Boiler room	6" Hard Pipe Insulation x1' 1" (0°-299°F) - 27.029	9	ΝΑΑ	6.00	9.00	F
Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         4.00         3.45           Hopewille         Boiler room         4 Control Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         4.00         3.06           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27.034         n/a         125/150         4.00         3.45           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.034         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.036         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.036         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.036         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.036         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.036         n/a         125/150         3.00         2.67	27.03	Hopeville	Boiler room	0.75" Hard Pipe Insulation x1'1" (0°-299°F) - 27.03	35	N/A	0.75	7.00	
Hopewille         Boiler room         4 Control Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         4.00         2.06           Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         4.00         3.45           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.044         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.042         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.042         n/a         125/150         3.00         2.67	27.031	Hopeville	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 27.031	n/a	125/150	4.00	3.45	-
Hopeville         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27.033         n/a         125/150         4.00         3.45           Hopeville         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27.034         n/a         125/150         4.00         3.45           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.035         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.037         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.037         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.039         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.044         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.042         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.043         n/a         125/150         3.00         2.67 <t< td=""><td>27.032</td><td>Hopeville</td><td>Boiler room</td><td></td><td>n/a</td><td>125/150</td><td>4,00</td><td>2.06</td><td>•</td></t<>	27.032	Hopeville	Boiler room		n/a	125/150	4,00	2.06	•
Hopewille         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27.034         n/a         125/150         4.00         3.45           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.035         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.037         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.038         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.039         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Control Valve 125/150 (0-299°F) 1" - 27.041         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.042         n/a         125/150         3.00         2.67           Kennedy         Boiler room         Condensate Tank - 27.043         n/a         125/150         4.00         3.45           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.002         n/a         125/150         4.00         9.11           Kennedy	27.033	Hopeville	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 27.033	n/a	125/150	4.00	3.45	
Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.035         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.035         n/a         125/150         3.00         1.47           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.038         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.039         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.044         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.042         n/a         125/150         3.00         2.67           Hopeville         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 27.043         n/a         125/150         3.00         2.67           Kennedy         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         4.00         3.45           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         9.01         9.11           K	27.034	Hopeville	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 27.034	n/a	125/150	4.00	3,45	<b>=</b>
Hopeville         Boiler room         3 Control Valve 125/150 (0-299°F) 1" - 27.036         n/a         125/150         3.00         1.47           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.038         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.039         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.044         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.041         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.042         n/a         125/150         3.00         2.67           Hopeville         Boiler room         Condensate Tank - 27.043         n/a         125/150         4.00         3.45           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         4.00         9.11           Kennedy         Boiler room         6 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         0.00         9.00	27.035	Hopeville	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 27.035	n/a	125/150	3.00	2.67	=
Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.037         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.039         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Control Valve 125/150 (0-299°F) 1" - 27.041         n/a         125/150         3.00         1.47           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.041         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.042         n/a         n/a         n/a         n/a         19.25           Hopeville         Boiler room         Condensate Tank - 27.043         n/a         n/a         n/a         n/a         19.25           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         4.00         9.11           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         6.00         5.04	27.036	Hopeville	Boller room	3 Control Valve 125/150 (0-299°F) 1" - 27.036	n/a	125/150	3.00	1.47	=
Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.038         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.039         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.041         n/a         125/150         3.00         2.67           Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.042         n/a         125/150         3.00         2.67           Hopewille         Boiler room         Condensate Tank - 27.043         n/a         n/a         n/a         n/a         19.25           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.002         n/a         125/150         4.00         3.45           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         6.00         5.04	27.037	Hopeville	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 27.037	n/a	125/150	3.00	2.67	
Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.039         n/a         125/150         3.00         2.67           Hopeville         Boiler room         3 Control Valve 125/150 (0-299°F) 1" - 27.041         n/a         125/150         3.00         1.47           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.042         n/a         125/150         3.00         2.67           Hopeville         Boiler room         Condensate Tank - 27.043         n/a         n/a         n/a         n/a         19.25           Kennedy         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 30.002         n/a         125/150         4.00         3.45           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         10.00         9.11           Kennedy         Boiler room         6 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         6.00         5.04	27.038	Hopeville	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 27,038	n/a	125/150	3.00	2.67	
Hopeville         Boiler room         3 Control Valve 125/150 (0-299°F) 1" - 27.041         n/a         125/150         3.00         1,47         7           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.042         n/a         125/150         3.00         2.67         2.67           Hopeville         Boiler room         Condensate Tank - 27.043         n/a         n/a         n/a         n/a         19.25           Kennedy         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 30.002         n/a         125/150         4.00         3.45           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.002         n/a         125/150         10.00         9.11           Kennedy         Boiler room         6 Gate Valve 125/150 (0-299°F) 1" - 30.002         n/a         125/150         6.00         5.04	27.039	Hopeville	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 27,039	n/a	125/150	3.00	2.67	=
Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.041         n/a         125/150         3.00         2.67         7           Hopeville         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.043         n/a         125/150         3.00         2.67         7           Kennedy         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 30.002         n/a         125/150         4.00         3.45           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         6.00         9.11           Kennedy         Boiler room         6 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         6.00         5.04	27.04	Hopeville	Boiler room	3 Control Valve 125,/150 (0-299°F) 1" - 27.04	η/a	125/150	3.00	1,47	
Hopewille         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 27.042         n/a         1/25/150         3.00         2.67         7           Hopeville         Boiler room         Condensate Tank - 27.043         n/a         n/a         n/a         n/a         19.25           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.002         n/a         125/150         0.00         9.11           Kennedy         Boiler room         6 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         6.00         5.04	27.041	Hopeville	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 27,041	n/a	125/150	3.00	2.67	
Hopeville         Boiler room         Condensate Tank - 27.043         n/a         n/a         n/a         19.25           Kennedy         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 9036         n/a         125/150         4.00         3.45           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         6.00         9.11           Kennedy         Boiler room         6 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         6.00         5.04	27.042	Hopeville	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 27:042	n/a	125/150	3.00	2.67	Test a port la marar es cuações de desprisa y municipale, que
Kennedy         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 9036         n/a         125/150         4.00         3.45           Kennedy         Boiler room         10 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         6.00         9.11	27.043	Hopeville	Boiler room	Condensate Tank - 27.043	n/a	n/a	n/a	19.25	<u>=</u>
Kennedy         Boller room         10 Gate Valve 125/150 (0-299°F) 1" - 30.002         n/a         125/150         10.00         9.11           Kennedy         Boller room         6 Gate Valve 125/150 (0-299°F) 1" - 30.003         n/a         125/150         6.00         5.04	30.001	Kennedy	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 9036	n/a	125/150	4.00	3,45	=
Kennedy Boiler room 6 Gate Valve 125/150 (0-299°F) 1" - 30.003 n/a 125/150 6.00 5.04	30.002	Kennedy	Boiler room	10 Gate Valve 125/150 (0-299°F) 1" - 30.002	n/a	125/150	10.00	9.11	<b>F</b>
	30.003	Kennedy	Boiler room	6 Gate Valve 125/150 (0-299°F) 1" - 30.003	n/a	125/150	6.00	5.04	Production of consequences and the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of the consequence of t

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ltem	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
30.004	Kennedy	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 9036	n/a	125/150	4.00	3,45	=
30,005	Kennedy	Boiler room	4 Elbows 90°1" (0-299°F) - 30.005	n/a	N/A	4.00	1.35	=
30.006	Kennedy	Boiler room	8 Gate Valve 125/150 (0-299°F) 1" - 30.006	n/a	125/150	8.00	6.77	=
30.007	Kennedy	Boiler room	8 Gate Valve 125/150 (0-299°F) 1" - 30.007	n/a	125/150	8.00	6.77	
30.008	Kennedy	Boiler room	8 Gate Valve 125/150 (0-299°F) 1" - 30.008	n/a	125/150	8.00	6.77	=
30,009	Kennedy	Boiler room	Low Water Cut-Off - 30,009	n/a	n/a	n/a	2.00	-
30.01	Kennedy	Boiler room	Low Water Cut-Off - 30.01	_/a	n/a	n/a	2.00	-
30.011	Kennedy	Boiler room	1.5" Hard Pipe Insulation x1'1" (0°-299°F) - 30.011	39	N/A	1.50	15.00	
30.012	Kennedy	Boiler room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 30.012	n/a	NPT	0.75	1.67	10mm
30.013	Kennedy	Boller room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 30.013	e/u	NPT	0.75	1.67	10mm
30.014	Kennedy	Boiler room	4 Tee 125/1501" (0-299°F) - 30.014	n/a	125/150	4.00	1.13	<b>L</b>
30.015	Kennedy	Boiler room	4 Flange 125/150 (0-299°F) 1" - 30.015	n/a	125/150	4.00	1.57	-
30.016	Kennedy	Boiler room	1.5" Union (0-299°F) 1" - 30.016	n/a	NPT	1.50	0.14	<b>B</b>
30.017	Kennedy	Boller room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 30.017	n/a	NPT	0.75	1.67	10mm
30.018	Kennedy	Boiler room	Low Water Cut-Off - 30.018	n/a	n/a	n/a	2.00	-
30.019	Kennedy	Boiler room	Low Water Cut-Off - 30.019	n/a	n/a	n/a	2.00	1
30.02	Kennedy	Boiler room	1.5 FT Steam Trap (0°-299°F) 10mm Exterior - 9036	n/a	NPT	1.50	2.06	10mm
30.021	Kennedy	Boiler room	5 Gate Valve 125/150 (0-299°F) 1" - 30.021	n/a	125/150	5.00	4.40	-
30.022	Kennedy	Boiler room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 30.022	n/a	NPT	0.75	1.67	10mm
30.023	Kennedy	Boiler room	1.5" Hard Pipe Insulation x1'1" (0°-299°F) - 9036	25	N/A	1.50	10.00	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
30.024	Kennedy	Boiler room	Condensate Tank - 9036	n/a	n/a	n/a	19.25	<u>-</u>
30.025	Kennedy	Boiler room	4" Hard Pipe Insulation x1' 1" (0°-299°F) - 30.025	16	N/A	4,00	17.00	=
30.026	Kennedy	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 30.026	n/a	125/150	4.00	3,45	-
30.027	Kennedy	Boiler room	4 Basket Strainer 125/150 1" (0-299°F) - 30.027	n/a	125/150	4,00	18,92	-
30.028	Kennedy	Boiler room	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 30.028	55	N/A	2.00	29.00	=

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ltem	Location 1	Location 2	Description	LE of Pibling	Flange	Nom. Pipe	SqFt/ Item	Insulation Thickness
00000	Von de de	00:100	0.75 TT 61-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-		TOTA	Size	10.7	Ç
00.00	Vellileuy		O// 2 T I STEAM I L'AD (OT-2997F) JUMM EXTEMOT-30,029			ر ر	/01	EEO.
30.03	Kennedy	Boiler room	0.75" Hard Pipe Insulation x1'1" (0°-299°F) - 30.03	20	N/A	0.75	80.00	<del>-</del>
30.031	Kennedy	Boiler room	0.75" Hard Pipe Insulation x1' 1" (0°-299°F) - 30.031	20	N/A	0.75	4.00	1.0
30.032	Kennedy	Boiler room	10 Flange 125/150 (0-299°F) 1" - 30.032	n/a	125/150	10.00	2.79	- London Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitution Constitut
30.033	Kennedy	Fan room	11/2 Amrstrong 75A6 Steam Trap 10mm - 30.033	n/a	TdN	1.50	2.06	10mm
30.034	Kennedy	Fan room	2" Steam Trap Station Sleeve Incoming (0"-299"F) 0.5" - 30.034	n/a	LAN	2.00	3.50	<b>E</b>
30.035	Kennedy	Fan room	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.035	n/a	LdN	2.00	3.53	-
30.036	Kennedy	Fan room	2 Control Valve 125/150 (0-299°F) 1" - 30.036	n/a	125/150	2.00	1.01	=
30.037	Kennedy	Fan room	2 Gate Valve 125/150 (0-299°F) 1" - 30,037	n/a	125/150	2.00	1.80	•
30.038	Kennedy	Fan room	2 Control Valve 125/150 (0-299°F) 1" - 30.038	n/a	125/150	2,00	1.01	=
30,039	Kennedy	Fan room	2 Control Valve 125/150 (0-299°F) 1" - 30,039	n/a	125/150	2.00	1.01	- The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the
30.04	Kennedy	Fan room	11/2 Amrstrong 75A6 Steam Trap 10mm - 30.04	n/a	NPT	1.50	2.06	10тт
30.041	Kennedy	Fan room	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.041	π/a	LIAN	2.00	3.50	l.
30.042	Kennedy	Fan room	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.042	n/a	TAN	2.00	3,53	-
30.043	Kennedy	Fan room	11/2 Amrstrong 75A6 Steam Trap 10mm - 30.043	n/a	TAN	1.50	2.06	10mm
30.044	Kennedy	Fan room	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.044	n/a	NPT	2.00	3.50	=
30.045	Kennedy	Fan room	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.045	n/a	LAN	2:00	3.53	
30.046	Kennedy	Fan room	11/2 Amrstrong 75A6 Steam Trap 10mm - 30.046	n/a	NPT	1.50	2.06	10mm
30.047	Kennedy	Fan room	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.047	n/a	TaN	2.00	3.50	<del>.</del>



Insulation Thickness	<del>.</del> .	10mm	<u>-</u>	# T	n	•	-	managed of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the sta	10mm		=	10mm	<b>B</b>	=	-		-	- Afficial temperature has been been been been been been been bee	10mm
SqFt/ Item	3.53	2.06	3.50	3.50	1.01	1.80	1.80	1.01	1.83	2.25	2.25	1.83	2.25	2,25	18.00	18.00	26.00	26.00	1.83
Nom. Pipe Size	2.00	1.50	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1,00	1.00	1.00	1.00	1,00	1.00	1,00	2.00	2.00	1.00
Flange Class	NPT	NPT	PA	LAN	125/150	125/150	125/150	125/150	NPT	Ä	MPH	TAN	FA	PA	N/A	N/A	N/A	N/A	LAN
LF of Piping	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	70	70	50	20	n/a
Description	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.048	11/2 Amrstrong 75A6 Steam Trap 10mm - 30.049	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.05	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.051	2 Control Valve 125/150 (0-299°F) 1" - 30.052	2 Gate Valve 125/150 (0-299°F) 1" - 30.053	2 Gate Valve 125/150 (0-299°F) 1" - 30.054	2 Control Valve 125/150 (0-299°F) 1" - 30.054	1 FT Steam Trap (0°-299°F) 10mm Exterior - 30.506	1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.057	1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.058	1 FT Steam Trap (0°-299°F) 10mm Exterior - 30,059	1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.06	1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.061	1" Hard Pipe Insulation x1" 1" (0°-299°F) - 30.062	1" Hard Pipe Insulation x1'1" (0º-299ºF) - 30,063	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 30.064	2" Hard Pipe Insulation x1'1" (0°-299°F) - 30.065	1 FT Steam Trap (0°-299°F) 10mm Exterior - 30.066
Location 2	Fan room	Fan room	Fan room	Fan room	Fan room	Fan room	Fan room	Fan room	Fan room	Fan room	Fan room	Fan room	Fan room	Fan room	Fan room	Fan room	Fan room	Бап гоот	Fan room
Location 1	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy
ltem	30.048	30.049	30.05	30,051	30.052	30,053	30.054	30,055	30.056	30.057	30.058	30.059	30.06	30.061	30,062	30,063	30.064	30.065	30.066



	<u>Location 1</u>	Location 2	Description	ur or Piping	class	Pipe Size	ltem	msuranon Thickness
statistatis (1). Tarifinas (1)	Kennedy	Fan room	1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.067	n/a	TdN	1,00	2,25	a.L
	Kennedy	Fan room	1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.068	n/a	Z	1.00	2.25	***************************************
	Kennedy	Fan room	3" Hard Pipe insulation x 1' 1" (0°-299°F) - 30.069	35	N/A	3.00	28.00	
	Kennedy	Roof penthouse	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 30.07	n/a	Z L	0.75	1.67	10mm
	Kennedy	Roof penthouse	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.074	n/a	LAN	0,75	1.96	-
30.072	Kennedy	Roof penthouse	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.072	n/a	Ę	0,75	1.96	<u>-</u>
30.073	Kennedy	Roof penthouse	0.5" Hard Pipe Insulation x1'1" (0°-299°F) - 30.073	39	N/A	05.0	5.00	Ę
30.074	Kennedy	Roof penthouse	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 30.074	n/a	LPN	0.75	1.67	10mm
30.075	Kennedy	Roof penthouse	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.075	n/a	LdN	0.75	1,96	-
30.076	Kennedy	Roof penthouse	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.076	n/a	L Z	0.75	1.96	Ę.
30.077	Kennedy	Roof penthouse	1.25 Control Valve NPT (0-299°F) 10mm - 30.077	n/a	La N	1.25	06'0	10mm
30.078	Kennedy	Roof penthouse	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 30.078	n/a	LPT	0.75	1.67	10mm
30.079	Kennedy	Roof penthouse	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.079	n/a	L L	0.75	1,96	<u>‡</u>
	Kennedy	Roof penthouse	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.08	n/a	L d N	0.75	1.96	<b>—</b>
30,081	Kennedy	Roof penthouse	1.25 Control Valve NPT (0-299°F) 10mm - 30.081	n/a	LAN	1.25	06.0	10тш
30.082	Kennedy	Roof penthouse	1.25 Control Valve NPT (0-299°F) 10mm - 30.082	n/a	LEN	1.25	06.0	10mm
30.083	Kennedy	Roof penthouse	1.25 FT steam trap (0°-299°F) 10mm Exterior - 30.083	n/a	L	1.25	1.88	10тт
30.084	Kennedy	Roof penthouse	1.25" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.084	11/a	불	1.25	2.61	-

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Insulation	1.1	10mm	<b>3</b>	<b>-</b>	10mm	F.	<u>*</u>	F	10mm	### ##################################	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s	10mm		=	10mm	=	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
SqFt/ Ifem	2.61	1.88	2.61	2.61	1.67	1.96	1,96	10,00	1.83	2.25	2.25	1.83	2.25	2.25	1.83	2.25	2.25
Nom. Pipe	<u>SFR</u> 6	1.25	1.25	1.25	0.75	0.75	0.75	1.00	100	1.00	1.00	1.00	1,00	1.00	1,00	1.00	1.00
Flange	LdN	NPT	LdN	TAN	LdN	NPT	LdN	N/A	TAN	NPT	NPT	NPT	LdN	LAN	LdN	NPT	TdN
LF of Piping	n/a	e/u	n/a	n/a	n/a	n/a	n/a	40	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Description	1.25" Steam Trap Station Sleeve Outgoing (0°-299°F)	4.7	1.25" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.087	1.25" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.088	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 30.089	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.09	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30,091	1" Hard Pipe Insulation x1'1" (0°-299°F) - 30.092	1 FT Steam Trap (0°-299°F) 10mm Exterior - 30.093	1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.094	1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.095	1 FT Steam Trap (0°-299°F) 10mm Exterior - 30.096	1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.097	1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30.098	1 FT Steam Trap (0°-299°F) 10mm Exterior - 30.099	1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 30.1	1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 30,101
Location 2	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse	Roof penthouse
Location	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy	Kennedy
ltem.	30,085	30.086	30.087	30.088	30.089	30.09	30.091	30.092	30,093	30.094	30,095	30,096	30.097	30.098	30,099	30.1	30.101

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i (tem)	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
30.102	Kennedy	Roof penthouse	1.5 Control Valve NPT (0-299°F) 10mm - 30.102	n/a	TdN	1.50	0.97	10mm
30,103	Kennedy	New wing	2" Flex Hose x 1" (0-299°F) 1" - 30.103	n/a	N/A	2.00	0.65	
30.104	Kennedy	New wing	2" Sleeve - 30.104	-	N/A	2.00	1.50	<b>.</b>
30,105	Kennedy	New wing	Suction Diffusor - 30.105	e/u	n/a	n/a		and the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second o
30.106	Kennedy	New wing	2" Flex Hose x 1' (0-299°F) 1" - 30.106	n/a	N/A	2.00	0.65	***
30,107	Kennedy	New wing	2" Spool 125/150 (0-299°F) 1" - 30,107	n/a	125/150	2.00	1.57	•
30.108	Kennedy	New wing	2" Centrifugal Pump - 30.108	n/a	N/A	2.00	10.25	-
30.109	Kennedy	New wing	2" Flex Hose x 1" (0-299°F) 1" - 30.109	n/a	N/A	2.00	0.65	The second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the second and the se
30.11	Kennedy	New wing	2" Sleeve - 30.11	-	N/A	2.00	1.50	-
30,111	Kennedy	New wing	Suction Diffusor - 30.111	n/a	n/a	1/a	Ë	-
30,112	Kennedy	New wing	2" Flex Hose x 1' (0-299°F) 1" - 30,112	n/a	N/A	2.00	0.65	-
30.113	Kennedy	New wing	2" Spool 125/150 (0-299°F) 1" - 30,113	n/a	125/150	2.00	1.57	And the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of t
30.114	Kennedy	New wing	2" Centrifugal Pump - 30.114	n/a	ΝΑ	2.00	10.25	
30.115	Kennedy	New wing	Air Separator - 30.115	e/u	n/a	e/a	5:00	
11.001	Kingsbury	Boiler room	8 Gate Valve 125/150 (0-299°F) 1" - 11.001	n/a	125/150	8,00	6.77	-
11.002	Kingsbury	Boiler room	8 Flange 125/150 (0-299°F) 1" - 11.002	n/a	125/150	8,00	2.36	1
11.003	Kingsbury	Boiler room	8 Flange 125/150 (0-299°F) 1" - 11.003	n/a	125/150	8,00	2.36	F
11.004	Kingsbury	Boiler room	8 Flange 125/150 (0-299°F) 1" - 11.004	n/a	125/150	8.00	2.36	<b>=</b>
11.005	Kingsbury	Boiler room	8" Blind Flange 125/150 (0-299°F) 1" - 11.005	n/a	125/150	8.00	3.28	<u>.</u>
11.006	Kingsbury	Boiler room	8 Flange 125/150 (0-299°F) 1" - 11.006	n/a	125/150	8,00	2,36	1
11.007	Kingsbury	Boiler room	8 Flange 125/150 (0-299°F) 1" - 11.007	n/a	125/150	8.00	2.36	F
11.008	Kingsbury	Boiler room	8 Flange 125/150 (0-299°F) 1" - 11,008	n/a	125/150	8.00	2.36	
11.009	Kingsbury	Boiler room	8 Flange 125/150 (0-299°F) 1" - 11.009	n/a	125/150	8.00	2.36	-
1.01	Kingsbury	Boiler room	8 Flange 125/150 (0-299°F) 1" - 11.01	n/a	125/150	8,00	2,36	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
11.011	Kingsbury	Boiler room	8 Flange 125/150 (0-299°F) 1" - 11.011	п/а	125/150	8.00	2.36	F.

City of Waterbury, Connecticut Investment Grade Energy Audit · May 13, 2016 (rev. June 29, 2016)



ind Flange 125/150 (0-299°F) 1" - 11.012			7/11/01/10 F00-00-00	Description	Piping	Class	Size	Item	Thickness
Kingsbury         Boller room         3 Gate Valve 125/150 (0-299°F) "- "11.013         n/a         125/150         3.00         2.67           Kingsbury         Boller room         8 Elbows 90°F1 (0-299°F) "- "11.014         n/a         N/A         8.00         5.19           Kingsbury         Boller room         3 Gate Valve 125/150 (0-299°F) "- "11.014         n/a         125/150         4.00         1.57           Kingsbury         Boller room         4 Flange 125/150 (0-299°F) "- "11.016         n/a         125/150         4.00         1.57           Kingsbury         Boller room         Low Water Cut-Off "11.018         n/a         125/150         4.00         1.57           Kingsbury         Boller room         Low Water Cut-Off "11.018         n/a         n/a         1.50         1.57           Kingsbury         Boller room         4 Gate Valve 125/150 (0-299°F) "- "11.022         n/a         1.57         1.00         1.57           Kingsbury         Boller room         5 Gate Valve 125/150 (0-299°F) "- "11.022         n/a         1.25/150         2.00         5.04           Kingsbury         Boller room         2 Gate Valve 125/150 (0-299°F) "- "11.024         n/a         125/150         2.00         5.04           Kingsbury         Boller room         2 F	land, i	ingsbury	Boiler room	8" Blind Flange 125/150 (0-299°F) 1" - 11.012	n/a	125/150	8.00	3.28	-L
Kingsbury         Boiler room         3 cate Valve 125/150 (0-299°F) - 11.013         n/a         125/150         3.00         5.19           Kingsbury         Boiler room         3 cate Valve 125/150 (0-299°F) T - 11.014         n/a         125/150         3.00         2.67           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) T - 11.016         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.018         n/a         n/a         1.25/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.02         n/a         n/a         n/a         2.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.02         n/a         n/a         n/a         2.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.02         n/a         n/a         1.25/150         6.00         5.04           Kingsbury         Boiler room         4 cate Valve 125/150 (0-299°F) T - 11.023         n/a         1.25/150         6.00         5.04           Kingsbury         Boiler room         2 cate Valve 125/150 (0-299°F) T - 11.023         n/a         1.25/150         2.50         1.11		ingsbury	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 11.013	n/a	125/150	3.00	2.67	-
Kingsbury         Boiler room         3 Gate Valve 125/150 (0-299°F) T°-11.015         n/a         125/150         3.00         2.67           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) T°-11.015         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) T°-11.016         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off -11.018         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         Low Water Cut-Off -11.02         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         Low Water Cut-Off -11.02         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         Low Water Cut-Off -11.02         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         Gate Valve 125/150 (0-299°F) T°-11.022         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) T°-11.022         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) T°-11.023		ingsbury	Boiler room	8 Elbows 90°1" (0-299°F) - 11.013	n/a	N/A	8.00	5,19	1
Kingsbury         Boiler room         8 Gate Valve 125/150 (0-299°F) 1" - 11,015         n/a         125/150         8.00         6.77           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11,016         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11,019         n/a         n/a         n/a         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11,019         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         Low Water Cut-Off - 11,019         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         Gate Valve 125/150 (0-299°F) 1" - 11,022         n/a         125/150         4.00         3.45           Kingsbury         Boiler room         Gate Valve 125/150 (0-299°F) 1" - 11,022         n/a         125/150         4.00         3.45           Kingsbury         Boiler room         2.5 Control Valve 125/150 (0-299°F) 1" - 11,022         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11,023         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         2.5 Flange	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s	ingsbury	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 11.014	n/a	125/150	3.00	2.67	1
Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11,016         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11,017         n/a         17/a         1.07         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11,018         n/a         n/a         n/a         1.04         2.00           Kingsbury         Boiler room         Low Water Cut-Off - 11,019         n/a         n/a         n/a         2.00         5.04           Kingsbury         Boiler room         G Gate Valve 125/150 (0-299°F) 1" - 11,022         n/a         17/a         n/a         2.00         5.04           Kingsbury         Boiler room         G Gate Valve 125/150 (0-299°F) 1" - 11,022         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11,022         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11,023         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11,023         n/a         1.6         1.57 <td< td=""><td></td><td>ingsbury</td><td>Boiler room</td><td>8 Gate Valve 125/150 (0-299°F) 1" - 11.015</td><td>n/a</td><td>125/150</td><td>8.00</td><td>6.77</td><td></td></td<>		ingsbury	Boiler room	8 Gate Valve 125/150 (0-299°F) 1" - 11.015	n/a	125/150	8.00	6.77	
Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11,017         n/a         1/25/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11,018         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         Low Water Cut-Off - 11,019         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         Low Water Cut-Off - 11,02         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         G Gate Valve 125/150 (0-299°F) 1" - 11,022         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         2.5 Control Valve 125/150 (0-299°F) 1" - 11,022         n/a         125/150         2.50         1.11           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11,023         n/a         125/150         2.50         1.22           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11,023         n/a         125/150         2.50         1.22           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11,023         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         1.0 W		ingsbury	Boiler room	4 Flange 125/150 (0-299°F) 1" - 11.016	n/a	125/150	4.00	1.57	-
Kingsbury         Boiler room         Low Water Cut-Off - 11.018         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         Low Water Cut-Off - 11.019         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         Low Water Cut-Off - 11.02         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 11.022         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         2 Gate Valve 125/150 (0-299°F) 1" - 11.022         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11.024         n/a         125/150         2.50         1.11           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11.024         n/a         125/150         2.00         1.57           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11.024         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.029         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.		ingsbury	Boiler room	4 Flange 125/150 (0-299°F) 1" - 11.017	n/a	125/150	4.00	1.57	
Kingsbury         Boiler room         Low Water Cut-Off- 11.019         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         Low Water Cut-Off- 11.02         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         6 Gate Valve 125/150 (0-299°F) 1"-11.022         n/a         125/150         4.00         5.04           Kingsbury         Boiler room         2.5 Control Valve 125/150 (0-299°F) 1"-11.022         n/a         125/150         5.04         1.01           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1"-11.024         n/a         125/150         2.50         1.11           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1"-11.024         n/a         125/150         2.50         1.12           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1"-11.025         n/a         125/150         2.50         1.12           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1"-11.028         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off- 11.03         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off- 11.03 </td <td></td> <td>ingsbury</td> <td>Boiler room</td> <td>Low Water Cut-Off - 11.018</td> <td>n/a</td> <td>e/u</td> <td>n/a</td> <td>2.00</td> <td>=</td>		ingsbury	Boiler room	Low Water Cut-Off - 11.018	n/a	e/u	n/a	2.00	=
Kingsbury         Boiler room         Low Water Cut-Off - 11.02         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         6 Gate Valve 125/150 (0-299°F) 1" - 11.021         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 11.023         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11.025         n/a         125/150         2.50         1.11           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11.025         n/a         125/150         2.50         1.12           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.025         n/a         125/150         2.50         1.12           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.025         n/a         125/150         2.50         1.57           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.025         n/a         125/150         2.50         1.50           Kingsbury         Boiler room         1 Hand Pipe Insulation x11" (0°-299°F) - 11.033         n/a         n/a         n/a         n/a         1.00         1.00		ingsbury	Boiler room	Low Water Cut-Off - 11.019	// a	n/a	n/a	2.00	and the second second second second
Kingsbury         Boiler room         6 Gate Valve 125/150 (0-299°F) 1" - 11.022         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         4 Gate Valve 125/150 (0-299°F) 1" - 11.022         n/a         125/150         4.00         3.45           Kingsbury         Boiler room         2.5 Control Valve 125/150 (0-299°F) 1" - 11.024         n/a         125/150         2.50         1.11           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11.026         n/a         125/150         2.50         1.12           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11.026         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.028         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.039         n/a         n/a         n/a         n/a         1.00         1.50           Kingsbury         Boiler room         Low Water Cut-Off - 11.03         2.0         N/A         1.00         12.00         12.00           Kingsbury         Boiler room         Low Water Cut-Off - 11.03         2.0         N/A         2.00         12.00	.,	ingsbury	Boiler room	Low Water Cut-Off - 11.02	n/a	n/a	n/a	2.00	=
Kingsbury         Boiler room         4 Gate Valve 125/150 (0-299°F) T" - 11.022         n/a         125/150         4.00         3.45           Kingsbury         Boiler room         2.5 Control Valve 125/150 (0-299°F) T" - 11.023         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) T" - 11.024         n/a         125/150         2.50         1.11           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) T" - 11.025         n/a         125/150         2.50         1.22           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) T" - 11.028         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) T" - 11.028         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.03         n/a         n/a         n/a         1.00         1.200           Kingsbury         Boiler room         2 Hard Pipe Insulation xi T" (0°-299°F) - 11.031         30         N/A         1.00         12.00           Kingsbury         Boiler room         2 Hard Pipe Insulation xi T" (0°-299°F) - 11.032         20         N/A         4.00         12.00		Ingsbury	Boiler room	6 Gate Valve 125/150 (0-299°F) 1" - 11.021	n/a	125/150	6.00	5,04	: <u>*</u>
Kingsbury         Boiler room         6 Gate Valve 125/150 (0-299°F) 1" - 11.024         n/a         125/150         6.00         5.04           Kingsbury         Boiler room         2.5 Control Valve 125/150 (0-299°F) 1" - 11.025         n/a         125/150         2.50         1.11           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11.025         n/a         125/150         2.50         1.22           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.028         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.029         n/a         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         Low Water Cut-Off - 11.03         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         2" Hard Pipe Insulation x! 1" (0°-299°F) - 11.031         30         N/A         4.00         12.00           Kingsbury         Boiler room         2" Hard Pipe Insulation x! 1" (0°-299°F) - 11.032         30         N/A         4.00         12.00           Kingsbury         Boiler room         4" Hard Pipe Insulation x! 1" (0°-299°F) - 11.032         30         N/A         4.00         12.00           Kingsbury <td></td> <td>ingsbury</td> <td>Boiler room</td> <td>4 Gate Valve 125/150 (0-299°F) 1" - 11.022</td> <td>n/a</td> <td>125/150</td> <td>4.00</td> <td>3.45</td> <td>TI VIII VIII VIII VIII VIII VIII VIII V</td>		ingsbury	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 11.022	n/a	125/150	4.00	3.45	TI VIII VIII VIII VIII VIII VIII VIII V
Kingsbury         Boiler room         2.5 Control Valve 125/150 (0-299°F) 1" - 11.024         n/a         125/150         2.50         1.11           Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11.025         n/a         125/150         2.50         1.22           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.028         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.028         n/a         1/a         1.57         1.27           Kingsbury         Boiler room         Low Water Cut-Off - 11.039         n/a         n/a         n/a         1.00         1.50           Kingsbury         Boiler room         1" Hard Pipe Insulation x1" (0°-299°F) - 11.031         30         N/A         4.00         12.00           Kingsbury         Boiler room         2" Hard Pipe Insulation x1" (0°-299°F) - 11.031         30         N/A         4.00         12.00           Kingsbury         Boiler room         3" Spool 125/150 (0-299°F) 1" - 11.033         n/a         4.00         12.00           Kingsbury         Boiler room         3" Spool 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         1.60           Kingsbury         Boiler ro		ingsbury	Boiler room	6 Gate Valve 125/150 (0-299°F) 1" - 11.023	n/a	125/150	6.00	5.04	Photo of G. Hardward Company (1)
Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11.025         n/a         125/150         2.50         1.22           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.026         n/a         125/150         2.50         1.22           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.028         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.029         n/a         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         1" Hard Pipe Insulation x1" (0°-299°F) - 11.031         30         N/A         4.00         12.00           Kingsbury         Boiler room         2" Hard Pipe Insulation x1" (0°-299°F) - 11.032         30         N/A         4.00         21.00           Kingsbury         Boiler room         2" Hard Pipe Insulation x1" (0°-299°F) - 11.033         20         N/A         4.00         21.00           Kingsbury         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         2.00           Kingsbury         Boiler room         3 Sate Valve 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         2.00		ingsbury	Boiler room	2.5 Control Valve 125/150 (0-299°F) 1" - 11.024	n/a	125/150	2.50	Ε	-
Kingsbury         Boiler room         2.5 Flange 125/150 (0-299°F) 1" - 11.026         n/a         125/150         2.50         1.22           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.028         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.029         n/a         n/a         n/a         1.57         2.00           Kingsbury         Boiler room         Low Water Cut-Off - 11.03         n/a         n/a         n/a         2.00         1.50           Kingsbury         Boiler room         2" Hard Pipe Insulation x1" (0°-299°F) - 11.031         30         N/A         2.00         16.00           Kingsbury         Boiler room         4" Hard Pipe Insulation x1" (0°-299°F) - 11.032         20         N/A         4.00         16.00           Kingsbury         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         2.67           Kingsbury         Boiler room         3 Sate Valve 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         2.67		ingsbury	Boiler room	2.5 Flange 125/150 (0-299°F) 1" - 11.025	n/a	125/150	2.50	1.22	-
Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.027         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.028         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.03         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         2" Hard Pipe Insulation x1" (0°-299°F) - 11.031         30         N/A         1.00         12.00           Kingsbury         Boiler room         4" Hard Pipe Insulation x1" (0°-299°F) - 11.032         20         N/A         4.00         21.00           Kingsbury         Boiler room         4" Hard Pipe Insulation x1" (0°-299°F) - 11.033         20         N/A         4.00         21.00           Kingsbury         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         2.67           Kingsbury         Boiler room         3 Sate Valve 125/150 (0-299°F) 1" - 11.034         n/a         125/150         3.00         1.96		ingsbury	Boiler room	2.5 Flange 125/150 (0-299°F) 1" - 11.026	n/a	125/150	2.50	1.22	
Kingsbury         Boiler room         4 Flange 125/150 (0-299°F) 1" - 11.028         n/a         125/150         4.00         1.57           Kingsbury         Boiler room         Low Water Cut-Off - 11.033         n/a         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         1" Hard Pipe Insulation x! 1" (0°-299°F) - 11.031         30         N/A         1.00         12.00           Kingsbury         Boiler room         4" Hard Pipe Insulation x! 1" (0°-299°F) - 11.032         20         N/A         2.00         16.00           Kingsbury         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         2.67           Kingsbury         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         2.67		ingsbury	Boiler room	4 Flange 125/150 (0-299°F) 1" - 11.027	n/a	125/150	4.00	157	The second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the second state of the se
Kingsbury         Boiler room         Low Water Cut-Off-11.029         n/a         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         1" Hard Pipe Insulation x1" 1" (0°-299°F) - 11.031         45         N/A         1.00         12.00           Kingsbury         Boiler room         2" Hard Pipe Insulation x1" 1" (0°-299°F) - 11.032         20         N/A         4.00         21.00           Kingsbury         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         2.67           Kingsbury         Boiler room         3" Spool 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         1.96		ingsbury	Boiler room	4 Flange 125/150 (0-299°F) 1" - 11.028	п/а	125/150	4.00	1.57	-
Kingsbury         Boiler room         Low Water Cut-Off - 11.03         n/a         n/a         n/a         n/a         2.00           Kingsbury         Boiler room         1" Hard Pipe Insulation x1" 1" (0°-299°F) - 11.032         30         N/A         2.00         16.00           Kingsbury         Boiler room         4" Hard Pipe Insulation x1" 1" (0°-299°F) - 11.033         20         N/A         4.00         21.00           Kingsbury         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         2.67           Kingsbury         Boiler room         3" Spool 125/150 (0-299°F) 1" - 11.034         n/a         125/150         3.00         1.96		ingsbury	Boiler room	Low Water Cut-Off - 11,029	n/a	n/a	n/a	2.00	-
Kingsbury         Boiler room         1" Hard Pipe Insulation x1" 1" (0°-299°F) - 11.031         45         N/A         1.00         12.00         7           Kingsbury         Boiler room         2" Hard Pipe Insulation x1" 1" (0°-299°F) - 11.032         20         N/A         4.00         21.00           Kingsbury         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         2.67           Kingsbury         Boiler room         3" Spool 125/150 (0-299°F) 1" - 11.034         n/a         125/150         3.00         1.96		ingsbury	Boiler room	Low Water Cut-Off - 11.03	n/a	n/a	n/a	2.00	-
Kingsbury         Boiler room         2" Hard Pipe Insulation x1" (0°-299°F) - 11.032         30         N/A         2.00         16.00           Kingsbury         Boiler room         4" Hard Pipe Insulation x1" (0°-299°F) - 11.033         20         N/A         4.00         21.00           Kingsbury         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 11.034         n/a         125/150         3.00         2.67           Kingsbury         Boiler room         3" Spool 125/150 (0-299°F) 1" - 11.034         n/a         125/150         3.00         1.96		ingsbury	Boiler room	1" Hard Pipe Insulation x1' 1" (0°-299°F) - 11.031	45	ΝΆ	1,00	12.00	I I
Kingsbury         Boiler room         4" Hard Pipe Insulation X1.1" (0°-299°F) - 11.032         20         N/A         4.00         21.00           Kingsbury         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 11.034         n/a         125/150         3.00         1.96		ingsbury	Boiler room	2" Hard Pipe Insulation x1'1" (0°-299°F) - 11.032	30	N/A	2.00	16.00	-
Kingsbury         Boiler room         3 Gate Valve 125/150 (0-299°F) 1" - 11.033         n/a         125/150         3.00         2.67         7           Kingsbury         Boiler room         3" Spool 125/150 (0-299°F) 1" - 11.034         n/a         125/150         3.00         1.96         7		ingsbury	Boller room	4" Hard Pipe Insulation x1'1" (0°-299°F) - 11.032	20	N/A	4.00	21.00	1
Kingsbury Boiler room 3" Spool 125/150 (0-299°F) 1" - 11,034 n/a 125/150 3.00		ingsbury	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 11.033	n/a	125/150	3.00	2.67	ŧ
		ingsbury	Boiler room	3" Spool 125/150 (0-299ºF) 1" - 11,034	n/a	125/150	3.00	1,96	1

City of Waterbury, Connecticut Investment Grade Energy Audit · May 13, 2016 (rev. June 29, 2016)



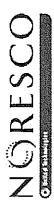
Kingsbury		Pescription	Piping	Class	Pipe Size	SqFtV Item	Thickness
Supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemental and the supplemen	Boiler room	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 11.035	10	N/A	2.00	5.00	1.
Police	Boiler room	4 Hyspan Expansion Joints 125/150 (0°-299°F) 1" - 7035	n/a	125/150	4.00	7.05	-
Police	Boiler room	2" Spool 125/150 (0-299°F) 1" - 7035	n/a	125/150	2.00	1.57	-
Police	Boiler room	2 Check Valve 125/150 (0-299°F) 1" - 1003	n/a	125/150	2.00	1,96	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
Police	Boiler room	2" Centrifugal Pump - 1004	n/a	N/A	2.00	10.25	=
Police	Boller room	4 Hyspan Expansion Joints 125/150 (0°-299°F) 1" - 1005	n/a	125/150	4.00	7,05	-
Police	Boiler room	4 Hyspan Expansion Joints 125/150 (0°-299°F) 1" - 1006	n/a	125/150	4.00	7.05	=
Police	Boiler room	4 Check Valve 125/150 (0-299°F) 1" - 1007	n/a	125/150	4.00	3.44	=
Police	Boiler room	2" Reducer 125/150 (0-299°F) 1" - 1008	n/a	125/150	2.00	1.57	-
Police	Boiler room	2" Centrifugal Pump - 1009	n/a	N/A	2.00	10.25	11
Police	Boiler room	4 Hyspan Expansion Joints 125/150 (0°-299°F) 1" - 1010	n/a	125/150	4.00	7.05	Ę
Police	Boller room	3 Gate Valve 125/150 (0-299°F) 1" - 1011	n/a	125/150	3.00	2.67	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
Police	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 1012	n/a	125/150	4.00	3,45	**************************************
Police	Boller room	3 Gate Valve 125/150 (0-299°F) 1" - 1013	n/a	125/150	3.00	2.67	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
Police	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 1014	n/a	125/150	3.00	2.67	-
Police	Boiler room	4" Hard Pipe Insulation x1'1" (0°-299°F) - 1015	35	N/A	4.00	37,00	
Police	Boiler room	3" Hard Pipe Insulation x 1' 1" (0°-299°F) - 1016	56	N/A	3.00	21.00	* <b>:</b>
Police	Boller room	3 Gate Valve 125/150 (0-299°F) 1" - 1017	<b>□/a</b>	125/150	3.00	2.67	II I
Police	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 1018	n/a	125/150	3.00	2.67	Ę
Police	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 1019	n/a	125/150	4,00	3,45	
Police	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 1020	n/a	125/150	3.00	2.67	=
Police	Boller room	4 Bonnet - Gate 125/150 (0-299°F) 1" - 1021	n/a	125/150	4.00	1.73	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
Police	Boiler room	4 Bonnet - Gate 125/150 (0-299°F) 1" - 1022	n/a	125/150	4.00	1,73	<u>-</u>
Police	Boiler room	4" 3-Way Valve 125/150 (0-299°F) 1" - 1023	n/a	125/150	4.00	6.28	
Police	Boiler room	4" 3-Way Valve 125/150 (0-299°F) 1" - 1024	n/a	125/150	4.00	6.28	=

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1025     Police       1026     Police       1027     Police       1028     Police       1029     Police       1030     Police				THE PERSON NAMED IN COLUMN TWO IS NOT THE OWNER.	CONTRACTOR CONTRACTOR OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PARTY OF THE PA		
		4 Bonnet - Gate 125/150 (0-299°F) 1" - 1025	n/a	125/150	4.00	1.73	=_
		2" Centrifugal Pump - 1026	n/a	N/A	2.00	10.25	-
	boiler room	2" Centrifugal Pump - 1027	n/a	N/A	2,00	10.25	-
	Boiler room	2" Centrifugal Pump - 1028	n/a	N/A	2.00	10.25	T Property Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Special Spe
	Boiler room	2" Centrifugal Pump - 1029	n/a	N/A	2.00	10.25	a construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the construction of the cons
	Boiler room	4 Control Valve 125/150 (0-299°F) 1" - 7035	n/a	125/150	4.00	2.06	
1031 Police	Boiler room	2" Centrifugal Pump - 1031	n/a	N/A	2.00	10.25	# <b>.</b>
1032 Police		Water Tank - 1032	n/a	n/a	n/a	29.27	-
15.001 Reed	Mech room 200	4 Angle Stop Check Valve 125/150 (0-299°F) 1" - 15,001	n/a	125/150	4.00	4.67	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
15.002 Reed	Mech room 200	4" Flex Hose x 1' (0-299°F) 1" - 15.002	n/a	N/A	4.00	1.18	-
15,003 Reed	Mech room 200	4" Pump Jacket ~ 9037	n/a	N/A	4.00	9.33	
15.004 Reed	Mech room 200	Suction Diffusor - 15.004	n/a	n/a	n/a	11.11	-
15.005 Reed	Mech room 200	4 Angle Stop Check Valve 125/150 (0-299°F) 1" - 9037	n/a	125/150	4.00	4.67	and the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second s
15.006 Reed	Mech room 200	4" Flex Hose x 1' (0-299°F) 1" - 15.006	n/a	N/A	4.00	1.18	-
15.007 Reed	Mech room 200	4" Pump Jacket - 15.007	n/a	N/A	4.00	9.33	
15.008 Reed	Mech room 200	Suction Diffusor - 15.008	n/a	n/a	n/a	11.11	-
15.009 Reed	Mech room 200	2 Wye Strainer 125/150 (0-299°F) 1" - 15.009	п/а	125/150	2.00	1.62	E Company
15.01 Reed	Mech room 200	2 Wye Strainer 125/150 (0-299°F) 1" - 15.01	n/a	125/150	2.00	1.62	=
15.011 Reed	Mech room 200	2 Wye Strainer 125/150 (0-299°F) 1" - 15.011	n/a	125/150	2.00	1.62	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
15,012 Reed	Mech room 200	2" Union (0-299°F) 1" - 15.012	n/a	NPT	2.00	0.19	<b>-</b>
15.013 Reed	Mech room 200	2" Union (0-299°F) 1" - 15.013	n/a	LAN	2.00	0.19	
15,014 Reed	Mech room 200	2" Union (0-299°F) 1" - 15.014	n/a	NPT	2.00	0.19	=
.15.015 Reed	Mech room 200	2" Union (0-299°F)1" - 15.015	n/a	NPT	2.00	0.19	4
15.016 Reed	Mech room 200	2" Union (0-299°F) 1" - 15.016	n/a	NPT	2.00	0.19	Ę.
15.017 Reed	Mech room 200	2" Union (0-299°F) 1" - 15.017	n/a	NPT	2.00	0.19	

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liteim	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
5001	Silas Bronson Library	Boiler 3	2" Pump Jacket - 5001	n/a	N/A	2.00	6.67	<del>[</del> _
5002	Silas Bronson Library	Boiler 3	2 Angle Stop Check Valve 125/150 (0-299°F) 1" - 5002	n/a	125/150	2.00	2.43	
5003	Silas Bronson Library	Boiler 3	3 Wye Cap 125/150 (0-299°F) 1" - 5003	n/a	125/150	3.00	1.24	# 1
5004	Sílas Bronson Library	Boiler 3	3 Bonnet - Gate 125/150 (0-299°F) 1" - 5004	n/a	125/150	3.00	134	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
5005	Silas Bronson Library	Boiler 2	2" Pump Jacket - 5005	n/a	N/A	2.00	6.67	# <b>#</b>
5005	Silas Bronson Library	Boiler 2	2 Angle Stop Check Valve 125/150 (0-299°F) 1" - 5006	n/a	125/150	2:00	2.43	J. J. J. J. J. J. J. J. J. J. J. J. J. J
5007	Silas Bronson Library	Boiler 2	3 Wye Cap 125/150 (0-299°F) 1" - 5007	n/a	125/150	3.00	1.24	
5008	Silas Bronson Library	Boiler 3	3 Bonnet - Gate 125/150 (0-299°F) 1" - 5008	n/a	125/150	3,00	1.34	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
5009	Silas Bronson Library	Boiler 1	2" Pump Jacket - 5009	n/a	N/A	2.00	6.67	
5010	Silas Bronson Library	Boiler 1	2 Angle Stop Check Valve 125/150 (0-299"F) 1" - 5010	n/a	125/150	2.00	2.43	-
5011	Silas Bronson Library	Boiler 2	3 Wye Cap 125/150 (0-299°F) 1" - 5011	n/a	125/150	3.00	1.24	<u>-</u>
5012	Silas Bronson Library	Boiler 1	3 Bonnet - Gate 125/150 (0-299°F) 1" - 5012	n/a	125/150	3.00	1.34	
5013	Silas Bronson Library	Boiler 2	3" Pump Jacket - 5013	n/a	n/a	2	2.51	£ .
5014	Silas Bronson Library	Boiler 2	4 Nibco Gate Valve 125/150 (0-299°F) 1" - 5014	n/a	125/150	4.00	3.45	<b>"</b>



	Location 2	Description	LF of Piping	Flange Class	Nom, Pipe Size	SqFt/ Item	Insulation Thickness
Boiler 2 4" Fl	4"FI	4" Flex Hose x 1' (0-299°F) 1" - 5015	e/u	N/A	4.00	1.18	Attenuate addid na la Alba Attenuate in teles
Boiler 2 3" Spo	3" Sp	3" Spool 125/150 (0-299°F) 1" = 5016	n/a	125/150	3.00	1.96	=
Boiler 2 3 Kecl	3 Keck	kley Wye Strainer 125/150 (0-299°F) 1" - 5017	п/а	125/150	3.00	2.47	- - - - - - - - - - - - - - - - - - -
Boiler 2 4" Re	4" Re	4" Reducer 125/150 (0-299°F) 1" - 5018	n/a	125/150	4,00	2.36	-
Boiler 2 4" Fley	4" Fle	4" Flex Hose x 1' (0-299°F) 1" - 5019	n/a	N/A	4,00	1.18	-
Boiler 2 3" Pum	3" Pum	mp Jacket - 5020	n/a	n/a	n/a	2.51	1
Boiler 2 4 Nibco	4 Nibco	4 Nibco Gate Valve 125/150 (0-299°F) 1" - 5021	п/а	125/150	4.00	3.45	-
Boiler 2 4" Flex I	4" Flex I	4" Flex Hose x 1" (0-299%F) 1" - 5022	n/a	N/A	4.00	1.18	
Boiler 2 3" Spool	3" Spool	3" Spool 125/150 (0-299°F) 1" - 5023	n/a	125/150	3.00	1.96	<b>!</b>
Boiler 2 3 Keckle	3 Keckle	3 Keckley Wye Strainer 125/150 (0-299°F) 1" - 5024	n/a	125/150	3,00	2.47	<u>=</u>
Boiler 2 4" Redu	4" Redu	4" Reducer 125/150 (0-299°F) 1" - 5025	n/a	125/150	4.00	2.36	<del>-</del>
Boiler 2 4" Flex H	4" Flex h	4" Flex Hose x 1" (0-299°F) 1" - 5026	n/a	N/A	4.00	1,18	-
Boiler 1 Air Sepa	Air Sepa	Air Separator - 5027	n/a	11/a	n/a	5.00	-
Boller room Low W	N wo⊓	Low Water Cut-Off - 9001	n/a	n/a	n/a	2.00	
Boiler room Low W	Low M	Low Water Cut-Off - 9002	n/a	n/a	n/a	2.00	<b>.</b>

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ltem	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom, Pipe Size	SqFt/ Item	Insulation Thickness
	Sprague	Boiler room	4 Flange 125/150 (0-299°F) 1" - 9003	n/a	125/150	4.00	1.57	a.
9004	Sprague	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 9004	n/a	125/150	4.00	3,45	ŧ.
9005	Sprague	Boiler room	1 FT Steam Trap (0°-299°F) 10mm Exterior - 9005	n/a	NPT	1.00	1.83	10mm
9006	Sprague	Boiler room	1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 9006	n/a	NPT	1.00	2.25	<b>.</b>
2006	Sprague	Boller room	1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 9007	n/a	LMN	1.00	2.25	THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT OF THE CONTRACT O
8006	Sprague	Boiler room	2 FT Steam Trap (0°-299°F) 10mm Exterior - 9008	n/a	NPT	2.00	3.1	10mm
6006	Sprague	Boiler room	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0,5" - 9009	n/a	TAN	2.00	3.50	
9010	Sprague	Boiler room	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 9010	п/а	LAN	2.00	3.53	
9011	Sprague	Boiler room	2 FT Steam Trap (0°-299°F) 10mm Exterior - 9011	n/a	NPT	2.00	3.11	10mm
9012	Sprague	Boiler room	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 9012	n/a	NPT	2.00	3.50	a L
9013	Sprague	Boller room	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 9013		NPT	2.00	3.53	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
	Sprague	Boiler room	2 FT Steam Trap (0°-299°F) 10mm Exterior - 9014	n/a	NPT	2.00	3.11	10mm
9015	Sprague	Boiler room	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 9015	11/a	LAN	2.00	3.50	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
9016	Sprague	Boiler room	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 9016	n/a	NPT	2.00	3,53	=
9017	Sprague	Boiler room	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 9017	20	N/A	2.00	11.00	and an index to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to the first to th
	Sprague	Boiler room	1" Hard Pipe Insulation x1'1" (0°-299°F) - 9018	22	N/A	1.00	6.00	2
	Sprague	Boiler room	4" Hard Pipe Insulation x1' 1" (0°-299°F) - 9019	10	N/A	4.00	11.00	
9020	Sprague	Boiler room	3 Crane Gate Valve 125/150 (0-299°F) 1" - 9020	п/а	125/150	3.00	2.67	=
9021	Sprague	Boiler room	Tank - 9021	n/a	n/a	n/a	30.28	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s



Item	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom, Pipe Size	SqFt/ Item	Insulation Trickness
9022	Sprague	Boiler room	Low Water Cut-Off - 9022	n/a	n/a	n/a	2.00	1
9023	Sprague	Boiler room	Low Water Cut-Off - 9023	n/a	n/a	e/u	2.00	i.
9024	Sprague	Boiler room	4 Flange 125/150 (0-299°F) 1" - 9024	n/a	125/150	4.00	1.57	-
9025	Sprague	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 9025	n/a	125/150	4,00	3,45	A section of Contract Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract of Contract
9056	Sprague	Boiler room	2.5" Hard Pipe Insulation x1' 1" (0°-299°F) - 9026	12	N/A	2.50	8.00	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
9027	Sprague	Boiler room	0.75" Hard Pipe Insulation x1'1" (0°-299°F) - 9027	9	N/A	0.75	1,00	
9028	Sprague	Boiler room	Boiler Drum - 9028	n/a	n/a	n/a	13.40	-
6206	Sprague	Boiler room	Boiler Drum - 9029	n/a	n/a	n/a	13.40	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
9030	Sprague	Boiler room	4 Flange 125/150 (0-299°F) 1" - 9030	n/a	125/150	4.00	1.57	
9031	Sprague	Boiler room	4 Flange 125/150 (0-299°F) 1" - 9031	n/a	125/150	4.00	1.57	•
9032	Sprague	Boiler room	3 Crane Gate Valve 125/150 (0-299°F) 1" - 9032	n/a	125/150	3.00	2.67	
9033	Sprague	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 9033	n/a	125/150	3.00	2.67	the age of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the sta
9034	Sprague	Boiler room	2.5 Gate Valve 125/150 (0-299°F) 1" - 9034	n/a	125/150	2.50	2.14	-
9035	Sprague	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 9035	n/a	125/150	3.00	2.67	
33.001	Tinker	Boiler room	Low Water Cut-Off - 33.881	n/a	n/a	n/a	2.00	-
33.002	Tinker	Boiler room	Low Water Cut-Off - 33.002	n/a	n/a	n/a	2,00	1.
33,003	Tinker	Boiler room	5 Flange 125/150 (0-299°F) 1" - 33.003	n/a	125/150	5.00	1.75	
33.004	Tinker	Boiler room	5" Hard Pipe Insulation x1'11/2" - 33.004	ĸ	N/A	5.00	4,00	1.5.1
33.005	Tinker	Boiler room	5 Gate Valve 125/150 (0-299°F) 1" - 33.005	n/a	125/150	5.00	4.40	<u>-</u>
33,006	Tinker	Boiler room	8 Flange 125/150 (0-299°F) 1" - 33.006	n/a	125/150	8.00	2.36	
33.007	Tinker	Boiler room	8 Flange 125/150 (0-299°F) 1" - 33.007	n/a	125/150	8.00	2.36	-
33.008	Tinker	Воіїег гоот	5 Gate Valve 125/150 (0-299°F) 1" - 9036	n/a	125/150	5.00	4.40	
33.009	Tinker	Boiler room	5 Gate Valve 125/150 (0-299°F) 1" - 33.009	n/a	125/150	5.00	4.40	-
33.01	Tinker	Boiler room	5 Gate Valve 125/150 (0-299°F) 1" - 33.01	n/a	125/150	5.00	4.40	
33.011	Tinker	Boiler room	5 Gate Valve 125/150 (0-299°F) 1" - 33.011	n/a	125/150	5.00	4.40	_

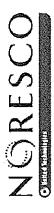
City of Waterbury, Connecticut Investment Grade Energy Audit · May 13, 2016 (rev. June 29, 2016)



ltem Location 1	on I Location 2	Description	Piping	Class	Pipe Size	SqFt/ Item	Insulation Thickness
Tinker	Boiler room	5 Gate Valve 125/150 (0-299°F) 1" - 33,012	n/a	125/150	5.00	4.40	1
Tinker	Boiler room	8 Flange 125/150 (0-299°F) 1" - 33.013	n/a	125/150	8.00	2.36	-
Tinker	Boiler room	8 Flange 125/150 (0-299°F) 1" - 33.014	n/a	125/150	8.00	2.36	-
Tinker	Boiler room	3 Flange 125/150 (0-299°F) 1" - 33.015	n/a	125/150	3.00	1.31	-
Tinker	Boiler room	5 Flange 125/150 (0-299°F) 1" - 33.016	n/a	125/150	5.00	1,75	i L
Tinker	Boiler room	5 Flange 125/150 (0-299°F) 1" - 33.017	n/a	125/150	5.00	1.75	-
Tinker	Boller.room	5 Gate Valve 125/150 (0-299°F) 1" - 33.018	n/a	125/150	5.00	4.40	=
33.019 Tinker	Boiler room	Low Water Cut-Off - 33.019	n/a	n/a	n/a	2.00	-
Tinker	Boiler room	Low Water Cut-Off - 33.02	n/a	n/a	n/a	2.00	
Tinker	Boiler room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 33.021	n/a	NPT	0.75	1.67	10mm
33:022 Tinker	Boiler room	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 33.022	п/а	NPT	0,75	196	-
33.023 Tinker	Boiler room	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 33.023	n/a	NPT	0.75	1.96	<b>—</b>
33.024 Tinker	Boiler room	2" Hard Pipe Insulation x1'1" (0°-299°F) - 33.024	æ	N/A	2.00	2.00	
Tinker	Boiler room	0.75" Hard Pipe Insulation x1'1" (0°-299°F) - 33.025	48	N/A	0.75	10.00	<u>-</u>
33.026 Tinker	Boiler room	2" Hard Pipe Insulation x111" (09-2999F) - 33.026	09	N/A	2.00	31.00	•
Tinker	Boiler room	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 33.027	12	N/A	2.00	6.00	
Tinker	Boller room	Condensate Receiver - 33,028	e/u	n/a	n/a	15.55	
Tinker	Boiler room	2.5" Hard Pipe Insulation x1'1" (0°-299°F) - 33.029	18	N/A	2.50	12.00	-
Tinker	Boiler room	2.5" Union (0-299°F) 1" - 33:03	1/a	TdN	2.50	0,29	
Tinker	Boiler room	2.5" Union (0-299°F) 1" - 33.031	n/a	NPT	2.50	0.29	=
Tinker	Boiler room	2.5" Union (0-299°F) 1" - 33.032	n/a	TdN	2.50	0.29	1.
Tinker	Boiler room	12" Hard Pipe Insulation x1' 2" - 33.033	2	N/A	12.00	6.00	2"
Tinker	Boiler room	Condensate Receiver - 33 034	2/2	7/1	1/1	L	



ltem	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
19.001	Walsh	Boiler room	2 Gate Valve 125/150 (0-299°F) 1" - 19.001	n/a	125/150	2.00	1.80	<u>-</u>
19,002	Walsh	Boiler room	6" Hard Pipe Insulation x1' 1" (0°-299°F) - 19.002	28	N/A	6.00	44.00	<b>"</b>
19.003	Walsh	Boiler room	6" 3-Way Valve 125/150 (0-299°F) 1" - 19.083	n/a	125/150	6.00	8.50	-
19.004	Walsh	Boiler room	4" 3-Way Valve 125/150 (0-299°F) 1" - 9036	n/a	125/150	4.00	6,28	=
19.005	Walsh	Boiler room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 19.005	n/a	NPT	0.75	1.67	10mm
19.006	Walsh	Boiler room	6"3-Way Valve 125/150 (0-299°F) 1" - 16.006	n/a	125/150	6.00	8.50	=
19.007	Walsh	Boiler room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 19.007	n/a	NPT	0.75	1.67	10mm
19.008	Walsh	Boilerroom	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 19,008	n/a	TAN	0.75	1,96	-
19.009	Walsh	Boiler room	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 19,009	n/a	NPT	0.75	1.96	=
19.01	Walsh	Boiler room	Low Water Cut-Off - 19.01	n/a	n/a	n/a	2.00	-
19,011	Walsh	Boiler room	Low Water Cut-Off - 19.011	n/a	n/a	 	2.00	=
19.012	Walsh	Boiler room	4 Flange 125/150 (0-299ºF) 1" - 19.012	n/a	125/150	4,00	1.57	-
19.013	Walsh	Boiler room	4 Flange 125/150 (0-299°F) 1" - 19.013	n/a	125/150	4.00	1.57	-
19.014	Walsh	Boiler room	4" Hard Pipe Insulation x1'1" (0°-299°F) - 19.014	n/a	N/A	4.00	11.00	=
19.014	Walsh	Boiler room	6" 3-Way Valve 125/150 (0-299°F) 1" - 19.014	10	125/150	6.00	8.50	<del>-</del>
19.015	Walsh	Boiler room	Low Water Cut-Off - 19,015	n/a	n/a	n/a	2.00	-
19.016	Walsh	Boiler room	Low Water Cut-Off - 19.016	n/a	n/a	n/a	2.00	-
19.017	Walsh	Boiler room	6 Flange 125/150 (0-299ºF) 1" - 19.017	n/a	125/150	6.00	1.92	-
19,018	Walsh	Boiler room	4 Butterfly Valve 125/150 (0-299°F) 1" - 19.018	п/а	125/150	4.00	1,47	_
19.019	Walsh	Boiler room	5" 3-Way Valve 125/150 (0-299°F) 1" - 119.019	n/a	125/150	5.00	8.50	1.
19.02	Walsh	Boiler room	5" Hard Pipe Insulation x1' 1" (0°-299°F) - 19.02	ന	N/A	5.00	4.00	-
19.021	Walsh	Boiler room	Condensate Receiver - 19.021	n/a	n/a	n/a	15.55	<b>;</b>
19.022	Walsh	Boiler room	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 19.022	35	N/A	2.00	18.00	<del>-</del>



Item	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
19,023	Walsh	Boiler room	1" Hard Pipe Insulation x1'1" (0°-299°F) - 19.023	45	N/A	1,00	12.00	1
19.024	Walsh	Boiler room	0.75" Hard Pipe Insulation x1'1" (0°-299°F) - 19.024	12	N/A	0.75	2.00	-
29.001	Wendell Cross	Boiler room	6 Gate Valve 125/150 (0-2999F) 1" - 26.001	n/a	125/150	6.00	5,04	=
29.002	Wendell Cross	Boiler room	4 Flange 125/150 (0-299°F) 1" - 29.002	n/a	125/150	4.00	1.57	=
29.003	Wendell Cross	Boiler room	4 Flange 125/150 (0-299°F) 1" - 29.003	n/a	125/150	4.00	157	and the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of t
29.004	Wendell Cross	Boiler room	Low Water Cut-Off - 26.004	n/a	n/a	e/u	2.00	The Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Special and Sp
29.005	Wendell Cross	Boiler room	Low Water Cut-Off - 29,005	e/u	n/a	n/a	2.00	
29.006	Wendell Cross	Boiler room	Low Water Cut-Off - 29.006	n/a	e/u		2.00	
29.007	Wendell Cross	Boiler room	0.75" Hard Pipe Insulation x11" (0°-299°F) - 26.007	40	N/A	0.75	8.00	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
29.008	Wendell Cross	Boiler room	2" Hard Pipe Insulation x1'1" (0°-299°F) - 29.008	12	N/A	2.00	6.00	<b>=</b>
29.009	Wendell Cross	Boiler room	2 Flange 125/150 (0-299°F) 1" - 29.009	n/a	125/150	2.00	1.13	± -
29.01	Wendell Cross	Boiler room	8 Gate Valve 125/150 (0-299°F) 1" - 29.01	n/a	125/150	8.00	6.77	-
29.011	Wendell Cross	Boiler room	4 Gate Valve 125/150 (0-299ºF) 1" - 29.011	п/а	125/150	4.00	3,45	
29.012	Wendell Cross	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 29.012	_/a	125/150	4.00	3.45	-
29.013	Wendell Cross	Boiler room	4 Gate Valve 125/150 (0-299ºF) 1" - 29.013	n/a	125/150	4.00	3,45	=
29.014	Wendell Cross	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 29,014	n/a	125/150	4.00	3.45	=
29.015	Wendell Cross	Boiler room	2 Flange 125/150 (0-299°F) 1" - 29,015	n/a	125/150	2.00	1.13	The second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of th
29.016	Wendell Cross	Boiler room	4 Flange 125/150 (0-299°F) 1" - 29.016	n/a	125/150	4.00	1.57	-
29.017	Wendell Cross	Boiler room	4 Flange 125/150 (0-299°F) 1" - 29.017	n/a	125/150	4.00	1.57	-
29.018	Wendell Cross	Boiler room	Low Water Cut-Off - 26.018	n/a	n/a	n/a	2.00	-
29.019	Wendell Cross	Boiler room	Low Water Cut-Off - 29.019	n/a	n/a	n/a	2.00	Particular construction of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular confidence of the particular con
,29.02	Wendell Cross	Boiler room	Low Water Cut-Off - 29.02	n/a	n/a	n/a	2.00	-
29.021	Wendell Cross	Boiler room	4 Blind Flange 250/300 1" (0-299°F) - 29.021	n/a	250/300	4.00	2.29	The second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of th
29.022	Wendell Cross	Boiler room	4 Blind Flange 250/3001" (0-299°F) - 29.022	n/a	250/300	4.00	2.29	-
29.023	Wendell Cross	Boiler room	4 Blind Flange 250/300 1" (0-299°F) - 26.023	n/a	250/300	4.00	2.29	:

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liem	Location 1	Location 2	Description	LF of Piping	Flange Glass	Nom, Pipe Size	SqFV/ ltem	Insulation Thickness
29.024	Wendell Cross	Boiler room	4 Blind Flange 250/300 1" (0-299°F) - 29.024	n/a	250/300	4.00	2.29	=
29,025	Wendell Cross	Boiler room	Condensate Receiver - 29.025	n/a	n/a	u/a	15,55	<b>1</b>
29.026	Wendell Cross	Boiler room	1.5" Hard Pipe Insulation x1'1" (0°-299°F) - 29.026	52	N/A	1.50	20.00	-
29.027	Wendell Cross	Boiler room	1.25" Hard Pipe Insulation x1' 1" (0°-299°F) - 29.027	20	N/A	1.25	7.00	•
29.028	Wendell Cross	Boiler room	2" Hard Pipe Insulation x1'1" (0°-299°F) - 29.028	10	N/A	2.00	5.00	
29.029	Wendell Cross	Војјег гоот	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 29.029	n/a	NPT	0.75	1,67	10mm
29.03	Wendell Cross	Boiler room	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 29.03	n/a	NPT	0.75	1.96	-
29.031	Wendell Cross	Boilerroom	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 29.031	n/a	NPT	9/20	1.96	<b>.</b>
29.031	Wendell Cross	Boiler room	0.75" Hard Pipe Insulation x1' 1" (0°-299°F) - 29.031	21	N/A	0.75	4.00	-
29.032	Wendell Cross	Boiler room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 29.032	n/a	NPT	0.75	1.67	10mm
10.001	West Side	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 1000,1	n/a	125/150	6.00	2.52	-
10.002	West Side	Boiler room	2.5 Bonnet - Gate 125/150 (0-299°F) 1" - 10,002	n/a	125/150	2.50	1.07	And a second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of
10.003	West Side	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 10.003	n/a	125/150	6.00	2.52	
10,004	West Side	Boiler room	2.5 Bonnet - Gate 125/150 (0-299°F) 1" - 10,004	n/a	125/150	2.50	1,07	-
10,005	West Side	Boiler room	6 Flange 125/150 (0-299°F) 1" - 10.005	n/a	125/150	6.00	1.92	ŧ.
10,006	West Side	Boiler room	6 Flange 125/150 (0-299°F) 1" - 10.006	n/a	125/150	6.00	1.92	<b>-</b>
10.007	West Side	Boiler room	Low Water Cut-Off - 10.007	п/а	п/а	n/a	2.00	=
10.008	West Side	Boiler room	Low Water Cut-Off - 10.008	n/a	n/a	n/a	2.00	-
10.009	West Side	Boiler room	Low Water Cut-Off - 10.009	n/a	n/a	n/a	2.00	-
10.01	West Side	Boiler room	6 Bonnet - Gate 125/150 (0-2999F) 1" - 10,01	n/a	125/150	6.00	2.52	<b>.</b>
10.01	West Side	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 10.011	п/а	125/150	6.00	2.52	=
10.012	West Side	Boiler room	Low Water Cut-Off - 10.012	n/a	n/a	n/a	2.00	<b>=</b>
10.013	West Side	Boiler room	Low Water Cut-Off - 10.013	n/a	n/a	n/a	2.00	= :

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West Side         Boiler room         Low Water Cut-Off - 10.014         n,n a         n,n a         n,n a         n,n a         n,n a         n,n a         125/150           West Side         Boiler room         5 Bonnet - Gate 125/150 (0-299°F) 1" - 10.016         n,n a         125/150           West Side         Boiler room         5 Bonnet - Gate 125/150 (0-299°F) 1" - 10.016         n,n a         125/150           West Side         Boiler room         5 Bonnet - Gate 125/150 (0-299°F) 1" - 10.016         n,n a         125/150           West Side         Boiler room         Low Water Cut-Off - 10.009         n,n a         n,n a         125/150           West Side         Boiler room         Low Water Cut-Off - 10.023         n/n a         n/n a         n/n a           West Side         Boiler room         Low Water Cut-Off - 10.023         n/n a         n/n a         n/n a           West Side         Boiler room         IT Steam Trap Station Sleeve Incoming (0°-299°F) 0.57**         n/n a         n/n a         n/n a           West Side         Boiler room         IT Steam Trap Station Sleeve Outgoing (0°-299°F) 0.57**         n/n a         n/n a         n/n a           West Side         Boiler room         G Flange 125/150 (0-299°F) 1" - 10.022         n/n a         n/n a         n/n a	lkem	Location 1	Location 2	Desgription	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
West Side         Boiler room         6 Bonnet - Gate 125/150 (0-299°F) 1" - 10.015         n/a         125/150         6.00         2.52           West Side         Boiler room         5 Bonnet - Gate 125/150 (0-299°F) 1" - 10.016         n/a         125/150         5.00         2.20           West Side         Boiler room         5 Bonnet - Gate 125/150 (0-299°F) 1" - 10.018         n/a         n/a         n/a         2.00         2.20           West Side         Boiler room         Low Water Cut-Off - 10.029         n/a         n/a         n/a         n/a         2.00           West Side         Boiler room         Low Water Cut-Off - 10.021         n/a         n/a         n/a         2.00           West Side         Boiler room         Low Water Cut-Off - 10.022         n/a         n/a         n/a         2.00           West Side         Boiler room         Low Water Cut-Off - 10.023         n/a         n/a         n/a         2.00           West Side         Boiler room         O.75* Hard Pipe Insulation xl1** (0°-299°F) 1.0.022         n/a         n/a         n/a         1.00         2.20           West Side         Boiler room         1°-5 team Trap Station Sleeve Incoming (0°-299°F) 0.5°F*         n/a         n/a         n/a         n/a         n/a <td< td=""><td>4</td><td>West Side</td><td>Boiler room</td><td>Low Water Cut-Off - 10.014</td><td>n/a</td><td>n/a</td><td>n/a</td><td>2.00</td><td>=</td></td<>	4	West Side	Boiler room	Low Water Cut-Off - 10.014	n/a	n/a	n/a	2.00	=
West Side         Boiler room         5 Bonnet - Gate 125/150 (0-299°F) 1° - 9036         n/a         125/150         5.00         2.20           West Side         Boiler room         5 Bonnet - Gate 125/150 (0-299°F) 1° - 10.016         n/a         125/150         5.00         2.20           West Side         Boiler room         Low Water Cut-Off - 10.019         n/a         n/a         n/a         2.00           West Side         Boiler room         Low Water Cut-Off - 10.021         n/a         n/a         n/a         2.00           West Side         Boiler room         Low Water Cut-Off - 10.021         n/a         n/a         n/a         2.00           West Side         Boiler room         0.75° Hard Pice Includition xII " (0°-299°F) - 10.022         n/a         n/a         1.00           West Side         Boiler room         1.75 Ream Trap Station Sleeve Incoming (0°-299°F) 0.5° -         n/a         n/a         1.00         2.25           West Side         Boiler room         1.75 Ream Trap Station Sleeve Outgoing (0°-299°F) 0.5° -         n/a         n/a         1.00         2.25           West Side         Boiler room         1.75 Ream Trap Station Sleeve Outgoing (0°-299°F) 0.5° -         n/a         n/a         1.00         2.25           West Side         Boiler room <td>5</td> <td>West Side</td> <td>Boiler room</td> <td>6 Bonnet - Gate 125/150 (0-299°F) 1" - 10.015</td> <td>п/а</td> <td>125/150</td> <td>6.00</td> <td>2.52</td> <td>=</td>	5	West Side	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 10.015	п/а	125/150	6.00	2.52	=
West Side         Boiler room         5 Bonnet - Gate 125/150 (0-299°F) 1" - 10.016         n/a         125/150         5.00         2.20           West Side         Boiler room         Low Water Cut-Off - 10.019         n/a         n/a         n/a         n/a         2.00         2.20           West Side         Boiler room         Low Water Cut-Off - 10.019         n/a         n/a         n/a         n/a         2.00         2.20           West Side         Boiler room         Low Water Cut-Off - 10.021         n/a         n/a         n/a         2.00         2.00           West Side         Boiler room         Low Water Cut-Off - 10.021         n/a         n/a         n/a         2.00         1.00           West Side         Boiler room         1.75 Hard Pipe Insulation xiT (0°-299°F) 10.022         n/a         n/a         1.00         1.83           West Side         Boiler room         1.75 Steam Trap Station Sleeve Dutgoing (0°-299°F) 0.5°°-         n/a         n/a         n/a         1.00         2.25           West Side         Boiler room         1.75 Steam Trap Station Sleeve Dutgoing (0°-299°F) 0.5°°-         n/a         n/A         n.00         1.00         2.00           West Side         Boiler room         1.75 Steam Trap Station Sleeve Dutgoing (0°-299°F) 0	9	West Side	Boiler room		n/a	125/150	5.00	2.20	
West Side         Boiler room         5 Bonnet - Gate 125/150 (0-299°F) 1" - 10,018         n/a         1/25/150         5.00         2.20           West Side         Boiler room         Low Water Cut-Off - 10,019         n/a         n/a         n/a         n/a         200           West Side         Boiler room         Low Water Cut-Off - 10,021         n/a         n/a         n/a         2,00           West Side         Boiler room         Low Water Cut-Off - 10,021         n/a         n/a         n/a         2,00           West Side         Boiler room         Low Water Cut-Off - 10,021         n/a         n/a         n/a         n/a         2,00           West Side         Boiler room         I T Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 1,023         n/a         NPT         1,00         2.25           West Side         Boiler room         I T Steam Trap Station Sleeve Dutgoing (0°-299°F) 0.5" - 1,02         1,7a         NPT         1,00         2.25           West Side         Boiler room         I T Hard Pipe Insulation xIT " (0°-299°F) - 10.027         n/a         1,27         0         0.0         1,20           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.023         n/a         N/A         4.0         1,70         0	17	West Side	Boiler room	5 Bonnet - Gate 125/150 (0-299°F) 1" - 10.016	п/а	125/150	5.00	2.20	
West Side         Boiler room         Low Water Cut-Off - 10.019         n/a         n/a         n/a         2.00           West Side         Boiler room         Low Water Cut-Off - 10.02         n/a         n/a         n/a         2.00           West Side         Boiler room         Low Water Cut-Off - 10.021         n/a         n/a         n/a         2.00           West Side         Boiler room         0.75° Hard Pipe Insulation xl 1" (0°-299°F) - 10.023         n/a         NPT         1.00         2.25           West Side         Boiler room         1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5° - n/a         n/a         NPT         1.00         2.25           West Side         Boiler room         1" Hard Pipe Insulation xl 1" (0°-299°F) - 10.025         35         N/A         1.00         2.00           West Side         Boiler room         4" Hard Pipe Insulation xl 1" (0°-299°F) - 10.025         n/a         N/A         1.00         2.25           West Side         Boiler room         4" Hard Pipe Insulation xl 1" (0°-299°F) - 10.025         n/a         1.50         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.025         n/a         N/A         0.0         1.92           West Side         Boiler room         6 Flange	<u>8</u> 2	West Side	Boiler room	5 Bonnet - Gate 125/150 (0-299°F) 1" - 10.018	n/a	125/150	5.00	2.20	
West Side         Boiler room         Low Water Cut-Off - 10.02         n/va         n/va         n/va         2.00           West Side         Boiler room         Low Water Cut-Off - 10.021         n/va         n/va         n/va         2.00           West Side         Boiler room         0.75" Hard Pipe Insulation x1" (°0-299°F) - 10.022         80         N/A         0.75" 16.00           West Side         Boiler room         1FT Steam Trap Station Sleeve Incoming (°0-299°F) 0.5" - n/va         NPT         1.00         2.25           West Side         Boiler room         1" Steam Trap Station Sleeve Incoming (°0-299°F) 0.5" - n/va         NPT         1.00         2.25           West Side         Boiler room         1" Hard Pipe Insulation x1" (°0-299°F) - 10.026         35         N/A         4.00         1.00           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.023         n/va         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.023         n/va         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.033         n/va         NPT         0.75         1.96           West Side         Boiler room         6 Flange 125/150	19	West Side	Boiler room	Low Water Cut-Off - 10.019	n/a	п/а	n/a	2.00	Ę
West Side         Boiler room         Low Water Cut-Off - 10.021         n/a         n/a         n/a         n/a         n/a         2.00           West Side         Boiler room         0.75" Hard Pipe insulation x1" (°0°-299°F) - 10.022         80         N/A         0.75         16.00           West Side         Boiler room         1"Steam Trap Station Sleeve Incoming (°0~-299°F) 0.5" - n/a         NPT         1.00         2.25           West Side         Boiler room         1"Steam Trap Station Sleeve Incoming (°0~-299°F) 0.5" - n/a         NPT         1.00         2.25           West Side         Boiler room         1"Hard Pipe Insulation x1" (°0~-299°F) - 10.026         35         N/A         1.00         2.05           West Side         Boiler room         6 Flange 125/150 (°0~299°F) 1" - 10.026         35         N/A         1.00         1.02           West Side         Boiler room         6 Flange 125/150 (°0~299°F) 1" - 10.028         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (°0~299°F) 1" - 10.033         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (°0~299°F) 1" - 10.033         n/a         NPT         0.75         1.67           West Side	2	West Side	Boilerroom	Low Water Cut-Off - 10.02	n/a	n/a	n/a	2.00	
West Side         Boiler room         0.75" Hard Pipe Insulation x1" (0°-299°F) - 10.022         RO         N/A         0.75         f6.00           West Side         Boiler room         1 FT Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - n/a         n/a         NPT         1.00         2.25           West Side         Boiler room         1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - n/a         n/a         NPT         1.00         2.25           West Side         Boiler room         1" Hard Pipe Insulation x1" (0°-299°F) - 10.026         35         N/A         1.00         2.25           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.027         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.023         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.023         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.033         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.033         n/a         NPT         0.75         1.96	21	West Side	Boiler room	Low Water Cut-Off - 10.021	n/a	п/а	n/a	2.00	The special special services at below
West Side         Boiler room         1FT Steam Trap (0~2999°F) 10mm Exterior - 10.023         n/a         NPT         1.00         1.83           West Side         Boiler room         1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - n/a         n/a         NPT         1.00         2.25           West Side         Boiler room         1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - n/a         n/a         NPT         1.00         2.25           West Side         Boiler room         4" Hard Pipe Insulation x! 1" (0°-299°F) -10.027         16         N/A         4.00         17.00           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" -10.028         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" -10.033         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" -10.033         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" -10.033         n/a         125/150         6.00         1.92           West Side         Boiler room         0.75 FT Steam Trap Station Sleeve Incoming (0°-299°F)         n/a         NPT         0.75         1.96	122	West Side	Boiler room	0.75" Hard Pipe Insulation x1'1" (0°-299°F) - 10.022	80	ŊA	0.75	16.00	u Luciani de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona de la companiona del companiona de la companiona dela companiona dela companiona
West Side         Boiler room         1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - n/a         n/a         NPT         1.00         2.25           West Side         Boiler room         1" Steam Trap Station Sleeve Outgoing (0°-299°F) - 10.027         n/a         NPT         1.00         2.25           West Side         Boiler room         4" Hard Pipe Insulation x11" (0°-299°F) - 10.027         16         N/A         4.00         17.00           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.028         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.028         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.038         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.033         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.033         n/a         NPT         0.75         1.96           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.033         n/a         NPT         0.75         1.96           West	123	West Side	Boiler room	1 FT Steam Trap (0°-299°F) 10mm Exterior - 10.023	n/a	NPT	1.00	1.83	10mm
West Side         Boiler room         1" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - n/a         n/a         NPT         1.00         2.25           West Side         Boiler room         4" Hard Pipe Insulation XI 1" (0°-299°F) -10.026         35         N/A         1.00         9.00           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" -10.029         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" -10.039         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" -10.031         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" -10.031         n/a         NPT         0.75         1.67           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" -10.031         n/a         NPT         0.75         1.67           West Side         Boiler room         0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 1" -1         1.7a         NPT         0.75         1.96           West Side         Boiler room         0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 1" -1         1.7a         NPT         0.75         1.96	10,024	West Side	Boller room	I" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 10.024	n/a	LMPT	1.00	2,25	Ţ
West Side         Boiler room         1' Hard Pipe Insulation x1'1" (0°-299°F) -10.026         35         N/A         1.00         9.00           West Side         Boiler room         4" Hard Pipe Insulation x1'1" (0°-299°F) 1" -10.028         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" -10.029         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" -10.033         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" -10.033         n/a         NPT         0.75         1.67           West Side         Boiler room         0.75 FT Steam Trap Station Sleeve Incoming (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         0.75 Steam Trap Station Sleeve Outgoing (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         0.55" 10.033         0.75         0.75         1.96         1.96           West Side         Boiler room         0.75" Steam Trap Station Sleeve Outgoing (0°-299°F)         n/a         NPT         0.75         1.96           West Side	10.025	West Side	Boller room		n/a	LdN	1.00	2.25	# L
West Side         Boiler room         4" Hard Pipe Insulation x11" (0°-299°F) -10.027         16         N/A         4.00         17.00           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.028         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.033         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.033         n/a         125/150         6.00         1.92           West Side         Boiler room         0.75 FT Steam Trap Station Sleeve Incoming (0°-299°F)         n/a         NPT         0.75         1.67           West Side         Boiler room         0.75" Steam Trap Station Sleeve Outgoing (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         0.5" - 10.033         n/a         NPT         0.75         1.96           West Side         Boiler room         0.5" - 10.034         n/a         NPT         0.75         1.96	97(	West Side	Boiler room	1" Hard Pipe Insulation x1"1" (0°-299°F) - 10.026	35	N/A	1.00	9.00	
West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.028         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.029         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.031         n/a         125/150         6.00         1.92           West Side         Boiler room         0.75 FT Steam Trap Station Sleeve Incoming (0°-299°F)         n/a         NPT         0.75         1.67           West Side         Boiler room         0.75" Steam Trap Station Sleeve Incoming (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         0.75" Steam Trap Station Sleeve Outgoing (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         0.5" - 10.033         1.96         1.96         1.96	127	West Side	Boiler room	4" Hard Pipe Insulation x1' 1" (0°-299°F) - 10.027	16	N/A	4.00	17.00	-
West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.029         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.031         n/a         125/150         6.00         1.92           West Side         Boiler room         0.75" Steam Trap Station Sleeve Incoming (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         0.75" Steam Trap Station Sleeve Incoming (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         0.75" Steam Trap Station Sleeve Outgoing (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         3.00         3.00         1.47         1.47	28	West Side	Boiler room	6 Flange 125/150 (0-299°F) 1" - 10.028	п/а	125/150	6.00	1.92	a control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the cont
West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.031         n/a         125/150         6.00         1.92           West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.031         n/a         125/150         6.00         1.92           West Side         Boiler room         0.75 FT Steam Trap Station Sleeve Incoming (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         0.75" Steam Trap Station Sleeve Outgoing (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         3 Control Valve 125/150 (0-299°F) 1" - 10.035         n/a         125/150         3.00         1.47	29	West Side	Boiler room	6 Flange 125/150 (0-299°F) 1" - 10.029	п/а	125/150	6.00	1.92	
West Side         Boiler room         6 Flange 125/150 (0-299°F) 1" - 10.031         n/a         125/150         6.00         1.92           West Side         Boiler room         0.75 FT Steam Trap (0°-299°F) 1" - 10.033         n/a         NPT         0.75         1.96           West Side         Boiler room         0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 1" - 10.033         n/a         NPT         0.75         1.96           West Side         Boiler room         0.5" - 10.034         0.5" - 10.034         0.75         1.96         1.96           West Side         Boiler room         3 Control Valve 125/150 (0-299°F) 1" - 10.035         n/a         125/150         3.00         1.47	m	West Side	Boiler room	6 Flange 125/150 (0-299°F) 1" - 10.03	n/a	125/150	6.00	1.92	
West Side         Boiler room         0.75 FT Steam Trap Station Sleeve Incoming (0°-299°F)         n/a         NPT         0.75         1.67           West Side         Boiler room         0.75" Steam Trap Station Sleeve Outgoing (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         3 Control Valve 125/150 (0-299°F) 1" - 10.035         n/a         125/150         3.00         1.47	3	West Side	Boiler room	6 Flange 125/150 (0-299°F) 1" - 10.031	n/a	125/150	6.00	1.92	
West Side         Boiler room         0.75" Steam Trap Station Sleeve Incoming (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         0.5"-10.034         0.5"-10.035         1"-10.035         n/a         125/150         3.00         1.47	32	West Side	Boiler room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 10.032	n/a	NPT	0.75	1.67	10mm
West Side         Boiler room         0.75" Steam Trap Station Sleeve Outgoing (0°-299°F)         n/a         NPT         0.75         1.96           West Side         Boiler room         3 Control Valve 125/150 (0-299°F) 1" - 10.035         n/a         125/150         3.00         1.47	93	West Side	Boiler room		n/a	TAN	0.75	1.96	<b>-</b>
West Side   Boiler room   3 Control Valve 125/150 (0-299°F) 1" - 10.035 n/a   125/150   3.00	34	West Side		0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 10.034	n/a	TdN	0.75	1.96	-
		West Side	Boiler room	3 Control Valve 125/150 (0-299°F) 1" - 10.035	n/a	125/150	3.00	1.47	2

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Insulation Thickness	u.l	=-	1.1.	10mm	Land American	a L	a l	1	11	-	-	-	10mm	<b>.</b>	-	-	<b>;</b>	· ·	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s	<u> </u>
SqFtV (term	1,47	1.92	14.50	3.11	3.50	3.50	3.53	18.00	19,25	1.22	2.14	1.22	1.67	1.96	1.96	9.00	3.05	14.50	1.22	1.67
Nom, Pipe Size	3,00	6.00	n/a	2.00	2.00	2.00	2.00	2.00	n/a	2.50	2.50	2.50	0,75	0.75	0.75	0.75	1.50	n/a	2.50	0.75
Flange Class	125/150	125/150	n/a	NPT	LdN	NPT	LdN	Α×	π/a	125/150	125/150	125/150	PP	NPT	LdN	N/A	N/A	n/a	125/150	NPT
LF of Pipling	n/a	n/a	n/a	n/a	n/a	n/a	n/a	35	n/a	n/a	n/a	п/а	n/a	n/a	n/a	45	n/a	n/a	n/a	n/a
Description	3 Control Valve 125/150 (0-299°F) 1" - 10.036	6 Flange 125/150 (0-299°F) 1" - 10.037	Heat Exchanger Head	2 FT Steam Trap (0°-299°F) 10mm Exterior - 10.039	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 9037	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 10.041	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 10.042	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 10.043	Condensate Tank - 10,044	2.5 Flange 125/150 (0-299°F) 1" - 10.045	2.5 Crane Gate Valve 125/150 (0-299°F) 1" - 10,046	2.5 Flange 125/150 (0-299°F) 1" - 10.047	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 10.048	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 10.049	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 10.05	0.75" Hard Pipe Insulation x1' 1" (0°-299°F) - 10.051	1.5 Armstrong Heat Exchanger 1" (0°-299°F) - 10.052	Heat Exchanger Head - 10.053	2.5 Flange 125/150 (0-299°F) 1" -10.054	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 10.055
Location 2	Boiler room	Boiler room	Boiler room	Mech A124	Mech A124	Mech A124	Mech A124	Mech A124	Mech A124	Mech A124	Mech A124	Mech A124	Mech A124	Mech A124	Mech A124	Mech A124	Pool pit	Pool pit	Pool pit	Pool pit
Location1	West Side	West Side	West Side	West Side	West Side	West Side	WestSide	West Side	West Side	West Side	West Side	West Side	West Side	West Side	West Side	West Side	West Side	West Side	West Side	West Side
ltem	10,036	10.037	10.038	10.039	10.04	10.041	10.042	10.043	10.044	10.045	10,046	10.047	10.048	10.049	10.05	10.051	10.052	10.053	10.054	10.055



Utem	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
10.056	West Side	Pool pit	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 10.056	n/a	LAN	0.75	1.96	<u> </u>
10.057	West Side	Pool pit	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 10.057	n/a	NPT	0.75	1.96	<del>[</del> _
10.058	West Side	Pool pit	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 10.058	n/a	NPT	0.75	1,67	10mm
10.059	West Side	Pool pit	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 10.059	n/a	LAN	0.75	1.96	
10.06	West Side	Paol pit	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 10.06	n/a	LdN	0.75	1.96	III
10.061	West Side	Pool pit	2 FT Steam Trap (0°-299°F) 10mm Exterior - 10.061	n/a	NPT	2.00	3.11	10mm
10.062	West Side	Pool pit	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 9037	n/a	LAN	2.00	3.50	11
10.063	West Side	Pool pit	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 10.063	n/a	TAN	2.00	3.50	# P
10.064	West Side	Pool pit	Condensate Receiver - 10.064	n/a	n/a	n/a	15,55	1
10.065	West Side	Pool pit	2" Hard Pipe Insulation x1' 1" (0°-299°F) - 10.065	12	N/A	2.00	6.00	<del>-</del>
10,066	West Side	Pool pit	1" Hard Pipe Insulation x1' 1" (0°-299°F) - 10.066	20	N/A	1.00	5.00	-
10.067	West Side	Pool pit	0.75" Hard Pipe Insulation x1' 1" (0°-299°F) - 10.067	20	ΝΆ	0.75	4.00	
10,068	West Side	House penthouse	2 FT Steam Trap (0°-299°F) 10mm Exterior - 10.068	n/a	NPT	2.00	3.11	10mm
10.069	West Side	House penthouse	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 10.069	n/a	LAN	2,00	3.50	Ę.
10.07	West Side	House penthouse	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 10.07	n/a	LdN	2.00	3,53	
10.071	West Side	House penthouse	2" Hard Pipe Insulation x1'1" (0°-299°F) - 10,071	25	N/A	2.00	13.00	III
10.072	West Side	House penthouse	5 Gate Valve 125/150 (0-299°F) 1" - 10.072	n/a	125/150	5.00	4.40	<b>=</b>
10.073	West Side	House penthouse	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 10.073	n/a	NPT	0.75	1.67	10mm



ltem	Location	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
10.074	West Side	House penthouse	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 10.071	n/a	TdN	0.75	1.96	
10.075	West Side	House penthouse	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 10.075	п/а	NPT	0.75	1.96	<b>-</b>
10.076	West Side	House penthouse	0.75" Hard Pipe Insulation x1"1" (0°-299°F) - 10.077	15	N/A	0.75	3.00	=
10.077	West Side	Red House penthouse	1.25 FT steam trap (0°-299°F) 10mm Exterior - 10.077	n/a	TAN	1.25	1.88	10mm
10.078	West Side	Red House penthouse	1.25 FT steam trap (0°-299°F) 10mm Exterior - 10.078	n/a	TAN	1,25	1.88	10mm
10.079	West Side	Red House penthouse	1.25" Hard Pipe Insulation x1' 1" (0°-299°F) - 10.079	0.	N/A	1.25	3.00	<u>-</u>
10.08	West Side	Red House penthouse	1.25" Steam Trap Station Sleeve Outgoing (0°-299°F) 1" - 10,079	n/a	TAN	1.25	2.61	_
10.081	West Side	Red House penthouse	2 Control Valve NPT (0-299°F) 10mm - 10.081	п/а	NPT	2.00	1.01	10mm
10.082	West Side	Red House penthouse	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 10.082	n/a	Lan	0.75	1.67	10mm
10.083	West Side	Red House penthouse	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 10.083	n/a	TAN	0.75	1.96	<u>-</u> -
10.084	West Side	Red House penthouse	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 10.084	n/a	TAN	0.75	1.96	-
10.085	West Side	Red House penthouse	0.75" Hard Pipe Insulation x1' 1" (0°-299°F) - 10.085	15	N/A	0.75	3.00	-
10.086	West Side	Pool house penthouse	1 FT Steam Trap (0°-299°F) 10mm Exterior - 10.86	n/a	LdN	1.00	1.83	10mm
10.087	West Side	Pool house penthouse	1" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 10.087	n/a	LAN	00.	2.25	<u>-</u>

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frem	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom, Pipe Size	SqFt/ Item	Insulation Thickness
9009	Wilby	Boiler room	Low Water Cut-Off - 6006	n/a	n/a	n/a	2.00	-
6007	Wilby	Boiler room	Low Water Cut-Off - 6007	n/a	n/a	n/a	2.00	1
8009	Wilby	Boiler room	Low Water Cut-Off - 6008	n/a	n/a	n/a	2.00	-
6009	Wilby	Boiler room	Low Water Cut-Off - 6009	n/a	n/a	n/a	2.00	9
6010	Wilby	Boiler room	5 Bonnet - Gate 125/150 (0-299°F) 1" - 6010	n/a	125/150	5.00	2.20	=
6011	Wilby	Boiler room	5" Flex Hose x 1" (0-299°F) 1" - 6011	n/a	N/A	5,00	1.44	<b>=</b>
6012	Wilby	Boiler room	5 Elbows 45° 1" (0-299°F) - 6012	n/a	N/A	5.00	0.87	F
6013	Wilby	Boiler room	5 Elbows 45° 1" (0-299°F) - 6013	n/a	N/A	5,00	0.87	
6014	Wilby	Boiler room	3" Inline Pump - 6014	n/a	N/A	3.00	4.59	F.
6015	Willby	Boiler room	3" Flex Hose x 1' (0-299°F) 1" - 6015	n/a	N/A	3,00	0.92	and programmed in the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the second collection of the
6016	Wilby	Boiler room	3" Expansion Joint 125/150 (0°-299°F) 1" - 6016	n/a	125/150	3.00	6.09	Ę.
6017	Wilby	Boiler room	4 Gate Valve 125/150 (0-299°F) 1" - 6017	n/a	125/150	4.00	3,45	
6018	Wilby	Boiler room	5 Gate Valve 125/150 (0-299°F) 1" - 6018	n/a	125/150	5.00	4.40	<b>.</b>
6019	Wilby	Boiler room	5" Flex Hose x 1' (0-299 °F) 1" - 6019	n/a	N/A	5.00	1,44	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
6020	Wilby	Boiler room	5 Elbows 45° 1" (0-299°F) - 6020	n/a	N/A	5.00	0.87	
6021	Wilby	Boiler room	5 Elbows 45° 1" (0-299°F) - 6021	n/a	N/A	5.00	0.87	
6022	Wilby	Boiler room	4" Pump Jacket - 6022	n/a	N/A	4.00	9.33	
6023	WIIby	Boiler room	4" Flex Hose x 1" (0-299°F) 1" - 6023	n/a	N/A	4.00	1.18	and the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second s
6024	Wilby	Boiler room	4" Expansion Joint 125/150 (0°-299°F) 1" - 6024	n/a	125/150	4.00	7.83	
6025	Wilby	Boller room	4 Gate Valve 125/150 (0-299ºF) 1" - 6025	n/a	125/150	4.00	3,45	
6026	Wilby	Boiler room	Air Separator - 6026	n/a	n/a		5.00	
6027	Wilby	Boiler room	5 Flange 125/150 (0-299°F) 1" - 6027	n/a	125/150	5.00	1.75	B Comment
6028	Wilby	Boiler room	5 Flange 125/150 (0-299°F) 1" - 6028	n/a	125/150	5.00	1.75	A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A CAMPAGE AND A
6029	Wilby	Boiler room	3 Gate Valve 125/150 (0-299°F) 1" - 6029	n/a	125/150	3.00	2.67	
6030	Wilby	Boiler room	3 Wye Strainer 125/150 (0-299°F) 1" - 6030	n/a	125/150	3.00	2.47	=

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fem	Location 1	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
6031	Wilby	Boiler room	3 Elbows 45° 1" (0-299°F) - 6031	n/a	N/A	3.00	0.35	1
6032	Wilby	Boiler room	3 Elbows 45° 1" (0-299°F) - 6032	п/а	N/A	3,00	0.35	-
6033	Wilby	Boiler room	3 Flange 125/150 (0-299°F) 1" - 6033	n/a	125/150	3,00	131	<b></b>
6034	Wilby	Boiler room	2 FT Steam Trap (0°-299°F) 10mm Exterior - 6034	n/a	NPT	2.00	3,11	10mm
6035	Wilby	Boiler room	2" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 6035	n/a	TAN	2.00	3.50	#
6036	Wilby	Boiler room	2" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 6036	n/a	LAN	2.00	3.53	-
6037	Wilby	Boiler room	2.5 Crane Gate Valve 125/150 (0-299°F) 1" - 6037	n/a	125/150	2.50	2.14	u V
6038	Wilby	Boiler room	2.5 Crane Gate Valve 125/150 (0-299°F) 1" - 6038	n/a	125/150	2.50	2.14	ŧ-
6039	Wilby	Boiler room	2.5 Elbows 90°1" (0-299°F) - 6039	1/a	N/A	2.50	0.54	
6040	Wilby	Boiler room	2.5 Keckley Wye Strainer 125/150 (0-299°F) 1" - 6040	n/a	125/150	2.50	1.92	
6041	Wilby	Boller room	5 Bonnet - Gate 125/150 (0-299ºF) 1" - 6041	n/a	125/150	5.00	2.20	
6042	Wilby	Boiler room	5 Crane Gate Valve 125/150 (0-299°F) 1" - 6042	n/a	125/150	5.00	4.40	*
6043	Wilby	Boller room	5 Crane Gate Valve 125/150 (0-299°F)1" - 6043	n/a	125/150	5.00	4.40	-
6045	Wilby	Boiler room	5 Crane Gate Valve 125/150 (0-299°F) 1" - 6045	n/a	125/150	5.00	4,40	20 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
6046	Wilby	Boiler room	5 Crane Gate Valve 125/150 (0-299°F) 1" - 6046	n/a	125/150	5.00	4,40	The section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the se
6047	Wilby	Boiler room	5 Crane Gate Valve 125/150 (0-299°F) 1" - 6047	n/a	125/150	5.00	4.40	
6048	Wilby	Boiler room	10 Blind Flange 250/3001" (0-299°F) - 6048	n/a	250/300	10:00	4.72	
6049	Wilby	Boiler room	3 Tee 125/150 1" (0-299°F) - 6049	n/a	125/150	3.00	0.80	-
6050	Wilby	Boiler room	0.75" Steam Trap Station Sleeve Incoming (0°-299°F) 0.5" - 6050	n/a	NPT	0.75	1,96	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
6051	Wilby	Boiler room	0.75 FT Steam Trap (0°-299°F) 10mm Exterior - 6051	n/a	LAN	0.75	1.67	10mm
6052	Wilby	Boiler room	0.75" Steam Trap Station Sleeve Outgoing (0°-299°F) 0.5" - 6052	n/a	TAN	0.75	1.96	The little for the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the latter and the la
6053	Wilby	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 6053	п/а	125/150	6.00	2.52	1



(tem	Location	Location 2	Description	LF of Piping	Flange Class	Nom. Pipe Size	SqFt/ Item	Insulation Thickness
6054	Wilby	Boiler room	6 Bonnet - Gate 125/150 (0-299°F) 1" - 6054	n/a	125/150	6.00	2.52	J.
6055	Wilby	Boiler room	12 Gate Valve 125/150 (0-299°F) 1" - 6055	n/a	125/150	12.00	12.71	<del>-</del>
6056	Wilby	Boiler room	12 Elbows: 90° 1" (0-299°F) - 6056	n/a	N/A	12.00	11.52	=
6057	Wilby	Boiler room	10 Blind Flange 250/300 1" (0-299°F) - 6057	n/a	250/300	10.00	4.72	=-
6058	Wilby	Boiler room	4 Gate Valve 125/150 (0-299ºF) 1" - 6058	n/a	125/150	4.00	3.45	A Character by contracting a second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the s
6029	Wilby	Boiler room	2.5 Control Valve 125/150 (0-299°F) 1" - 6059	n/a	125/150	2.50	1.1	=
0909	Wilby	Boiler room	2.5 Gate Valve 125/150 (0-299°F) 1" - 6060	n/a	125/150	2.50	2.14	
6061	Wilby	Boiler room	2.5 Control Valve 125/150 (0-299°F) 1" - 6061	n/a	125/150	2.50	-	=
6062	Wilby	Boiler room	2.5 Control Valve 125/150 (0-299°F) 1" - 6062	n/a	125/150	2.50		The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
6063	Wilby	Boiler room	4" Hard Pipe Insulation x1' 1" (0°-299°F) - 6063	9	N/A	4.00	6.00	
6064	Wilby-North End	Boilerroom	6" Hard Pipe Insulation x1" 1" (0°-299°F) - 6064	12	N/A	9.00	19.00	=
6065	Wilby	Boiler room	5" Hard Pipe Insulation x1' 1" (0°-299°F) - 6065	17	N/A	5.00	22.00	-
9909	Wilby	Mech room FD	Heat Exchanger	n/a	n/a	<b>2</b>	9.02	2
6068	Wilby	Mech room FD	0.75" TD42 Steam Trap 10mm - 6068	n/a	NPT	0.75	09'0	
6909	Wilby	Mech room FD	3" Pump Jacket - 6069	n/a	n/a	n/a	2.51	distribution and the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the second field of the secon
6070	Wilby	Mech room FD	4" Flex Hose x 1' (0-299°F) 1" - 6070	n/a	N/A	4.00	1.18	=
6071	Wilby	Mech room FD	4 Angle Stop Check Valve 125/150 (0-299°F) 1" - 6071	n/a	125/150	4.00	4.67	
6072	Wilby	Mech room FD	5 Crane Gate Valve 125/150 (0-299°F) 1" - 6072	n/a	125/150	5.00	4.40	=
6073	Wilby	Mech room FD	5" Flex Hose x 1" (0-299°F) 1" - 6073	n/a	N/A	5.00	1.44	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
6074	Wilby	Mech room FD	3" Pump Jacket - 6074	n/a	n/a	n/a	2.51	
6075	Wilby	Mech room FD	4" Flex Hose x 1' (0-299°F) 1" - 6075	n/a	N/A	4.00	1.18	
9209	Wilby	Mech room FD	5"3-Way Valve 125/150 (0-299°F) 1" - 6076	n/a	125/150	5.00	8.50	=
6077	Wilby	Mech room FD	4 Gate Valve 125/150 (0-299°F) 1" - 6077	n/a	125/150	4.00	3,45	and the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of t
6078	Wilby	Mech room FD	4" Flex Hose x 1' (0-299°F) 1" - 6078	n/a	N/A	4.00	1.18	

City of Waterbury, Connecticut Investment Grade Energy Audit · May 13, 2016 (rev. June 29, 2016)



ltem	Location 1	Location 2	Description	L.F.of Piping	Flange Class	Nom, Pipe Size	SqFt/ Ttem	Insulation Thickness
6079	Wilby	Mech room FD	2.5 Gate Valve 125/150 (0-299°F) 1" - 6079	n/a	125/150	2.50	2,14	u.
6080	Wilby	Mech room FD	2 Elbows 90° 1" (0-299°F) - 6080	e/u	N/A	2.00	0.36	=
6081	Wilby	Mech room FD	1.25 Control Valve NPT (0-299°F) 10mm - 6081	п/а	LdN	1,25	0.90	10mm
6082	Wilby	Mech room FD	1.25" Union (0-299°F) 1" - 6082	n/a	FAN	1.25	0.12	11
6083	Wilby	Mech room FD	1.25 Crane Gate Valve NPT (0-299°F) 10mm - 6083	п/а	NPT	1.25	135	10mm
6084	Wilby	Mech room FD	2" Spool 125/150 (0-299°F) 1" - 6084	n/a	125/150	2.00	1.57	<b>–</b>
6085	Wilby	Mech room FD	2 Keckley, Wye Strainer 125/150 (0-299°F) 1" - 6085	n/a	125/150	2.00	1.62	
9809	Wilby	Mech room FD	2 Crane Gate Valve 125/150 (0-299°F) 1" - 6086	n/a	125/150	2.00	1.80	A CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR
6087	Willby	Mech room FD	2" Union (0-299°F) 1" - 6087	n/a	NPT	2.00	0.19	The second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of th
6088	Wilby	Mech room FD	2" Sleeve - 6088	2	N/A	2.00	1.50	-
6809	Wilby	Mech room FD	2 Control Valve 125/150 (0-299°F) 1" - 6089	n/a	125/150	2.00	1.01	<b>!</b>
0609	Wilby	Mech room FD	2" Pump Jacket - 6090	n/a	ΑΆ	2.00	6.67	**************************************
6091	Willby	Mech room FD	2" Union (0-299°F) 1" - 6091	n/a	NPT	2.00	0.19	
6092	Wilby	Mech room FD	1.25" Hard Pipe Insulation x1'1" (0°-299°F) - 6092	25	ΑΆ	1.25	8.00	-
6093	Wilby	Mech room FD	0.75" TD42 Steam Trap 10mm - 6093	n/a	LdN	0.75	09'0	-
6094	Wilby	Mech room FD	0.75" Hard Pipe Insulation x1"1" (0°-299°F) - 6094	9	ΝΆ	0.75	1.00	-
6095	Wilby	Mech room FD	0.75" TD42 Steam Trap 10mm - 6095	n/a	PPA	0.75	09'0	
9609	Wilby	Mech room FD	0.75" TD42 Steam Trap 10mm - 6096	n/a	LAP	0.75	09:0	-
2609	Wilby	Mech room FD	0.75" Hard Pipe Insulation x1'1" (0°-299°F) - 6097	13	N/A	0.75	3.00	



# **Interface with Existing Systems & Operations**

NORESCO will coordinate all work with facility personnel to minimize the impact on all occupants.

### Maintenance Procedures

The new insulation and removable insulating jackets will not require any regular maintenance. The removable insulating jackets will improve safety and reduce the time required to maintain or service the insulated equipment. These jackets are designed to quickly and easily be removed and reinstalled for maintenance and repair work.

### Special Operating Requirements

There are no special operations requirements with this ESM.

# **Equipment Information**

### Manufacturer & Type

NORESCO will provide Type A Fiberglass blanket manufactured by Knauf, or approved equal. 850° Pipe Insulation, ASTM C547, Class 1, k value of 0.23 at 75°F, with all service jacketing (ASJ).

NORESCO will provide removable insulation jackets manufactured by Thermaxx. Glass mat, type E needled fiber. 1/4", 1/2" @ 9 LB/CF and 1" @ 11.3 LB/CF.

# **Savings Calculations**

NORESCO used the 3E Plus (version 4.1) software program from the North American Insulation Manufacturers Association (NAIMA). This program was designed for the industrial process, environmental managers and the insulation industry. It is a valuable tool for calculating and selecting the insulation thickness needed to reduce heat transfer, and maintain a safe insulated surface temperature for personnel protection and condensation control. NAIMA provides technical input and guidance to standards and energy code-setting organizations that are important to energy-efficient building design and maintenance; and, with organizations that set standards regarding the thermal, acoustical and fire safety performance of materials used in building construction.

Conduction losses in the uninsulated pipe and mechanical equipment were calculated using pipe and equipment surface areas and their thermal conduction properties. Temperatures of piping and equipment were obtained via infrared surface temperature measurements.

The analysis inputs include exposed pipe lengths, sizes, emissivity, and temperatures as well as the operating hours and ambient space temperature in determining thermal heat loss. Development of the baseline energy consumption (losses) for this ESM includes site-specific parameters used for the 3E Plus software calculations and are included in *Appendix 1: Savings Calculations*.



# **ESM 8:**

STEAM TRAPS & THERMOSTATIC RADIATOR VALVES



# ESM 8: Steam Traps & Thermostatic Radiator Valves

**Benefits:** This measure will generate energy savings, extend equipment service life, enhance safety for maintenance staff, and greatly improve occupant comfort.

Buildings: Barnard Adult Education Bucks Hill School

Bunker Hill School Chase Building

Chase School Crosby-Wallace Complex

Driggs School Generali School

Hopeville School Kennedy High School

Kingsbury School Sprague School

Tinker School Walsh School

Wendell Cross West Side School

Wilby-North End Complex Wilson School

Summary: NORESCO performed a comprehensive steam trap audit, identifying all traps as well as quantifying leaking and plugged traps. We will repair two hundred and sixty-two (262) traps to generate energy savings and prolong the service life of equipment served by the steam system. NORESCO also performed a comprehensive audit of all the standalone perimeter steam terminal devices such as radiators, convectors, and baseboard fin tube, cataloguing each piece of equipment and its control device. NORESCO will install eight hundred and twelve (812) thermostatic radiator valves (TRVs) to automatically control the steam equipment's heat output to generate energy savings as well as significantly improve the comfort conditions in the spaces served. The installation of these temperature control valves will also include the removal of existing obsolete and problematic pneumatic valves and thermostats, resulting in additional maintenance cost savings as well as the energy savings associated with running the building air compressors.

Implementation Cost: \$784,363

Energy Cost Savings: \$93,420

Annual Energy Reduction: 77,878 CCF

M & V Protocol: Option A

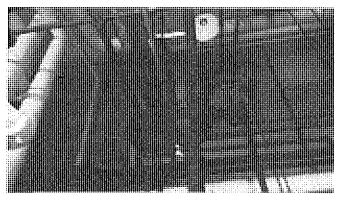


# **Detailed Description**

### Existing Description

The steam systems at the eighteen buildings included in this scope have a significant number of leaking and failed steam traps. The heating, ventilation, and air conditioning (HVAC) systems, domestic hot water, and pool water systems use steam for heat. A critical component of these systems is the steam trap. The function of a steam trap is to separate and discharge liquid condensate from the steam condensing equipment and piping systems. A trap that is leaking or has failed in the open position allows steam to pass through equipment such as radiators and other heat exchangers continuously, without giving up its energy. This results in significant energy losses through condensate system vents and poor heat transfer to the heating equipment.

The steam radiators, convectors, and baseboard fin tube (emitters) generally have three types of individual control valves -- pneumatic, manual shutoffs, and thermostatic. Many of the control valves are manual valves, which are typically left open all the time or are inoperable (open). The audit identified buildings where the emitters are primarily controlled by pneumatic valves with a single thermostat per valve, which are very maintenance intensive to keep calibrated and working properly. Some of the



Float and thermostatic (F&T) steam trap in the Wilby-North End boiler room.

radiators and convectors have a combination of manual valves and/or thermostatic valves, some of which have failed. The majority of the rooms and buildings in the audit that are overheating are doing so because they cannot be controlled. As a result, students and staff are using windows to control the overheating resulting in wasted energy. In some cases, mechanical air conditioning is being used to keep space temperatures tolerable, even during the winter.

The City-wide comprehensive steam trap and thermostatic radiator valve audits are included in *Appendix 4: Audit Data*.

### Recommended Improvements

Traps that leak cause a loss of heat transfer, water hammer, corrosion, and damage to heat transfer equipment. By repairing or replacing faulty steam traps with new, properly functioning traps and instituting an annual trap testing and repair program, comfort conditions in these buildings will be improved and thermal energy savings will be achieved.

NORESCO's experience is that without a comprehensive trap maintenance program, a significant number of traps will not operate properly over time. For the steam buildings, NORESCO will repair or replace the existing leaking or plugged steam traps with new, properly functioning traps or components to improve comfort conditions and reduce thermal energy losses.

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### Scope of Work

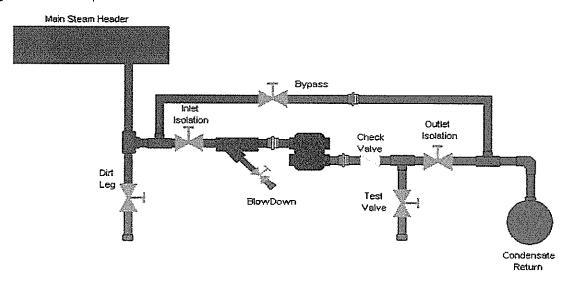
NORESCO will repair or replace a total of two hundred and sixty-two (262) steam traps at the locations and in quantities as listed in the tables below. The scope of work is:

- Confirm trap locations, sizes, and types for repair or replacement, including failed traps and traps that are operating correctly but that are of the incorrect type (such as an inverted bucket trap being used in an application where a float and thermostatic trap should be used).
- After verification, remove the existing traps, strainers, and isolation valves as required to install the new traps.
- Install correctly sized and type trap.

All the trap stations were evaluated for the components below:

- Dirtleg blow down valve
- Inlet isolation valve
- · Strainer with blow down valve
- Steam trap
- Outlet check valve
- Test valve
- Outlet isolation valve
- Bypass (on critical applications)

Figure 1: Ideal Trap Station



### City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. Customer shall

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relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or otherwise interfere with the ESM implementation and installation process.

#### Hazardous Materials Abatement Allowance

The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.



Table 1: Barnard Building: Leaking and Plugged Traps Audit

Type Trap Size Result	T 3/4" P	T 3/4" L	T 3/4" P	2"
Manufacturer   Typo	Hoffman 90RT	Hoffman 90RT	Hoffman 90RT	Spirax Sarco
Trap Location/Elevation	Back Right Wall, 0-5'	Under Window on Left, 0-5'	Under Window, 0-5'	To Right of Condensate Drain TK
Building/Floor/Room	Radiator Trap Barnard/1st/102	144497 Radiator Trap Barnard/1st/106	144499 Radiator Trap Barnard/1st/116	Barnard/Basement/Boiler Rm
Tag # Application	Radiator Trap	Radiator Trap	Radiator Trap	
# Stell	144443	144497	144499	144447 Drip Leg

Table 2: Bucks Hill Elementary: Leaking and Plugged Traps Audit

Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Manufedurer	ezis deiled()T	Size	Result
144478	Radiator Trap	Bucks Hill/1st/Boy's Bathroom, Halfway Down Middle Hallway	Under Window, 0-5'	Spirax Sarco	90RT	1/2"	J
144481	Radiator Trap	Bucks Hill 1st/F113	Left of Back Door, 0-5'	Spirax Sarco	90RT	3/4"	distribution of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of th
144466	Radiator Trap	Bucks Hill/1st/F126	Back Right, Under Window, 0-5'	Hoffman	90RT	1/2"	4
144468	Radiator Trap	Bucks Hill/1st/F127	Back Left, 0-5'	Dunham Bush	90RT		۵
144453	Radiator Trap	Bucks Hill/1st/F129	Back Left, 0-5'	Hoffman	90RT	3/4"	۵
144467	Radiator Trap	Bucks Hill/1st/F134	Back Right Behind Teacher's Desk, 0-5'	Spirax Sarco	90RT	1/2"	۵
144492	Radiator Trap	Bucks Hill/1st/Girl's Bathroom	Behind Kitchen, 0-5'	Spirax Sarco	90RT	1/2"	4
144486	Radiator Trap	Bucks Hill/1st/Girl's Bathroom, Left Hallway	By Window, 0-5'	Spirax Sarco	90RT	1/2"	
144452	Radiator Trap	Bucks Hill/1st/Hallway	Outside Rm F135, 0-5'	Dunham Bush	90RT	1/2"	
144464	Radiator Trap	Bucks Hill/1st/Hallway	Outside Rm F134, 0-5'	Dunham Bush	90RT	1/2"	
144473	Radiator Trap	Bucks Hill/1st/Middle Hallway	Directly Across from F123, 0-5'	Spirax Sarco	90RT	1/2"	_
144454	Radiator Trap	Bucks Hill/1st/Office	Under Outside Window, 0-5'	Spirax Sarco	90RT	1/2"	۰
144458	Radiator Trap	Bucks Hill/Basement/B101	Back Left, 0-5'	Spirax Sarco	90RT	1/2"	۵
144438	Drip Leg	Bucks Hill/Basement/Boiler Rm	Above Brick Rm, 10-15'	Spirax Sarco	90RT	1/2"	a de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la constanta de la consta

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lt.	
Resu	۵.
Size	3/4"
Type Trap	90RT
Manufacturer	Spirax Sarco
Trap Location/Elevation	Behind Teachers Desk, 0-5
Building/Floor/Room	Bucks Hill/Basement/Music   Be
Application	Radiator Trap
Teg #	144459

Table 3: Bunker Hill: Leaking and Plugged Traps Audit

# Bel	Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap	Size	Result
144552	Drip Leg	Bunker Hill/1st/Custodian Office	Above Blue Desk, 0-5'	Ноffтал	90RT	3/4"	В
144547	Drip Leg	Bunker Hill/1st/Speech	Above Sink, 5-10'	Hoffman	90RT	3/4"	8
144540	Radiator Trap	Bunker Hill/2nd/Main Office	Bathroom, 0-5'	Hoffman	90RT	1/2"	_
144538	Radiator Trap	Bunker Hill/2nd/S112	Under Window, Right Side, 0-5'	Dunham Bush	90RT	3/4"	<b>a</b>
144537	Radiator Trap	Bunker Hill/2nd/Principal's Office	Under Window, Left Side, 0-5'	Hoffman	90RT	1/2"	Ь
144533	Radiator Trap	Bunker Hill/2nd/S118	Back Wall, 0-5'	Spirax Sarco	90RT	1/2"	8
144531	Radiator Trap	Bunker Hill/2nd/Main Hallway	Outside Rm S112, 0-5'	Hoffman	90RT	1/2"	
144530	Radiator Trap	Bunker Hill/3rd/S117	Under Window, Left Side, 0-5	Spirax Sarco	90RT	=	Δ.
144528	Radiator Trap	Bunker Hill/4th/Boy's Bathroom	Under Window, 0-5'	Spirax Sarco	90RT	1/2"	7
144527	Radiator Trap	Bunker Hill/4th/T114	Left of Emergency Exit, 0-5'	Spirax Sarco	90RT	1/2"	<b>D</b>
144524	Radiator Trap	Bunker Hill/2nd/F107	Under Window, Right Side, 0-5'	Dunham Bush	CAPS	3/4"	7
144518	Radiator Trap	Bunker Hill/Between 2nd and 3rd/Stairwell	Under Window, 0-5'	Hoffman	90RT	1/2"	
144501	Drip Leg	Bunker Hill/Basement/Boiler Rm	Boiler #2, 5-10'	Spirax Sarco	H	=	7

Table 4: Chase Building: Leaking and Plugged Traps Audit

Manufacturer Type Trap Size Result	Warren Webster   90RT   1/2"   B	ster 90RT 1/2" P
n Manufactu	Warren Web	0-5 Warren Web
Trap Location/Elevation	Next to Outside Door, 0-5'	Small Rm. in Back Left Corner, 0-5: Warren Webster 90RT
Building/Floor/Room	Chase/1st/Entrance Rm on Right Side of Bldg	151952 Radiator Trap   Chase/1st/Rm.106
Application	151935 Radiator Trap	Radiator Trap
Tag#	151935	151952



Tag#	Tag# Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap   Size		Result
151928	Radiator Trap	Chase/1st/Rm 110	Second Radiator Along Left Wall, 0-5	Warren Webster	90RT	1/2" L	
151930	Radiator Trap	Chase/1st/Rm 110	Break Rm, Left Wall, 0-5'	Warren Webster	90RT	1/2"   P	
151933	Radiator Trap	Chase/1st/Rm 110	Back Office, Back Wall, Right Side, 0-5'	Warren Webster	90RT	1/2" L	
151910	Radiator Trap	Chase/1st/Rm 130	Under Right Window, 0-5'	Warren Webster	90RT	1/2"	
151911	Radiator Trap	Chase/1st/Rm130	Under Left Window, 0-5'	Warren Webster	90RT	1/2"	
149594	Radiator Trap	Chase/1st/Rm 161	Under Window, O-5'	Hoffman	CAPS	1/2"   P	
151902	Radiator Trap	Chase/1st/Rm 164	Closet in Back Right Corner, 0-5'	Warren Webster	90RT	1/2" P	•
149581	Radiator Trap	Chase/1st/Superintendent Office	Rm Next to Women's Bathroom, Right Window, 0-5'	Warren Webster	90RT	1/2" P	
149582	Radiator Trap	Chase/1st/Superintendent Office	Rm Next to Women's Bathroom, Left Window, 0-5'	Warren Webster	90RT	1/2" P	
151990	Radiator Trap	Chase/2nd/Human Resources Back Offices	Rm to Left of Personnel Director Office, Office on Right Side, Left Window, 0-5'	Warren Webster	90RT	1/2 [	
151991	Radiator Trap	Chase 2nd/Human Resources Back Offices	Rm to Left of Personnel Director Office, Office on Right Side, Right Window, 0-5'	Warren Webster	90RT	1/2" B	
152410	Radiator Trap	Chase/2nd/Human Resources Back Offices	Back Conference Rm, Back Wall, Right Window, 0-5'	Warren Webster	90RT	1/2" P	
151938	Radiator Trap	Chase/2nd/Rm 250	Left Back Office, 0-5'	Warren Webster	90RT	1/2"	
151945	Radiator Trap	Chase/2nd/Rm 250	Front Wall, Right Radiator, 0-5'	Warren Webster	90RT	1/2" P	
151946	Radiator Trap	Chase/2nd/Rm 250	Front Wall, Left Radiator, 0-5'	Warren Webster	90RT	1/2" P	
151947	Radiator Trap	Chase/2nd/Rm 250	Right Side Conference Rm, Right Wall, 0-5'	Warren Webster	90RT	1/2" P	
151955	Radiator Trap	Chase/2nd/Rm 250	Connecting Office With Unnumbered Door to Hallway, 0-5'	Warren Webster	90RT	1/2" L	
151960	Radiator Trap	Chase/2nd/Rm 253	Under Window, 0-5'	Warren Webster	90RT	1/2"   L	

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Building/Floor/Room Chase/2nd/Rm 268	Unde	Trap Location/Elevation Under Window, 0-5	Manufacturer Warren Webster	Type Trap 90RT	Size Result
Chase/3rd/Rm 305	Unde	Under Window, 0-5'	Hoffman	90RT	1/2"
Chase/3rd/Rm 360	Back	Back Wall, Far Left Radiator, 0-5'	Warren Webster	90RT	1/2"
Chase/3rd/School Inspectors Office	Scho to Le	School Inspector Private Office to Left, 0-5'	Hoffman	CAPS	1/2,"
Chase/4th/Assistant Chief's Office	nd.	Under Left Window, 0-5'	Warren Webster	90RT	1/2"
Chase/4th/Dept. of Ed Business Office	Brea	Break Rm to Left, 0-5'	Warren Webster	90RT	1/2"
Chase/4th/Dept. of Ed Business Office	Cubi Left	Cubicles Along Left Wall, Under Left Window, 0-5'	Warren Webster	90RT	1/2"
Chase/4th/Men's Bathroom	Unde	Under Window, 0-5'	Warren Webster	CAPS	1/2"
Chase/4th/Waterbury Fire Department Administration	Desk Winc	Desks Along Left Wall, Left Window, 0-5	Warren Webster	90RT	1/2"
Chase/4th/Waterbury Fire Department Administration	Fire ( Alon, Wind	Fire Chief's Office, Back Office, Along Right Wall, Under Right Window, 0-5'	Warren Webster	90RT	1/2"
Chase/4th/Waterbury Fire Department Administration	Fire ( Alon, Wind	Fire Chief's Office, Back Office, Along Right Wall, Under Left Window, 0-5	Warren Webster	90RT	1,27
Chase/4th/Waterbury Fire Department Administration	Fire ( Left )	Fire Chief's Office, Conference Rm, Left Window, 0-5'	Warren Webster	90RT	1/2"
Chase/4th/Waterbury Fire Department Administration	Offic	Office to Right of Entrance, 0-5'	Warren Webster	90RT	1/2"
Chase/Basement/Electric Shop	Abov	Above Garage Door, 0-5'	NA	90RT	3/4"
Chase/Basement/Garage	Abov	Above Double Doors, 5-10'	NA	90RT	3/4"
Chase/Basement/Garage	Next	Next to Double Doors, 0-5'	ĄZ	90RT	3/4" B



Table 5: Crosby/Wallace Complex: Leaking and Plugged Traps Audit

App	Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap Size	Size	Result
Radiator Trap		Crosby-Wallace/2nd/Hallway	Outside of Natatorium, 0-5'	Spirax Sarco	90RT	1/2"	_
Radiator Trap		Crosby-Wallace/2nd/Hallway	Outside of Storage B201, 0-5'	Spirax Sarco	90RT	1/2"	B
Drip Leg		Crosby-Wallace/2nd/Mech Rm By Faculty Lounge A351	Past AHU 12, 0-5'	N/A		1.1/4""	۵
Air Handling Unit	<u></u> 20	Crosby-Wallace/2nd/Mezzanine Above Gym	AHU 21, 0-5'	Spirax Sarco	E	-	₽
Air Handling Unit	ng.	Crosby-Wallace/3rd/Mech Rm Faculty Lounge A351	Behind AHU 11, 0-5'	N/A	<u> </u>	1-1/4""	۵
Drip Leg		Crosby-Wallace/Roof/Penthouse 1	to Right of Entrance, 5-10'	Steamloc	OR	3/4"	<b>_</b>
Drip Leg		Crosby-Wallace/Roof/Penthouse 7	to Left of Entrance, 5-10'	Steamloc	OR	3/4"	Д.
Drip Leg		Crosby-Wallace/Roof/Penthouse 8	to Left of Entrance, 5-10'	Steamloc	OR	3/4"	۵.
Drip Leg		Crosby-Wallace/Roof/Penthouse 9	to Left of Entrance, 5-10'	Steamloc	OR	3/4"	Д.

Table 6: Driggs: Leaking and Plugged Traps Audit

# geT	Application	Building/Floor/Room	Trap Location/Elevation	Wenufedurer	Type Trap Size Result	Size	Result
156199	Radiator Trap	Driggs/1st/F102	Left Side of Window, 0-5'	Spirax Sarco	90RT	3/4"	В
156193	Radiator Trap	Driggs/1st/F107	Back Left, 0-5'	Spirax Sarco	90RT	1/2"	_
156194	Radiator Trap	Driggs/1st/F109	Right Corner Behind Tan Cabinet, 0-5'	Spirax Sarco	90RT	1/2	8
149026	149026 Drip Leg	Driggs/Basement/B101	Back Right Corner, 5-10'	Spirax Sarco		-	В
149016	Drip Leg	Driggs/Basement/Boiler Rm	Above Boiler 2, 10-15'	Spirax Sarco	FT	11/4"	_
149019	Drip Leg	Driggs/Basement/Boiler Rm	Front Left Corner, 5-10'	Hoffman	Ŀ	3/4"	В
149032	Radiator Trap	Driggs/Basement/Men's Restroom at Bottom of Stairs	Above Urinals in Corner, 5-10'	Hoffman	90RT	1/2"	ط
149023	Radiator Trap	Radiator Trap Driggs/Basement/Sprinkler Valve	Next to Sprinkler Valves, 5-10'	Hoffman	90RT	1/2"	

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Building/Floor/Room	S.	Driggs/Basement/Storage Next to Boiler Rm
tlon Building/Floor/Room		Driggs/Basement/Storage Next to Boiler Rm
Application	Area	
Application	Area	49022 Drip Leg Driggs/Basement/Storage Next to

Table 7: Generali: Leaking and Plugged Traps Audit

Tag# Application	2027 (Carrowa	Building/Floor/Room	Trap Location/Elevation	Manufacturer Type Trap Size Result	Туре Ткар	Síze	Result
Radiator Trap Generali/2nd/Boy's Bathroom	Generali/2nd/Boy's Bathro	oom	Right Wall, 0-5'	Warren Webster	CAPS	1/2"	
143241 Radiator Trap Generali/2nd/Girl's Bathroom	Generali/2nd/Girl's Bathro	mc	Under Window, 0-51	Warren Webster	CAPS	3/4"	
Radiator Trap Generally/2nd/5104, Right Door	Generally/2nd/5104, Right [	Joor	Left Windows, 0-5'	Spirax Sarco	90RT	1/2"	_
143236 Radiator Trap Generali/2nd/S106	Generali/2nd/S106		Back Left, 0-5'	Spirax Sarco	90RT	1/2"	_
Radiator Trap Generali/2nd/5108			Back Left, 0-5'	Warren Webster	90RT	3/4"	В
Radiator Trap Generali/2nd/S109	Generali/2nd/S109		Back Right, 0-5'	Warren Webster	90RT	3/4"	മ
Radiator Trap   Generali/2nd/5110	Generali/2nd/5110		Back Right, 0-5'	Warren Webster	90RT	1/2"	

Table 8: Chase School: Leaking, and Plugged Traps Audit

Result	В		Д.	<u>.</u>	T John Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strategy of the Strateg	8
Size	1/2	1/2" L	1/2."	3/4"	3/4"	3/4" B
Type Trap	90RT	90RT	90RT	90RT	90RT	90RT
Manufacturer Type Trap Size Result	Spirax Sarco	Spirax Sarco	Spirax Sarco	Dunham Bush	Dunham Bush	Dunham Bush
Trap Location/Elevation	Around Corner, 0-5'	Back Right Corner, Behind Access Panel, 0-5	Behind Teachers Desk, Behind Access Panel, 0-5'	Back Left Corner, 0-5'	Back Left Corner, 0-5'	Center Left of Back Wall, 0-5'
Building/Floor/Room	Chase School/1st/Boys Restroom in Gym Entrance	154228 Radiator Trap Chase School/1st/F104	Chase School/1st/F107	Radiator Trap   Chase School/1st/F113	Chase School/1st/F115	Radiator Trap   Chase School/1st/F116
Tag# Application	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap
Tag #	154206	154228	154233	154234	154235	154239



Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap Size		Result
154240	Radiator Trap	Chase School/1st/F116	Center Right of Back Wall, 0-5'	Dunham Bush	90RT	3/4"	В
154238	Radiator Trap	Chase School/1st/F117	Back Right Corner, 0-5'	Dunham Bush	90RT	1/2"	رد
154236	Radiator Trap	Chase School/1st/Girls Restroom Near F115	Under Window, 0-5'	Warren Webster	90RT	1/2"	
154204	Radiator Trap	Chase School/1st/Gym Entrance	Right Wall, 0-5'	Spirax Sarco	90RT	1/2"	
154202	Radiator Trap	Chase School/2nd/Boys Restroom, Kindergarten Wing	Back Wall, 0-5'	Dunham Bush	90RT	1/2"	
154224	Radiator Trap	Chase School/2nd/S100	Behind Teachers Desk, Behind Access Panel, 0-5'	Warren Webster	90RT	3/4"	
154223	Radiator Trap	Chase School/2nd/S102	Back Left Corner, Behind Access Panel, 0-5'	Spirax Sarco	90RT	3/4"	
154220	Radiator Trap	Chase School/2nd/S104	Behind Teachers Desk, Inside Access Panel, 0-5	Spirax Sarco	90RT	1/2"	<b>-</b>
154216	Radiator Trap	Chase School/2nd/S113	Behind Computers, in Access Panel, 0-5'	Spirax Sarco	90RT	3/4"	m
154212	Radiator Trap	Chase School/2nd/5116	Back Left Corner Behind Access Door, 0-5'	Hoffman	90RT	3/4"	
154201	Radiator Trap	Chase School/2nd/S117	Under Left Radiator, 0-5'	Spirax Sarco	90RT	1/2"	
154213	Radiator Trap	Chase School/2nd/S121	Back Left Corner, 0-5'	Dunham Bush	90RT	3/4"	<b>ω</b>
136286	Drip Leg	Chase School/Basement/8108	Under Radiator Control Valve, 0-5'	Warren Webster	90RT	3/4"	۵
136269	Drip Leg	Chase School/Basement/B110	Back Right Corner, 0-5'	Warren Webster	90RT	3/4"	۵
136263	Drip Leg	Chase School/Basement/Boiler Rm	Above First Boiler Gas Line, 5-10'	Hoffman	FT	3/4"	_
136270	Radiator Trap	Chase School/Basement/Stairwell	Landing Between Basement and 1st Floor, 0-5'	Warren Webster	90RT	3/4"	۵
136264	Drip Leg	Chase School/Basement/Storage Rm Above Boiler Rm	Along Wall Around First Right Corner, 10-15'	Hoffman	L	3/4"	_
136265	Drip Leg	Chase School/Basement/Storage Rm Above Boiler Rm	Above Old Furnace, 10-15'	Warren Webster	E		

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Table 9: Hopeville: Leaking and Plugged Traps Audit

Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap Size	Size	Result
143392	Radiator Trap	Hopeville/1st/Main Corridor	Outside F114, 0-5'	Spirax Sarco	90RT	1/2"	Ь
143225	Radiator Trap	Hopeville/2nd/F106	Back Right, 0-5'	Spirax Sarco	90RT	1/2"	
143376	Radiator Trap	Hopeville/Basement/Cafe	Windows, 5-10'	Hoffman	90RT	1/2"	_
143377	Drip Leg	Hopeville/Basement/Cafe	Windows, 5-10	Hoffman	90RT	3/4"	<b>a</b>
	Radiator Trap	Hopeville/Basement/Girl's Bathroom	In Private Stall, 5-10'	Spirax Sarco	90RT	1/2"	_
143389	Radiator Trap	Hopeville/Basement/Rear Entrance to Cafe	Right of Doors, 5-10'	Hoffman	90RT	1/2"	8
143395	Radiator Trap	Hopeville/Between 1st and Basement/Stairwell to Gym Balcony	Left Side, 0-5'	Hoffman	90RT	1/2"	<u> </u>
	Radiator Trap	Hopeville/Between 1st and Gymnasium Balcony/Stairwell	Right, 0-5'	Hoffman	90RT	1/2"	<b>Q</b> _

Table 10: Kennedy: Leaking and Plugged Traps Audit

Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap Size	2000 No. 200	Result
155234	Drip Leg	Kennedy/1st/Boiler Rm	Behind Left Boiler on Left Side, 0-5'	Hoffman	FT	3/4"	7
155346	Radiator Trap	Kennedy/2nd/Rm 152	Under Window, Left Side, 0-5'	Spirax Sarco	90RT	3/4"	
155351	Radiator Trap	Kennedy/2nd/Rm 154	Under Window, Right Side, 0-5'	Spirax Sarco	90RT	_	8
155354	Radiator Trap	Kennedy/2nd/Rm 158	Under Window, Right Side, 0-5'	Hoffman	90RT	3/4"	മ
155356	Radiator Trap	Kennedy/2nd/Rm at End of Hallway Next to Rm 155	Above Outside Doors, 5-10'	Spirax Sarco	90RT	1/2"	
155357	Radiator Trap	Kennedy/2nd/Staircase Next to Rm 158	Next to Outside Doors, 0-5'	Spirax Sarco	90RT	1/2"	
155374	Radiator Trap	Kennedy/3rd/Girl's Bathroom Near Cafeteria	Back Wall, 0-5'	Spirax Sarco	90RT	1/2"	B
155376	Radiator Trap	Kennedy/3rd/Girl's Bathroom Near Rm 131	Back Wall, 0-5'	Spirax Sarco	90RT	1/2"	



Tag#	Tag #   Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap	SIZE	Result
155337	Radiator Trap	Kennedy/3rd/Hallway	to Right of Media Center Entrance, 0-5'	Spirax Sarco	90RT	***	And the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second s
155339	Radiator Trap	Kennedy/3rd/Hallway	Next to Outside Doors Near Rm 123, 0-5	Spirax Sarco	90RT	<b>2</b>	മ
155332	Radiator Trap	Kennedy/3rd/Rm 109	Under Window, Left Side, 0-5'	Spirax Sarco	90RT	<u>.</u>	
155333	Radiator Trap	Kennedy/3rd/Rm 114	Under Window, Left Side, 0-5	Spirax Sarco	90RT	3/4"	m
155366	Radiator Trap	Kennedy/3rd/Rm 121	Social Worker Office, 0-5'	Spirax Sarco	90RT	3/4"	В
155321	Radiator Trap	Kennedy/3rd/Rm 124	Back Right Corner, 0-5'	Spirax Sarco	90RT	3/4"	۵
155310	Radiator Trap	Kennedy/3rd/Rm 130	Under Window, 0-5'	Spirax Sarco	90RT	1/2"	В
155327	Radiator Trap	Kennedy/3rd/Rm 131A	Under Window, Left of Middle, 0-5'	Spirax Sarco	90RT	3/4"	۵
155312	Radiator Trap	Kennedy/3rd/Rm 132	Back Left Corner, 0-5'	Spirax Sarco	90RT	3/4"	В
155314	Radiator Trap	Kennedy/3rd/Rm 134	Back Left Corner, 0-5'	Spirax Sarco	90RT	3/4"	L
155318	Radiator Trap	Kennedy/3rd/Rm 137	Back Left Corner, 0-5'	Spirax Sarco	90RT	-	_
155319	Radiator Trap	Kennedy/3rd/Rm 139	Back Left Corner, 0-5'	Spirax Sarco	90RT	3/4"	ட
155326	Radiator Trap	Kennedy/3rd/Rm 140	Under Window, 0-5'	Spirax Sarco	90RT	3/4"	_
155358	Radiator Trap	Kennedy/3rd/Stairwell Next to Rm 125	Down Stairs Next to Outside Doors, 0-5'	Spirax Sarco	90RT		
155361	Radiator Trap	Kennedy/4th/Hallway	Near Rm 250, 0-5'	Spirax Sarco	90RT	1/2"	
155360	Radiator Trap	Kennedy/4th/Hallway Next to Rm 226	Zone 11, Next to Stairs, 0-5'	Spirax Sarco	90RT	1/2"	
155359	Radiator Trap	Kennedy/4th/Rm 226	Under Window, Right Side, 0-5'	Spirax Sarco	90RT	3/4"	_
155248	Air Handling Unit	Kennedy/5th/AHU Penthouse	AHU-9, 0-5'	Spirax Sarco	E	14/1	
155250	Air Handling Unit	Kennedy/5th/AHU Penthouse	AHU-8, 0-5'	Spirax Sarco	13	11/4"	
155246	Air Handling Unit	Kennedy/5th/AHU Rm	HV-5, 0-5	Spirax Sarco	L	17/4	
155247	Drip Leg	Kennedy/5th/AHU Rm	HV-5, 5-10'	Spirax Sarco	i zazdo u Austilia e ustalia la destilla e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e sociale e soc	- Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Constitution of the Cons	2
155296	Radiator Trap	Kennedy/5th/Hallway	Radiator Near Rm 208, 0-51	Spirax Sarco	90RT	1/2"	m

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Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap	Size	Result
155297	Radiator Trap	Kennedy/5th/Hallway	Radiator Near Zone 6 Stairs, 0-5'	Spirax Sarco	90RT	-	Ь
155290	Radiator Trap	Kennedy/5th/Hallway By Rm Access	Radiator Along Wall, 0-5'	Spirax Sarco	90RT		۵.
155291	Radiator Trap	Kennedy/5th/Hallway Near Elevator	Radiator Along Wall, 0-5'	Spirax Sarco	90RT	1/2"	<u>~</u>
155284	Radiator Trap	Kennedy/5th/Rm 200B	Under Window, Right Corner, 0-5'	Spirax Sarco	90RT	3/4"	Δ.
155274	Radiator Trap	Kennedy/5th/Rm 211	Under Window, Right Corner, 0-5'	Spirax Sarco	90RT	1/2"	۵
155277	Radiator Trap	Kennedy/5th/Rm 211	Under Window, Right Corner, 0-5'	Spirax Sarco	90RT	-	Δ.
155278	Radiator Trap	Kennedy/5th/Rm 214	Under Window, Right Corner, 0-5'	Spirax Sarco	90RT	3/4"	۵
155276	Radiator Trap	Kennedy/5th/Rm 216	Under Window, Right Corner, 0-5'	Spirax Sarco	CAPS	3/4"	<b>a</b>
155275	Radiator Trap	Kennedy/5th/Rm 220	Under Window, Right Corner, 0-5'	Spirax Sarco	90RT	1/2"	۵
155272	Radiator Trap	Kennedy/5th/Rm 222	Under Window, Right Corner, 0-5'	Spirax Sarco	90RT	3/4"	Δ
155263	Radiator Trap	Kennedy/5th/Rm 231B	Under Window, Right Corner, 0-5'	Spirax Sarco	90RT	1/2"	۵
155264	Radiator Trap	Kennedy/5th/Rm 233	Under Window, 0-5'	Spirax Sarco	90RT	-	Δ.
155267	Radiator Trap	Kennedy/5th/Rm 235	Under Window, Right Corner, 0-5'	Spirax Sarco	90RT	1/2"	۵
155268	Radiator Trap	Kennedy/5th/Rm 236	Under Window, Right Corner, 0-5'	Spirax Sarco	90RT	1/2"	۵
155271	Radiator Trap	Kennedy/5th/Rm 238	Under Window, Left Corner, 0-5'	Spirax Sarco	90RT	3/4"	۵
155270	Radiator Trap	Kennedy/5th/Rm 239	Under Window, Right Corner, 0-51	Spirax Sarco	90RT	3/4"	۵
155285	Radiator Trap	Kennedy/5th/World Language Center	Under Window, 0-5'	Spirax Sarco	90RT	1/2"	_
155261	Radiator Trap	Kennedy/5th/World Language Office	Under Window, 0-5	Spirax Sarco	90RT	1/2"	Δ.

Table 11: Kingsbury: Leaking and Plugged Traps Audit

Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap	Size	Result
143252	Radiator Trap	Radiator Trap Kingsbury/1st/F112	Back Right, 0-5'	Dunham Bush	90RT	1/2"	<u>م</u>
143264	Radiator Trap	143264 Radiator Trap Kingsbury/1st/Main Entrance	Right Side, 0-51	Dunham Bush	90RT	1/2" B	8
143260	Radiator Trap	143260 Radiator Trap Kingsbury/1st/Vice Principal	Right, 0-5'	Dunham Bush	90RT	1/2"	
143266	Radiator Trap	143266 Radiator Trap Kingsbury/Between 1st and	Near Window, 0-5	Dunham Bush	90RT	1/2"	



Trap Location/Elevation Manufacturer Type Trap Size Result		Left Entrance, 0-5' Dunham Bush 90RT 1/2" L	Night Side of Exit; 0-5" Dunham Bush 90RT 1/2" L
Building/Floor/Room	5	Kingsbury/Between 1st and Basement/Stairwell	Kingsbury/Between 1st and Basement/Stairwell Outside F114
Tag # Application		143261 Radiator Trap	143249 Radiator Trap
Tag #		143261	143249

## Table 12: Sprague: Leaking and Plugged Traps Audit

Type Trap   Size   Result	. 90RT 3/4" B	90RT 3/4" B	. 90RT 3/4" L
Manufacturer	Warren Webster	Warren Webster 90RT	Warren Webster
Trap Location/Elevation	Next to Custodian Closet, 0-5'	Back Right, 0-5'	Outside F114, 0-5'
Building/Floor/Room	156552 Radiator Trap Sprague/2nd/Boy's Bathroom	27285 Radiator Trap Sprague/2nd/S119	Sprague/Between 1st and 2nd/Stairwell
Application	Radiator Trap	Radiator Trap	156549 Radiator Trap
Tag#	156552	27285	156549

## Table 13: Tinker: Leaking and Plugged Traps Audit

Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap Size Result	Size	Result
145431	Radiator Trap	Tinker/2nd/S110	Behind Bookshelves Under Left Window, 0-5'	Hoffman	90RT	1/2"	TACHETTA AMBAHAT TAGAHA
145429	Radiator Trap	Tinker/2nd/S112	Middle of Rm, 0-5'	Hoffman	90RT	1/2"	
145428	Radiator Trap	Tinker/2nd/S113	Behind Computers, 0-5'	Hoffman	90RT	1/2"	В
145427	Radiator Trap	Tinker/2nd/S114	Behind Teachers Desk, 0-51	Spirax Sarco	90RT	1/2"	ے
145425	Radiator Trap	Tinker/2nd/S118	Middle of Rm Left Radiator, 0-5'	Warren Webster	90RT	1/2"	_
145424	Radiator Trap	Tinker/2nd/S118	Middle of Rm Right Radiator, 0-5'	Warren Webster	90RT	1/2"	_
145422	Radiator Trap	Tinker/2nd/S116	Right Wall, 0-5'	Warren Webster	90RT	1/2"	В
149096	Radiator Trap	Tinker/1st/Girls Restroom	Under Window, 0-5'	Dunham Bush	90RT	1/2"	_
149092	Radiator Trap	Tinker/1st/F113	Left Radiator Under Window, 0-5'	Warren Webster	90RT	1/2"	ر



Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap Size	Size	Result
149091	Radiator Trap	Tinker/1st/F113	Right Radiator Behind Desk, 0-5'	Warren Webster	90RT	1/2"	8
149090	Radiator Trap	Tinker/1st/F114	Under Window Left Side, 0-5'	Spirax Sarco	90RT	3/4"	8
149088	Radiator Trap	Tinker/1st/F111	Right Radiator Under Window, 0-5'	Warren Webster	90RT	1/2"	В
149086	Radiator Trap	Tinker/1st/F110	Under Window, 0-5'	Warren Webster	90RT	1/2"	<b>г</b>
149081	Radiator Trap	Tinker/Ground/Cafeteria	Under Window Left Side, 0-5'	Dunham Bush	90RT	1/2"	۵
149080	Radiator Trap	Tinker/Ground/Gym Bldg, Hallway	By Courtyard Entrance at Bottom of Stairs, 0-5'	Hoffman	90RT	1/2"	۵
149077	Radiator Trap	Tinker/1st/Walkway to Gym	Courtyard Side, 0-5'	Spirax Sarco	90RT	1/2"	and the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of t
149075	Radiator Trap	Tinker/1st/Vice Principal's Office	Under Window, 0-5'	Spirax Sarco	CAPS	1/2"	
149073	Radiator Trap	Tinker/2nd/S111	Under Window, 0-5'	Hoffman	90RT	1/2"	
149078	Radiator Trap	Tinker/2nd/5120	Left Wall, 0-5'	Dunham Bush	90RT	1/2"	Ф
149067	Radiator Trap	Tinker/1st/Hallway	Across from F101, 0-51	Dunham Bush	90RT	1/2"	
149062	Radiator Trap	Tinker/Basement/Boys Restroom	Above Urinals, 5-10'	Spirax Sarco	90RT	1/2"	
149058	Drip Leg	Tinker/Basement/Storage Next to Boiler Rm	Above HEX on Wall, 10-15'	Hoffman	90RT	3/4"	Δ.

Table 14: Walsh: Leaking and Plugged Traps Audit

Tag #	Tag # Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap Size Result	Size	Result
145509	Radiator Trap	Walsh/2nd/S1	Under Window, 0-5'	Hoffman	CAPS	3/4"	_1
145497	Radiator Trap	Walsh/2nd/S13	Right Radiator, 0-5'	Spirax Sarco	90RT	1/2"	
145506	Radiator Trap	Walsh/2nd/S5	Back Right Corner, 0-5'	Spirax Sarco	90RT	1/2"	
145501	Radiator Trap	Walsh/2nd/S7	Left Radiator, 0-5'	Spirax Sarco	90RT	1/2"	
145505	Radiator Trap	Walsh/2nd/S7	Right Radiator, 0-5'	Spirax Sarco	90RT	1/2"	
145511	Radiator Trap	Walsh/2nd/Stairwell	Landing Between 2 nd -1 st Floors, 0-5' Hoffman	Hoffman	90RT	1/2"	1
145473	Drip Leg	Walsh/Basement/B7	Back Left Corner, 5-10'	Sterling	L	3/4"	m
145533	145533 Unit Heater	Walsh/Basement/CrawIspace	Large Rm through Hole in Wall,	Barnes and Jones FT	<u> </u>	3/4"	

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Table 15: Wendell Cross: Leaking and Plugged Traps Audit

Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer	Type Trap	Size	Result
155226	Radiator Trap	Wendell Cross/1st/ Rm to Left of Stage in Gym	Back Bathroom, 0-5'	Spirax Sarco	90RT	1/2"	В
155206	Radiator Trap	Wendell Cross/1st/F101	Left Corner of Left Wall, 0-5'	Warren Webster	90RT	1/2"	
155210	Radiator Trap	Wendell Cross/1st/F103	Right Corner of Back Wall, 0-5'	Warren Webster	90RT	1/2"	
155209	Radiator Trap	Wendell Cross/1st/F105	Right Corner of Back Wall, 0-5'	Warren Webster	90RT	1/2"	æ
152486	Radiator Trap	Wendell Cross/1st/F109	Right Corner of Back Wall, 0-5'	Warren Webster	90RT		<b>6</b>
152488	Radiator Trap	Wendell Cross/1st/F109	Left Corner Under Window, 0-5'	Warren Webster	90RT	1/2"	m
155211	Radiator Trap	Wendell Cross/1st/F110	Left Corner of Back Wall, 0-5'	Spirax Sarco	90RT	1/2"	Д.
155212	Radiator Trap	Wendell Cross/1st/F112	Left Corner of Back Wall, 0-5'	Warren Webster	90RT	1/2"	æ
152484	Radiator Trap	Wendell Cross/1st/F116	Left Corner Under Window, 0-5'	Warren Webster	90RT	1/2"	
152482	Radiator Trap	Wendell Cross/1st/F118	Right Corner Under Window, 0-5'	Warren Webster	90RT	1/2"	
155217	Radiator Trap	Wendell Cross/1st/Hallway	Right of Library, 0-5'	Warren Webster	90RT	1/2"	
155223	Radiator Trap	Wendell Cross/1st/Hallway	Next to Outside Doors Before Gym, 0-5'	Spirax Sarco	90RT	1/2"	
152497	Radiator Trap	Wendell Cross/Basement/B101	Right Corner Under Window, 0-5'	Warren Webster	90RT	1/2"	
152494	Radiator Trap	Wendell Cross/Basement/8102	Right Corner Under Window, 0-5'	Warren Webster	90RT	1/2"	8
152493	Radiator Trap	Wendell Cross/Basement/B104	Right Corner Under Window, 0-5'	Warren Webster	90RT	1/2"	
152489	Radiator Trap	Wendell Cross/Basement/B107	Left Corner Under Window, 0-5'	Warren Webster	90RT	1/2"	8
152496	Radiator Trap	Wendell Cross/Basement/Girl's Bathroom	Along Left Wall, 0-5'	Warren Webster	90RT	1/2"	8
155204	Radiator Trap	Wendell Cross/Basement/Janitorial Office	Along Right Wall, 0-5'	Warren Webster	90RT	1/2"	

Information on this page is proprietory and subject to confidentiality restrictions



Table 16: West Side: Leaking and Plugged Traps Audit

Tag #	Tag # Application	Building/Floor/Room	Trap Location/Elevation	Manufacturer Type Trap Size Resu	Type Trap	Size	Result
145536	Drip Leg	West Side/1st/Gym Mech Rm	Left of Entrance Ladder, 5-10'	Spirax Sarco	FT	3/4" [	, ,
145455	145455 Drip Leg	West Side/Basement/Boiler Rm	Above Chillers, 10-15'	Spirax Sarco	E	3/4" L	
145467	Drip Leg	West Side/Rooftop/Blue House Penthouse	Behind AHU, 10-15'	Spirax Sarco	느	3/4" L	
145468	Air Handling Unit	West Side/Rooftop/Blue House Penthouse	Behind AHU, 5-10'	Spirax Sarco	L	11/2" B	60
1145463	Air Handling Unit	West Side/Rooftop/Red House Penthouse	Behind AHU, 0-5'	Spirax Sarco	<u></u>	2.	<b>^</b>

Table 17: Wilby-North End Complex: Leaking and Plugged Traps Audit

Tag#	Tag # Application	Building/Floor/Room	Trap Location/Elevation	Menufecturer	Type Trap Size Result	Size Res	ault
135505	Drip Leg	Wilby-North End/Basement/Boiler Rm	to Right of Large HEXs, 5-10'	Barnes and Jones	Ц	-L	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
135509	Air Handling Unit	Wilby-North End/Basement/Boiler Rm - Pool Pit	Back AHU, 0-5'	Barnes and Jones	LH.	3/4" P	
135527	Drip Leg	Wilby-North End/Basement/Tunnel	Next to High School Mech Rm, 5- 10'	Steamloc	LBD		
135529 Drip Leg	Drip. Lég	Wilby-North End/Basement/Wilby Mech Rm	Next to Water Pumps Around Corner of Entrance, 0-5'	Spirax Sarco	Thermodynamic	3/4"	
135536	Drip Leg	Wilby-North End/Basement/Wilby Mech Rm	Above H6, 5-10'	Steamloc	LBD	3/4" P	
135567	Air Handling Unit	Wilby-North End/Roof/Back Penthouse	C7, 0-5!	Spirax Sarco	E	_	



Table 18: Wilson: Leaking and Plugged Traps Audit

Result	<u>B</u>	В			_		<b>8</b>	<b>~</b>	_	m	_			<b>α</b>	۵	Ω		ட	<b>m</b>	m
Size	3/4"	3/4"	3/4"	1/2"	3/4"	1/2"	1/2"	1/2,	3/4"	3/4"	1/2"	1/2"	1/2"	1/2"	1/2"	3/4"	1/2"		3/4"	1/2"
Type Trap	90RT	90RT	90RT	90RT	90RT	90RT	90RT	90RT	90RT	90RT	90RT	90RT	90RT	90RT	Ŀ	E	CAPS	E	90RT	90RT
Manufacturer	Hoffman	Hoffman	Warren Webster	Hoffman	Hoffman	Spirax Sarco	Hoffman	Hoffman	Hoffman	Warren Webster	Hoffman	Hoffman	Hoffman	Hoffman	Spirax Sarco	Warren Webster	Spirax Sarco	Warren Webster	Hoffman	Hoffman
Trap Location/Elevation	Middle, 0-5'	Middle, 0-5'	Back Left Corner, Behind Access Panel, 0-5'	Front Entrance, Right Wall, 0-5	Right Wall, 0-5'	Under Window, 0-5'	1st Floor Landing, 0-5'	Landing Between 1st and Basement, 0-5'	Middle, 0-5'	Radiator at Top of Basement Stairs, 0-5	Left Radiator, 0-5'	Right Radiator, 0-5'	2nd Floor Landing, 0-5'	2nd Floor Landing, 0-5'	Right Window, 5-10'	Left of Condensate Tank, 0-5'	Above Computer in Corner, 10-15'	Above Condensate Tank, 0-5'	Middle of Rm, Above 15'	Landing Between Basement and 1st, 5-10'
Building/Floor/Room	Wilson/1st/Boisvert	Wilson/1st/Boisvert	Wilson/1st/Cafeteria	Wilson/1st/Hallway	Wilson/1st/Main Entrance	Wilson/1st/Nurses Office	Wilson/1st/Stairwell 2	Wilson/1st/Stairwell 2	Wilson/1st/Zinno	Wilson/2nd/Hallway	Wilson/2nd/Ms. Deeley's Rm	Wilson/2nd/Ms. Deeley's Rm	Wilson/2nd/Stairwell	Wilso/2nd/Stairwell 2	Wilson/Basement/BDLC Rm Near Boiler Rm	Wilson/Basement/Crawlspace	Wilson/Basement/Large Rm	Wilson/Basement/Old HEX Rm	Wilson/Basement/Sprinkler Valve Rm	Wilson/8asement/Stairwell
Application	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Unit Heater	Drip Leg	Drip Leg	Drip Leg	Drip Leg	Radiator Trap
Tag#	156573	156574	145590	145569	156577	145580	145563	145565	156569	145561	145584	145592	145560	145562	145586	145555	145567	145549	145551	145557

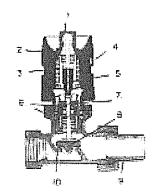
City of Waterbury, Connecticut Investment Grade Energy Audit · May 13, 2016 (rev. June 29, 2016)



The new thermostatic radiator valves (TRVs) are equipped with a highly responsive, non-electric temperature sensor, capable of full modulation of the valve without an outside power source, which can be set to the desired room temperature. They shall have a temperature setpoint range of  $48^{\circ}F$  to  $84^{\circ}F$  as well as a freeze protection setting of  $42^{\circ}F$ . The thermostatic controls shall incorporate a feature to internally limit or lock the temperature setting. They shall be capable of regulating the temperature to within  $+/-1^{\circ}F$ . An extension piece shall be available to mount the sensor and control

dial away from the valve and the emitter enclosure if needed.

The rugged and reliable construction provides years of service in steam heating systems. The temperature sensor expands or contracts based on room temperature changes. This movement adjusts the valve opening, which increases or



- 1. Room Temperature Sensor Element
- 2. Room Temperature Selector
- 3. Patented Special Balancing Spring
- 4. Locking/Limiting Stops
- 5. Insulated Push Rod
- 6. O Rings
- 7. Stainless Steel Valve Stem
- 8. EPDM Valve Disc Material
- 9. Union Connections (NPT or SWEAT)
- 10. Precision Machined

decreases the flow through the radiator. Continual modulation of the valve reduces energy consumption, prevents costly overheating and provides even temperature levels in each heating zone.

NORESCO will install a total of eight hundred and twelve (812) new thermostatic radiator valves in the steam heated buildings at the locations and in the quantities listed in the Tables below. Installation of a reliable thermostatic radiator valve will improve heating system control and reduce the need to open windows to mitigate overheating spaces. The scope of work for this measure includes the following:

- Identify selected radiator or convector valves
- Remove existing pneumatic, thermostatic, or manual valve to facilitate new installation
- Determine proper valve size and valve Cv to provide optimal control
- Determine proper valve type and sensor orientation for each valve
- Install new thermostatic radiator valve, including re-piping where required



Table 19: Barnard Control Valve Audit Sorted by Trap Tag Number

Radiator Valve Size	11/4"	11/4"
Comments	No Components	Manual Control Valve
Trap Location/Elevation	Back Wall, Right Side, 0-5'	Brick Wall, 0-5'
Building/Floor/Room	Radiator Trap Barnard/1st/103	or Trap Barnard/1st/Auditorium Stage
Application	Radiator Trap	Radiator Trap Ba
Trap Tag #	144444	

## Table 20: Bucks Hill Control Valve Audit Sorted by Trap Tag Number

Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
144475	Radiator Trap	Bucks Hill/1st/Boy's Bathroom, End of Middle Hallway	Under Window, 0-5'	Pneumatic Control Valve	£
144478	Radiator Trap	Bucks Hill/1st/Boy's Bathroom, Halfway Down Middle Hallway	Under Window, 0-5¹	Pneumatic Control Valve	3/4"
144485	Radiator Trap	Bucks Hill/1st/Boy's Bathroom, Left Hallway	Back Left, 0-5'	Manual Control Valve	1/2"
144487	Radiator Trap	Bucks Hill/1st/F107	Right of Back Door; 0-5'	Pneumatic Control Valve	1
144484	Radiator Trap	Bucks Hill/1st/F109	Right of Back Door, 0-5'	Pneumatic Control Valve	-
144483	Radiator Trap	Bucks Hill/1st/F110	Right Side of Window, 0-5'	Pneumatic Control Valve	-
144482	Radiator Trap	Bucks Hill/1st/F111	Right of Back Door, 0-5'	Pneumatic Control Valve	<del>-</del>
144480	Radiator Trap	Bucks Hill/1st/F112	Right of Back Door, 0-5'	Pneumatic Control Valve	-
144481	Radiator Trap	Bucks Hill/1st/F113	Left of Back Door, 0-5'	Pneumatic Control Valve	-
144466	Radiator Trap	Bucks Hill/1st/F126	Back Right, Under Window, 0-5'	Pneumatic Control Valve	3/4"
144468	Radiator Trap	Bucks Hill/1st/F127	Back Left, 0-5'	Pneumatic Control Valve	3/4"
144453	Radiator Trap	Bucks Hill/1st/F129	Back Left, 0-5'	Pneumatic Control Valve	
144467	Radiator Trap	Bucks Hill/1st/F134	Back Right Behind Teachers Desk, 0-5'	Pneumatic Control Valve	3/4"
144489	Radiator Trap	Bucks Hill/1st/F140	Library, 0-5'	Manual Control Valve	1/2"
144491	Radiator Trap	Bucks Hill/1st/F141	Library, 0-5'	Pneumatic Control Valve	3/4"



Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
144490	Radiator Trap	Bucks Hill/1st/Girl's Bathroom	Back of Library, 0-5'	Manual Control Valve	1/2"
144492	Radiator Trap	Bucks Hill/1st/Girl's Bathroom	Behind Kitchen, 0-5'	Manual Control Valve	1/2"
144477	Radiator Trap	Bucks Hill/1st/Girl's Bathroom, Halfway Down Middle Hallway	Under Window, 0-5'	Pneumatic Control Valve	3/4"
144476	Radiator Trap	Bucks Hill/1st/Girl's Bathroom, End of Middle Hallway	Under Window, 0-5'	Pneumatic Control Valve	
144486	Radiator Trap	Bucks Hill/1st/Girl's Bathroom, Left Hallway	By:Window; 0-5!	Pneumatic Control Valve	3/4"
144452	Radiator Trap	Bucks Hill/1st/Hallway	Outside Rm F135, 0-5'	Pneumatic Control Valve	3/4"
144460	Radiator Trap	Bucks Hill/1st/Hallway	Outside Rm F127, 0-5'	Pneumatic Control Valve	3/4"
144461	Radiator Trap	Bucks Hill/1st/Hallway	Outside Rm F125, 0-5'	Pneumatic Control Valve	3/4"
144462	Radiator Trap	Bucks Hill/1st/Hallway	Outside F128, 0-5'	Pneumatic Control Valve	3/4"
144463	Radiator Trap	Bucks Hill/1st/Hallway	Outside Rm F126, 0-5'	Pneumatic Control Valve	3/4"
144464	Radiator Trap	Bucks Hill/1st/Hallway	Outside Rm F134, 0-5'	Pneumatic Control Valve	3/4"
144465	Radiator Trap	Bucks Hill/1st/Hallway	Outside Rm F136, 0-5'	Pneumatic Control Valve	3/4"
144469	Radiator Trap	Bucks Hill/1st/Hallway	Under Window Looking at Modular on Left Side, 0-5†	Pneumatic Control Valve	3/4"
144470	Radiator Trap	Bucks Hill/1st/Middle Hallway	Across from Tag 144469 Under Window Looking at Pine Tree, 0-5'	Pneumatic Control Valve	3/4"
144471	Radiator Trap	Bucks Hill/1st/Middle Hallway	Under Window Across from Tag 144472, 0-5'	Pneumatic Control Valve	3/4"
144472	Radiator Trap	Bucks Hill/1st/Middle Hallway	Under Window Looking at Modular. Right Side of Heater, 0-5'	Pneumatic Control Valve	3/4"
144473	Radiator Trap	Bucks Hill/1st/Middle Hallway	Directly Across from F123, 0-5'	Pneumatic Control Valve	3/4"
144479	Radiator Trap	Bucks Hill/1st/Nurse's Bathroom	Across from Bathroom Door, 0-5'	Manual Control Valve	3/4"
144454	Radiator Trap	Bucks Hill/1st/Office	Under Outside Window, 0-5'	Pneumatic Control Valve	3/4"
144488	Radiator Trap	Bucks Hill/1st/Principal's Office	Back Left, 0-5'	Pneumatic Control Valve	3/4"



Trap Tag#	Trap Tag # Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
144457	Radiator Trap	Radiator Trap   Bucks Hill/Basement/B101	Left Wall Under Window, 0-5'	Pneumatic Control Valve	3/4"
144458	Radiator Trap	Radiator Trap Bucks Hill/Basement/B101	Back Left, 0-5'	No Components	11/2"
144451	Radiator Trap	Radiator Trap Bucks Hill/Basement/B103	Back Right Corner, 0-5'	No Components	11/2"
144456	Radiator Trap	Bucks Hill/Basement/Boy's Bathroom	Back Wall, 0-5'	Pneumatic Control Valve	3/4"
144459	Radiator Trap	Radiator Trap Bucks Hill/Basement/Music	Behind Teachers Desk, 0-5'	No Components	11/2"
144455	Radiator Trap	Radiator Trap Bucks Hill/Basement/Stairwell	Underneath Stairs, 0-5'	Pneumatic Control Valve	3/4"

Table 21: Bunker Hill Control Valve Audit Sorted by Trap Tag Number

Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
144553	Radiator Trap	Bunker Hill/1st/Custodian Office	Above White Desk, 0-5'	Manual Control Valve	3/4"
144550	Radiator Trap	Bunker Hill/1st/Speech Bathroom	Above 2nd Stall from Left, 5-10*	Manual Control Valve	3/4"
144546	Radiator Trap	Bunker Hill/1st/Speech Rm Across from Art	Above Laminator, 5-10'	Manual Control Valve	3/4"
144545	Radiator Trap	Bunker Hill/1st/Art	Fwd Right Side of Rm, 5-10'	Manual Control Valve	3/4"
144544	Radiator Trap	Bunker Hill/3rd/T113	Under Window, Left Side, 0-5'	Pneumatic Control Valve	3/4"
144543	Radiator Trap	Bunker Hill/3rd/T101	Behind Computers, Right Side, 0-5'	Pneumatic Control Valve	3/4"
144542	Radiator Trap	Bunker Hill/2nd/Faculty Bathroom Next to Main Office	In Stall, 0-5'	Manual Control Valve	3/4"
144541	Radiator Trap	Bunker Hill/2nd/Teacher Lounge	Under Window, Left Side, 0-5'	Pneumatic Control Valve	3/4"
144539	Radiator Trap	Bunker Hill/2nd/Main Office	Under Window, 0-5'	Manual Control Valve	3/4"
144540	Radiator Trap	Bunker Hill/2nd/Main Office	Bathroom, O-5'	Manual Control Valve	3/4"
144538	Radiator Trap	Bunker Hill/2nd/S112	Under Window, Right Side, 0-5'	Pneumatic Control Valve	3/4"
144537	Radiator Trap	Bunker Hill/2nd/Principal's Office	Under Window, Left Side, 0-5'	Pneumatic Control Valve	3/4"
144536	Radiator Trap	Bunker Hill/2nd/Principal's Bathroom	Under Window, 0-5'	Manual Control Valve	3/4"

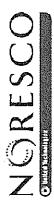


144535 F	Apprecion	ò	Trap Location/Elevation	Comments	Valve Size
	Radiator Trap	Bunker Hill/2nd/S113	Right of Windows, 0-5'	Pneumatic Control Valve	3,4"
144534 F	Radiator Trap	Bunker Hill/2nd/S116	Right Side of Window, 0-5'	Pneumatic Control Valve	3/4"
144533 F	Radiator Trap	Bunker Hill/2nd/5118	Back Wall, 0-5!	Manual Control Valve	3/4"
144532 F	Radiator Trap	Bunker Hill/2nd/5107	Behind Teachers Desk, Left End of Radiator, 0-5	Pneumatic Control Valve	3/4"
144531 R	Radiator Trap	Bunker Hill/2nd/Main Hallway	Outside Rm S112, 0-5'	Manual Control Valve	3/4"
144530 R	Radiator Trap	Bunker Hill/3rd/S117	Under Window, Left Side, 0-5'	Pneumatic Control Valve	11/4"
144529 R	Radiator Trap	Bunker Hill/3rd/Boy's Bathroom	Under Window, 0-5'	Pneumatic Control Valve	3/4"
144528 R	Radiator Trap	Bunker Hill/4th/Boy's Bathroom	Under Window, 0-5'	Pneumatic Control Valve	3/4"
144527 F	Radiator Trap	Bunker Hill/4th/T114	Left of Emergency Exit, 0-5'	Manual Control Valve	3/4"
144526 R	Radiator Trap	Bunker Hill/Between 3rd and 4th/Fwd Right Stairwell	Wall, 0-5'	Manual Control Valve	3/4"
144525 R	Radiator Trap	Bunker Hill/Between 2nd and 3rd/Fwd Right Stairwell, Facing Street	on Wall, 5-10'	Manual Control Valve	3,4"
144524 R	Radiator Trap	Bunker Hill/2nd/F107	Under Window, Right Side, 0-5'	Pneumatic Control Valve	11/4"
144523 R	Radiator Trap	Bunker Hill/2nd/Nurse's Rm	Under Window, 0-5'	Pneumatic Control Valve	3/4"
144521 R	Radiator Trap	Bunker Hill/Between 2nd and 3rd/Fwd Left Stairwell Facing Street	Fwd Wall, 5-10'	Manual Control Valve	3/4"
144520 R	Radiator Trap	Bunker Hill/Between 3rd and 4th/Forward Left Stairwell	Wall, 0-5'	Manual Control Valve	3/4"
144519 R	Radiator Trap	Bunker Hill/Between 3rd and 4th/Stairwell	Under Window, 0-5'	Manual Control Valve	3/4"
144518 R	Radiator Trap	Bunker Hill/Between 2nd and 3rd/Stairwell	Under Window, 0-5'	Manual Control Valve	3/4"
144426 R	Radiator Trap	Bunker Hill/Between 1st and 2nd/Stairwell	Under Window, 0-5'	Manual Control Valve	3/4"
144517 R	Radiator Trap	Bunker Hill/Between Basement and 1st Fl Outside Boiler Rm/Stairwell	Wall, 5-10'	Manual Control Valve	3/4"



Table 22: Chase Building Control Valve Audit Sorted by Trap Tag Number

Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
151935	Radiator Trap	Chase/1st/Entrance Rm on Right Side of Bldg	Next to Outside Door, 0-5'	No Components	2 
151905	Radiator Trap	Chase/1st/Hallway	Inside Main Entrance to Right, 0-5'	No Components	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
151906	Radiator Trap	Chase/1st/Hallway	Inside Main Entrance to Left, 0-5'	No Components	<u>-</u>
151903	Radiator Trap	Chase/1st/Men's Employee Bathroom	Under Left Window, 0-5"	Manual Control Valve	3/4"
151904	Radiator Trap	Chase/1st/Men's Employee Bathroom	Under Right Window, 0-5'	Manual Control Valve	3/4"
151914	Radiator Trap	Chase/1st/Rm 103	Under Window, 0-5'	Pneumatic Control Valve	3/4"
151915	Radiator Trap	Chase/1st/Rm 103	Office in Back Right, 0-5'	Pneumatic Control Valve	3/4"
151912	Radiator Trap	Chase/1st/Rm104	Under Right Window, 0-5'	Pneumatic Control Valve	3/4"
151913	Radiator Trap	Chase/1st/Rm 104	Under Left Window, 0-5'	Pneumatic Control Valve	3/4"
151954	Radiator Trap	Chase/1st/Rm105	Under Window, 0-5'	Pneumatic Control Valve	3/4"
151952	Radiator Trap	Chase/1st/Rm 106	Small Rm in Back Left Corner, 0-5'	Manual Control Valve	3/4"
151953	Radiator Trap	Chase/1st/Rm 106	Under Window, 0-5'	Pneumatic Control Valve	3/4"
151922	Radiator Trap	Chase/1st/Rm 110	Office 110-A, 0-5'	Pneumatic Control Valve	3/4"
151923	Radiator Trap	Chase/1st/Rm 110	First Radiator Along Right Wall, 0-5'	Pneumatic Control Valve	3/4"
151924	Radiator Trap	Chase/1st/Rm 110	Second Radiator Along Right Wall, 0-5'	Pneumatic Control Valve	3/4"
151925	Radiator Trap	Chase/1st/Rm 110	Third Radiator Along Right Wall, 0-5'	Pneumatic Control Valve	3/4"
151926	Radiator Trap	Chase/1st/Rm 110	Fourth Radiator Along Right Wall, 0-5'	Pneumatic Control Valve	3/4"
151927	Radiator Trap	Chase/1st/Rm 110	First Radiator Along Left Wall, 0-5'	Pheumatic Control Valve	3/4"
151928	Radiator Trap	Chase/1st/Rm 110	Second Radiator Along Left Wall, 0-5'	Pneumatic Control Valve	3/4"
151929	Radiator Trap	Chase/1st/Rm 110	Third Radiator Along Left Wall, 0-5'	Pneumatic Control Valve	3/4"
151930	Radiator Trap	Chase/1st/Rm 110	Break Rm, Left Wall, 0-5'	Pneumatic Control Valve	3/4"
151931	Radiator Trap	Chase/1st/Rm 110	Break Rm, Back Wall, 0-5'	Pneumatic Control Valve	3/4"
151932	Radiator Trap	Chase/1st/Rm 110	Back Office, Back Wall, Left Side, 0-5'	Pneumatic Control Valve	3/4"



				Valve Size
Radiator Trap Chase/1st/Rm 110 Radiator Trap Chase/1st/Rm 120 Radiator Trap Chase/1st/Rm 120 Radiator Trap Chase/1st/Rm 122 Radiator Trap Chase/1st/Rm 122 Radiator Trap Chase/1st/Rm 130 Radiator Trap Chase/1st/Rm 134 Radiator Trap Chase/1st/Rm 134 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 156 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Superintendent Office		Back Office, Back Wall, Right Side, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm 120 Radiator Trap Chase/1st/Rm 120 Radiator Trap Chase/1st/Rm 122 Radiator Trap Chase/1st/Rm 122 Radiator Trap Chase/1st/Rm 130 Radiator Trap Chase/1st/Rm 130 Radiator Trap Chase/1st/Rm 134 Radiator Trap Chase/1st/Rm 134 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 156 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office	sse/1st/Rm 110	Back Office, Right Wall, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm 120 Radiator Trap Chase/1st/Rm 122 Radiator Trap Chase/1st/Rm 122 Radiator Trap Chase/1st/Rm 130 Radiator Trap Chase/1st/Rm 130 Radiator Trap Chase/1st/Rm 134 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 154 Radiator Trap Chase/1st/Rm 156 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		Under Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm 122 Radiator Trap Chase/1st/Rm 122 Radiator Trap Chase/1st/Rm 130 Radiator Trap Chase/1st/Rm 130 Radiator Trap Chase/1st/Rm 134 Radiator Trap Chase/1st/Rm 134 Radiator Trap Chase/1st/Rm 152 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		File Rm to Left of Office., 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm 122 Radiator Trap Chase/1st/Rm 130 Radiator Trap Chase/1st/Rm 130 Radiator Trap Chase/1st/Rm 134 Radiator Trap Chase/1st/Rm 134 Radiator Trap Chase/1st/Rm 152 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 156 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		Under Left Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm 130 Radiator Trap Chase/1st/Rm 130 Radiator Trap Chase/1st/Rm 134 Radiator Trap Chase/1st/Rm 134 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 153 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		Under Middle Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm130 Radiator Trap Chase/1st/Rm134 Radiator Trap Chase/1st/Rm134 Radiator Trap Chase/1st/Rm152 Radiator Trap Chase/1st/Rm153 Radiator Trap Chase/1st/Rm155 Radiator Trap Chase/1st/Rm160 Radiator Trap Chase/1st/Rm160 Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm163 Radiator Trap Chase/1st/Rm163 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Superintendent Office	the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the co	Under Right Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm130 Radiator Trap Chase/1st/Rm134 Radiator Trap Chase/1st/Rm152 Radiator Trap Chase/1st/Rm153 Radiator Trap Chase/1st/Rm155 Radiator Trap Chase/1st/Rm160 Radiator Trap Chase/1st/Rm160 Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm163 Radiator Trap Chase/1st/Rm163 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Superintendent Office		Under Right Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm134 Radiator Trap Chase/1st/Rm152 Radiator Trap Chase/1st/Rm154 Radiator Trap Chase/1st/Rm155 Radiator Trap Chase/1st/Rm160 Radiator Trap Chase/1st/Rm160 Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm163 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		Under Left Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm134  Radiator Trap Chase/1st/Rm152  Radiator Trap Chase/1st/Rm154  Radiator Trap Chase/1st/Rm160  Radiator Trap Chase/1st/Rm160  Radiator Trap Chase/1st/Rm161  Radiator Trap Chase/1st/Rm161  Radiator Trap Chase/1st/Rm163  Radiator Trap Chase/1st/Rm164  Radiator Trap Chase/1st/Rm164  Radiator Trap Chase/1st/Rm164  Radiator Trap Chase/1st/Rm164  Radiator Trap Chase/1st/Superintendent Office  Radiator Trap Chase/1st/Superintendent Office		Under Right Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm152 Radiator Trap Chase/1st/Rm154 Radiator Trap Chase/1st/Rm155 Radiator Trap Chase/1st/Rm160 Radiator Trap Chase/1st/Rm160 Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm163 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Superintendent Office		Under Left Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm153  Radiator Trap Chase/1st/Rm154  Radiator Trap Chase/1st/Rm160  Radiator Trap Chase/1st/Rm160  Radiator Trap Chase/1st/Rm161  Radiator Trap Chase/1st/Rm163  Radiator Trap Chase/1st/Rm163  Radiator Trap Chase/1st/Rm164  Radiator Trap Chase/1st/Rm164  Radiator Trap Chase/1st/Rm164  Radiator Trap Chase/1st/Superintendent Office  Radiator Trap Chase/1st/Superintendent Office		Under Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm154 Radiator Trap Chase/1st/Rm160 Radiator Trap Chase/1st/Rm160 Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm163 Radiator Trap Chase/1st/Rm163 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		Under Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm 155 Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Superintendent Office		Under Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm 160 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 161 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		Under Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm160 Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm162 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		Under Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm161 Radiator Trap Chase/1st/Rm162 Radiator Trap Chase/1st/Rm163 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		Conference Rm to Left, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm 162 Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		Under Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm 163 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		Under Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm164 Radiator Trap Chase/1st/Ruperintendent Office Radiator Trap Chase/1st/Superintendent Office		Under Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Rm 164 Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		Under Window, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Chase/1st/Superintendent Office Radiator Trap Chase/1st/Superintendent Office		Closet in Back Right Corner, 0-5'	Manual Control Valve	3/4"
Radiator Trap Chase/1st/Superintendent Office		Far Left Wall, Under Window, 0-5'	Pneumatic Control Valve	3/4"
		Conference Rm, First Radiator on Left, 0-5'	Pneumatic Control Valve	3/4"
149576 Radiator Trap Chase/1st/Superintendent Office Conference Rm		Conference Rm, Second Radiator on	Pneumatic Control Valve	3/4"

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Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
			Left, 0-5'		
149577	Radiator Trap	Chase/1st/Superintendent Office	Conference Rm, Back Left Side, 0-5'	Pneumatic Control Valve	3/4"
149578	Radiator Trap	Chase/1st/Superintendent Office	Conference Rm, Back Right Side, 0-5'	Pneumatic Control Valve	3/4"
149579	Radiator Trap	Chase/1st/Superintendent Office	Filing Rm in Front of Entrance to Office, 0-5'	Pneumatic Control Valve	3/4"
149580	Radiator Trap	Chase/1st/Superintendent Office	Office to Right of Filing Rm, 0-5'	Pneumatic Control Valve	3/4"
149581	Radiator Trap	Chase/1st/Superintendent Office	Rm Next to Women's Bathroom, Right Window, 0-5'	Pneumatic Control Valve	3/4"
149582	Radiator Trap	Chase/1st/Superintendent Office	Rm Next to Women's Bathroom, Left Window, 0-5	Pneumatic Control Valve	3/4"
149583	Radiator Trap	Chase/1st/Superintendent Office	Back Right Office Before Superintendents Office, Left Window, 0-5'	Pneumatic Control Valve	3/4"
149584	Radiator Trap	Chase/1st/Superintendent Office	Back Right Office Before Superintendents Office, Right Window, 0-5	Pneumatic Control Valve	3/4"
149585	Radiator Trap	Chase/1st/Superintendent Office	Superintendent's Office, Right Wall, O-5'	Pneumatic Control Valve	3/4"
149586	Radiator Trap	Chase/1st/Superintendent Office	Superintendent's Office, Right Wall, 0-5'	Pneumatic Control Valve	3/4"
149587	Radiator Trap	Chase/1st/Superintendent Office	Superintendent's Office, Back Wall, 0-5'	Pneumatic Control Valve	3/4"
149588	Radiator Trap	Chase/1st/Superintendent Office	Superintendent's Office, Back Wall, 0-5'	Pneumatic Control Valve	3/4"
149589	Radiator Trap	Chase/1st/Superintendent Office	Superintendent's Office, Back Wall, 0-5'	Pneumatic Control Valve	3/4"
149590	Radiator Trap	Chase/1st/Superintendent Office	Superintendent's Office, Left Wall, 0-5'	Pneumatic Control Valve	3/4"
149591	Radiator Trap	Chase/1st/Superintendent Office	Superintendent's Office, Left Wall, 0-5'	Pneumatic Control Valve	3/4"
151916	Radiator Trap	Chase/1st/Women's Employee Bathroom	Under Window, 0-5'	Manual Control Valve	3/4"
151974	Radiator Trap	Chase/2nd/Human Resources	Under Far Right Window, 0-5'	Pneumatic Control Valve	3/4"

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Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
151975	Radiator Trap	Chase/2nd/Human Resources	Under Left Window in Front Rm, 0-5'	Pneumatic Control Valve	3/4"
151976	Radiator Trap	Chase/2nd/Human Resources	Break Rm, 0-5'	Manual Control Valve	3/4"
151977	Radiator Trap	Chase/2nd/Human Resources	First Rm of Offices Past Break Rm, 0-5'	Pneumatic Control Valve	3/4"
151978	Radiator Trap	Chase/2nd/Human Resources	Second Office Rm Past Break Rm, 0-5'	Manual Control Valve	3/4"
151980	Radiator Trap	Chase/2nd/Human Resources Back Offices	Copy Rm to Right of Entrance to Dept, 0-5'	Manual Control Valve	3/4"
151981	Radiator Trap	Chase/2nd/Human Resources Back Offices	Through Door Ahead of Entrance, First Office on Far Right, 0-5'	Pneumatic Control Valve	3/4"
151982	Radiator Trap	Chase/2nd/Human Resources Back Offices	Through Door Ahead of Entrance, First Office on Far Right, Back Rm, Right Wall, 0-5'	Pneumatic Control Valve	3/4"
151983	Radiator Trap	Chase/2nd/Human Resources Back Offices	Through Door Ahead of Entrance, First Office on Far Right, Back Rm, Back Wall, 0-5'	Pneumatic Control Valve	3/4"
151984	Radiator Trap	Chase/2nd/Human Resources Back Offices	Through Door Ahead of Entrance, Second Rm from The Right, 0-5'	Pneumatic Control Valve	3/4"
151985	Radiator Trap	Chase/2nd/Human Resources Back Offices	Through Door Ahead of Entrance, Second Rm from The Right, 0-5'	Manual Control Valve	3/4"
151986	Radiator Trap	Chase/2nd/Human Resources Back Offices	Through Door Ahead of Entrance, Rm to Far Left, 0-5'	Pneumatic Control Valve	3/4"
151987	Radiator Trap	Chase/2nd/Human Resources Back Offices	Across Hall from Personnel Director Office, 0-5'	Manual Control Valve	3/4"
151988	Radiator Trap	Chase/2nd/Human Resources Back Offices	Personnel Director Office, Left Window, 0-5'	Pneumatic Control Valve	3/4"
151989	Radiator Trap	Chase/2nd/Human Resources Back Offices	Personnel Director Office, Right Window, 0-5'	Pneumàtic Control Valve	3/4"
151990	Radiator Trap	Chase/2nd/Human Resources Back Offices	Rm to Left of Personnel Director Office, Office on Right Side, Left Window, 0-5'	Pneumatic Control Valve	3/4"
151991	Radiator Trap	Chase/2nd/Human Resources Back	Rm to Left of Personnel Director Office,	Pneumatic Control Valve	3/4"

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Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
TO THE REPORT OF THE PARTY.		Offices	Office on Right Side, Right Window, 0-5'		
151992	Radiator Trap	Chase/2nd/Human Resources Back Offices	Rm to Left of Personnel Director Office, Left Window, 0-5'	Pneumatic Control Valve	3/4"
151993	Radiator Trap	Chase/2nd/Human Resources Back Offices	Rm to Left of Personnel Director Office, Right Window, 0-5'	Pneumatic Control Valve	3/4"
152408	Radiator Trap	Chase/2nd/Human Resources Back Offices	Back Conference Rm, Left Wall, 0-5'	Pneumatic Control Valve	3/4"
152409	Radiator Trap	Chase/2nd/Human Resources Back Offices	Back Conference Rm, Back Wall, Left Window, 0-5'	Pneumatic Control Valve	3/4"
152410	Radiator Trap	Chase/2nd/Human Resources Back Offices	Back Conference Rm, Back Wall, Right Window, 0-5'	Pneumatic Control Valve	
152411	Radiator Trap	Chase/2nd/Human Resources Back Offices	Back Conference Rm, Right Wall, 0-5'	Pneumatic Control Valve	3/4"
151979	Radiator Trap	Chase/2nd/Men's Employee Bathroom	Under Window, 0-5'	Manual Control Valve	
151969	Radiator Trap	Chase/2nd/Rm 21B	Under Window, 0-5'	Pneumatic Control Valve	3/4"
151970	Radiator Trap	Chase/2nd/Rm 220	Under Window, 0-5'	Pneumatic Control Valve	3/4"
151971	Radiator Trap	Chase/2nd/Rm 222	Under Window, 0-5'	Pneumatic Control Valve	3/4"
151972	Radiator Trap	Chase/2nd/Rm 224	Under Right Window, 0-5'	Pneumatic Control Valve	3/4"
151973	Radiator Trap	Chase/2nd/Rm 224	Under Left Window, 0-5'	Pneumatic Control Valve	3/4"
151936	Radiator Trap	Chase/2nd/Rm 250	Left Front Office, Left Radiator, 0-5'	Pneumatic Control Valve	3/4"
151937	Radiator Trap	Chase/2nd/Rm 250	Left Front Office, Right Radiator, 0-5'	Manual Control Valve	-
151939	Radiator Trap	Chase/2nd/Rm 250	Back Wall, 1st Radiator from Left, 0-5'	Pneumatic Control Valve	3/4"
151940	Radiator Trap	Chase/2nd/Rm 250	Back Wall, 2nd Radiator from Left, 0-5'	Pneumatic Control Valve	3/4"
151941	Radiator Trap	Chase/2nd/Rm 250	Back Wall, 3rd Radiator from Left, 0-5'	Pneumațic Control Valve	3/4"
151942	Radiator Trap	Chase/2nd/Rm 250	Back Wall, 4th Radiator from Left, 0-5'	Pneumatic Control Valve	3/4"
151943	Radiator Trap	Chase/2nd/Rm 250	Back Wall, 5th Radiator from Left, 0-5'	Pneumatic Control Valve	3/4"
151944	Radiator Trap	Chase/2nd/Rm 250	Back Wall, Radiator to Far Right, 0-5'	Pneumatic Control Valve	3/4"

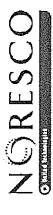


Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
151945	Radiator Trap	Chase/2nd/Rm 250	Front Wall, Right Radiator, 0-5'	Pneumatic Control Valve	3/4"
151946	Radiator Trap	Chase/2nd/Rm 250	Front Wall, Left Radiator, 0-5'	Pneumatic Control Valve	3/4"
151947	Radiator Trap	Chase/2nd/Rm 250	Right Side Conference Rm, Right Wall, 0-51	Pneumatic Control Valve	3/4"
151948	Radiator Trap	Chase/2nd/Rm 250	Right Side Conference Rm, Right Wall, 0-5'	Manual Control Vaive	3/4"
151949	Radiator Trap	Chase/2nd/Rm 250	Right Side Conference Rm, Back Wall, 0-5'	Manual Control Valve	3/4"
151950	Radiator Trap	Chase/2nd/Rm 250	Right Side Office, Left Wall, 0-5'	Pneumatic Control Valve	3/4"
151951	Radiator Trap	Chase/2nd/Rm 250	Right Side Office, Back Wall, 0-5'	Manual Control Valve	3/4"
151955	Radiator Trap	Chase/2nd/Rm 250	Connecting Office With Unnumbered Door to Hallway, 0-5'	Manual Control Valve	3/4"
151961	Radiator Trap	Chase/2nd/Rm 252	Under Window, 0-5:	Pneumatic Control Valve	3/4"
151960	Radiator Trap	Chase/2nd/Rm 253	Under Window, 0-5'	Pneumatic Control Valve	3/4"
151963	Radiator Trap	Chase/2nd/Rm 254	Under Window, 0-5:	Manual Control Valve	3/4"
151962	Radiator Trap	Chase/2nd/Rm 255	Under Window, 0-5'	Pneumatic Control Valve	3/4"
151964	Radiator Trap	Chase/2nd/Rm 263	Under Window, 0-5'	Manual Control Valve	3/4"
151958	Radiator Trap	Chase/2nd/Rm 265	Under Left Window, 0-5'	Pneumatic Control Valve	3/4"
151959	Radiator Trap	Chase/2nd/Rm 265	Under Right Window, 0-5'	Pneumatic Control Valve	3/4"
151957	Radiator Trap	Chase/2nd/Rm 267	Under Window, 0-5'	Pneumatic Control Valve	3/4"
151956	Radiator Trap	Chase/2nd/Rm 268	Under Window, 0-5'	Manual Control Valve	3/4"
151967	Radiator Trap	Chase/2nd/Rm 275	Under Left Window, 0-5'	Pneumatic Control Valve	3/4"
151968	Radiator Trap	Chase/2nd/Rm 275	Under Right Window, 0-5'	Pneumatic Control Valve	3/4"
151965	Radiator Trap	Chase/2nd/Women's Bathroom	Under Left Window, 0-5'	Manual Control Valve	3/4"
151966	Radiator Trap	Chase/2nd/Women's Bathroom	Under Right Window, 0-5'	Manual Control Valve	3/4"
152436	Radiator Trap	Chase/3rd/Information Technology	Under Window, 0-5'	Pneumatic Control Valve	3/4"



Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
152434	Radiator Trap	Chase/3rd/Information Technology Office	Under Left Window, 0-5'	Pneumatic Control Valve	3,4"
152435	Radiator Trap	Chase/3rd/Information Technology Office	Under Right Window, 0-5'	Pneumatic Control Valve	3/4"
152438	Radiator Trap	Chase/3rd/Information Technology Storage	Under Window, 0-5'	Pneumatic Control Valve	3/4"
152433	Radiator Trap	Chase/3rd/Information Technology Storage (Break Rm)	Under Window, 0-5'	Pneumatic Control Valve	3/4"
152429	Radiator Trap	Chase/3rd/Men's Bathroom	Under Right Window, 0-5'	Manual Control Valve	3/4"
152430	Radiator Trap	Chase/3rd/Men's Bathroom	Under Left Window, 0-5'	Manual Control Valve	3/4"
152423	Radiator Trap	Chase/3rd/Rm 302	Under Window, 0-5′	Manual Control Valve	3/4"
152478	Radiator Trap	Chase/3rd/Rm 303	Left Window, 0-5'	Pneumatic Control Valve	3/4"
152479	Radiator Trap	Chase/3rd/Rm 303	Right Window, 0-5'	Pneumatic Control Valve	3/4"
152419	Radiator Trap	Chase/3rd/Rm 305	Under Window, 0-5'	Pneumatic Control Valve	3/4"
152418	Radiator Trap	Chase/3rd/Rm 307	Under Window, 0-5'	Pneumatic Control Valve	3/4"
151994	Radiator Trap	Chase/3rd/Rm 310	First Radiator Along Right Wall, 0-5'	Manual Control Valve	3/4"
151995	Radiator Trap	Chase/3rd/Rm 310	Second Radiator Along Right Wall, 0-5'	Pneumatic Control Valve	3/4"
151996	Radiator Trap	Chase/3rd/Rm 310	Office in Back Right Corner, Back Wall, 0-5'	Manual Control Valve	3/4"
151997	Radiator Trap	Chase/3rd/Rm 310	Office in Back Right Corner,Right Wall, 0-5'	Manual Control Valve, Valved Out	3/4"
151998	Radiator Trap	Chase/3rd/Rm 310	Back Wall, 1st Radiator from Right, 0-5'	Pneumatic Control Valve.	3/4"
151999	Radiator Trap	Chase/3rd/Rm 310	Back Wall, 2nd Radiator from Right, 0-5'	Pneumatic Control Valve	3/4"
152000	Radiator Trap	Chase/3rd/Rm 310	First Office Along Back Wall When Heading Left from Entrance, 0-5'	Pneumatic Control Valve	3/4"
152401	Radiator Trap	Chase/3rd/Rm 310	Second Office on Right, Across from Printers, 0-5'	Pneumatic Control Valve	3/4"

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Radiator Valve Size	<b>z</b> .				: :: :: :: :: :: :: :: :: :: :: :: :: :		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				= .		***************************************		-	Particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and particular and partic	<b>t</b>	
Re	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"
Comments	Manual Control Valve	Manual Control Valve	Manual Control Valve	Pneumatic Control Valve	Manual Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve, Radiator Valve Stuck Open	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve
Trap Location/Elevation	First Office on Left Down Hallway, Left Window, 0-5'	First Office on Left Down Hallway, Right Window, 0-5'	Fourth Office on Right Down Hallway, 0-5'	Second Office on Left Down Hallway, 0-5'	Past Fourth Office on Right Down Hallway, Under Window, 0-5'	Down Hallway to Left, Under Window Straight Ahead, 0-5	Down Hallway to Left, Around Corner 8y Fridge, 0-5'	Conference Rm, 0-5'	Conference Rm, Left Window, 0-5'	Office Down Hallway to Left, in Back Right Corner, Back Wall, 0-5'	Office Down Halfway to Left, in Back Right Corner, Right Wall, 0-5'	Under Window, 0-5'	Under Window, 0-5'	Under Window, 0-5'	Under Right Window, 0-5'	Under Left Window, 0-5'	First Radiator on Left Wall, 0-5'	Second Radiator on Left Wall, 0-5"
Building/Floor/Room	Chase/3rd/Rm 310	Chase/3rd/Rm 310	Chase/3rd/Rm 310	Chase/3rd/Rm 310	Chase/3rd/Rm 310	Chase/3rd/Rm 310	Chase/3rd/Rm 310	Chase/3rd/Rm 310	Chase/3rd/Rm 310	Chase/3rd/Rm 310	Chase/3rd/Rm 310	Chase/3rd/Rm 319	Chase/3rd/Rm 341	Chase/3rd/Rm 344	Chase/3rd/Rm 354	Chase/3rd/Rm 354	Chase/3rd/Rm 360	Chase/3rd/Rm 360
Application	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap
Trap Tag #	152402	152403	152405	152406	152407	152414	152415	152416	152417	152420	152421	152439	152424	152427	152431	152432	152440	152441



Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
152442	Radiator Trap	Chase/3rd/Rm 360	Third Radiator on Left Wall, 0-5'	Pneumatic Control Valve	3/4"
152443	Radiator Trap	Chase/3rd/Rm 360	Back Wall, Far Left Radiator, 0-5'	Pneumatic Control Valve	3/4"
152444	Radiator Trap	Chase/3rd/Rm 360	Back Wall, Left-Middle Radiator, 0-5'	Pneumatic Control Valve	3/4"
152445	Radiator Trap	Chase/3rd/Rm 360	Back Wall, Right-Middle Radiator, 0-5'	Pneumatic Control Valve	3/4"
152446	Radiator Trap	Chase/3rd/Rm 360	Back Wall, Far Right Radiator, 0-5'	Pneumatic Control Valve	3/4"
152447	Radiator Trap	Chase/3rd/Rm 360	Conference Rm 1, 0-5	Pneumatic Control Valve	3/4"
152412	Radiator Trap	Chase/3rd/School Inspectors Office	Under Right Window, 0-5'	Pneumatic Control Valve	3/4"
152413	Radiator Trap	Chase/3rd/School Inspectors Office	Under Middle Window, 0-5'	Pneumatic Control Valve	3/4"
152425	Radiator Trap	Chase/3rd/School Inspectors Office	Under Left Window, 0-5'	Pneumatic Control Valve	3/4"
152426	Radiator Trap	Chase/3rd/School Inspectors Office	School Inspector Private Office to Left, 0-5:	Pneumatic Control Valve	3/4"
152422	Radiator Trap	Chase/3rd/Women's Bathroom	Under Window, 0-5	Manual Control Valve	3/4"
152480	Radiator Trap	Chase/4th/Assistant Chief's Office	Under Left Window, 0-5'	Pneumatic Control Valve	3/4"
152481	Radiator Trap	Chase/4th/Assistant Chief's Office	to Right of Outside Door, 0-5'	Pneumatic Control Valve	3/4"
152454	Radiator Trap	Chase/4th/Dept of Education Business Office	Cubicle in Back Right Corner of Rm, Under Window on Back Wall, 0-5	Pheumatic Control Valve	3/4"
152455	Radiator Trap	Chase/4th/Dept of Education Business Office	Cubicle in Back Right Corner of Rm, Under Window on Right Wall, 0-5'	Pneumatic Control Valve	3/4"
152456	Radiator Trap	Chase/4th/Dept of Education Business Office	Along Right Wall, Second Window from Back Wall, 0-5'	Pheumatic Control Valve	3/4"
152457	Radiator Trap	Chase/4th/Dept of Education Business Office	Along Right Wall, Third Window from Back Wall, 0-5'	Pneumatic Control Valve	3/4"
152458	Radiator Trap	Chase/4th/Dept of Education Business Office	Along Right Wall, Fourth Window from Back Wall., 0-51	Pneumatic Control Valve	3/4"
152461	Radiator Trap	Chase/4th/Men's Bathroom	Under Window, 0-5'	Manual Control Valve	3/4"
152464	Radiator Trap	Chase/4th/Rm 402	Under Left Window, 0-5'	Pneumatic Control Valve	3/4"
152465	Radiator Trap	Chase/4th/Rm 402	Under Right Window, 0-5'	Pneumatic Control Valve	3/4"

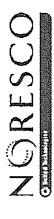
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Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
Radiator Trap   Chase/4th/Waterbury Fire Dept Administration		Rm to Left of Entrance, 0-5'	Pneumatic Control Valve	3/4"
Radiator Trap Administration		Desks Along Left Wall, Right Window, 0-5'	Thermostatic Control Valve	3/4"
Radiator Trap   Chase/4th/Waterbury Fire Dept Administration		Office in Back Left Corner of Dept, Middle Window, 0-5	Thermostatic Control Valve	3/4"
Radiator Trap Chase/4th/Waterbury Fire Dept Administration		Fire Chief's Office, Back Office, Along Back Wall, 0-5'	Thermostatic Control Valve	3/4"
Radiator Trap Chase/4th/Women's Bathroom		Under Left Window, 0-5'	Manual Control Valve	3/4"
Radiator Trap Chase/4th/Women's Bathroom	, i	Under Right Window, 0-5'	Manual Control Valve	3/4"
Radiator Trap   Chase/Basement/Electric Shop		Above Garage Door, 0-5'	Manual Control Valve	ŧ
Radiator Trap   Chase/Basement/Garage	2000	Above Garage Door, 5-10'	Manual Control Valve	11/4"
Radiator Trap   Chase/Basement/Garage		Above Double Doors, 5-10'	Manual Control Valve	11/4"
Radiator Trap Chase/Basement/Garage		Next to Garage Door, 0-5'	Manual Control Valve	11/4"
Radiator Trap Chase/Basement/Garage		Next to Double Doors, 0-5'	Manual Control Valve	17/4"
Radiator Trap   Chase/Basement/Parts Office		Middle of Rm in Ceiling, 5-10'	Manual Control Valve	3/4"
Radiator Trap   Chase/Basement/Stairwell		Next to Door to Garage, 0-5'	Manual Control Valve	-

Table 23: Chase School Control Valve Audit Sorted by Trap Tag Number

Trap Tag #	Frap Tag # Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
154230	Radiator Trap	Radiator Trap Chase School/1st/Boy's Restroom	Left Wall, 0-5'	Manual Control Valve	3/4"
154206	Radiator Trap	Chase School/1st/Boy's Restroom in Gym Around Corner, 0-5' Entrance	Around Corner, 0-5'	Pneumatic Control Valve	3/4"
154237	Radiator Trap	Chase School/1st/Boy's Restroom, Near F115	Under Window, 0-5'	Pneumatic Control Valve	3/4"



Titap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
154226	Radiator Trap	Chase School/1st/F102	Back Left Corner, Behind Access Panel, 0-5:	Pneumatic Control Valve	ŧ.
154227	Radiator Trap	Chase School/1st/F103	Back Right Corner, Behind Access Panel, 0-5'	Pneumatic Control Valve	-
154228	Radiator Trap	Chase School/1st/F104	Back Right Corner, Behind Access Panel, 0-5	Pneumatic Control Valve	=
154231	Radiator Trap	Chase School/1st/F105	Back Right Corner, Behind Access Panel, 0-5'	Pneumatic Control Valve	
154232	Radiator Trap	Chase School/1st/F106	Right End of Radiator, Behind Access Panel, 0-5	Pneumatic Control Valve	
154233	Radiator Trap	Chase School/1st/F107	Behind Teachers Desk, Behind Access Panel, 0-5'	Pneumatic Control Valve	
154234	Radiator Trap	Chase School/1st/F113	Back Left Corner, 0-5'	Pneumatic Control Valve	3/4"
154243	Radiator Trap	Chase School/1st/F113	Back Right Corner, 0-5'	Pneumatic Control Valve	3/4"
154235	Radiator Trap	Chase School/1st/F115	Back Left Corner, 0-5'	Pneumatic Control Valve	3/4"
154245	Radiator Trap	Chase School/1st/F115	Back Right Corner, 0-5'	Pneumatic Control Valve	3/4"
154239	Radiator Trap	Chase School/1st/F116	Center Left of Back Wall, 0-5!	Pneumatic Control Valve	3/4"
154240	Radiator Trap	Chase School/1st/F116	Center Right of Back Wall, 0-5'	Pneumatic Control Valve	3/4"
154238	Radiator Trap	Chase School/1st/F117	Back Right Corner, 0-5'	Pneumatic Control Valve	3/4"
154242	Radiator Trap	Chase School/1st/F117	Back Left Corner, 0-5'	Pneumatic Control Valve	3/4"
154241	Radiator Trap	Chase School/1st/F118	Back Left Corner, 0-5'	Pneumatic Control Valve	3/4"
154229	Radiator Trap	Chase School/1st/Girls Restroom	Right Wall, 0-5'	Manual Control Valve	3/4"
154236	Radiator Trap	Chase School/1st/Girls Restroom Near F115	Under Window, 0-5"	Pneumatic Control Valve	3/4"
154207	Radiator Trap	Chase School/1st/Girls Restroom Near Gym Entrance	Around Corner, 0-5'	Pneumatic Control Valve	3/4"
154204	Radiator Trap	Chase School/1st/Gym Entrance	Right Wall, 0-5	Pneumatic Control Valve	3/4"

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Radiator Valve Size	3/4"	3/4"	e 3/4"	3/4"	2	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s	1/2"	e 3/4"	1/2"	e 3/4"	1/2"	-	Ę	e 3/4"	<u>*</u>	=	
Comments	Manual Control Valve	Manual Control Valve	Pneumatic Control Valve	No Components	Manual Control Valve	Manual Control Valve	Manual Control Valve	Pheumatic Control Valve	Manual Control Valve	Pneumatic Control Valve	Manual Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve
Trap Location/Elevation	Outside F118, 0-5'	Right Wall, 0-5	Under Window, 0-5'	Back Wall, 0-5'	Landing Between 1st-2 nd Floors, O-5'	Right Wall, 0-5	Left Wall, 0-5'	Back Wall, 0-5'	Right Wall, 0-5'	Back Wall, 0-5'	Under Window, 0-5'	Behind Teachers Desk, Behind Access Panel, 0-5'	Back Left Corner, Behind Access Panel, 0-5'	Behind Teachers Desk, Inside Access Panel, 0-5'	Behind Teachers Desk, Inside Access Panel, 0-5'	Near Teachers Desk Under Radiator Vent, 0-5'	Behind Teachers Desk, Inside Access
Building/Floor/Room	Chase School/1st/Hallway	Chase School/1st/Main Entrance	Chase School/1st/Main Office	Chase School/1st/Social Workers Office Near Gym	Chase School/1st/Stairwell C	Chase School/1st/Stairwell E	Chase School/2nd/Boys Restroom, Across from Library	Chase School/2nd/Boys Restroom, Kindergarten Wing	Chase School/2nd/Girls Restroom, Across from Library	Chase School/2nd/Girls Restroom, Kindergarten Wing	Chase School/2nd/Meeting Rm	Chase School/2nd/S100	Chase School/2nd/S102	Chase School/2nd/S103	Chase School/2nd/S104	Chase School/2nd/S108	Chase School/2nd/S112
Application	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap
Trap Tag #	136273	136271	154225	154205	136274	136276	154218	154202	154219	154211	154222	154224	154223	154221	154220	154215	154214

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Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
154216	Radiator Trap	Chase School/2nd/S113	Behind Computers, in Access Panel, 0-5'	Pneumatic Control Valve	ul
154212	Radiator Trap	Chase School/2nd/S116	Back Left Corner Behind Access Door, 0-5'	Pneumatic Control Valve	=
154201	Radiator Trap	Chase School/2nd/S117	Under Left Radiator, 0-5'	Preumatic Control Valve	3/4"
154246	Radiator Trap	Chase School/2nd/S117	Back Right Corner, 0-5'	Pneumatic Control Valve	3/4"
154210	Radiator Trap	Chase School/2nd/5118	Behind Teachers Desk, 0-5'	Pneumatic Control Valve	3/4"
154208	Radiator Trap	Chase School/2nd/5119	Left Radiator, 0-5'	Pneumatic Control Valve	
154209	Radiator Trap	Chase School/2nd/5120	Back Right Corner, 0-5'	Pneumatic Control Valve	Į.
154244	Radiator Trap	Chase School/2nd/S120	Center Left Under Radiator, 0-5'	Pneumatic Control Valve	3/4"
154213	Radiator Trap	Chase School/2nd/S121	Back Left Corner, 0-5'	Pneumatic Control Valve	
136277	Radiator Trap	Chase School/2nd/Stairwell A	Top Landing, 0-5'	Manual Control Valve	-
154203	Radiator Trap	Chase School/2nd/Stairwell D	By Exit, 0-5'	Manual Control Valve	3/4"
136281	Radiator Trap	Chase School/Basement/B104	Back Right Corner, 0-5'	Pneumatic Control Valve	3/4"
136285	Radiator Trap	Chase School/Basement/B108	Above Small Shelves, 0-5'	Pneumatic Control Valve	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
136282	Radiator Trap	Chase School/Basement/B109	Left Radiator, 0-5'	Pneumatic Control Valve	-
136314	Radiator Trap	Chase School/Basement/B109	Right Radiator, 0-5'	Pneumatic Control Valve	
136268	Radiator Trap	Chase School/Basement/B110	Under Window, 0-5'	Pneumatic Control Valve	-
136288	Radiator⊤rap	Chase School/Basement/B111	Back Radiator, 0-51	Thermostatic Control Valve	11/4"
136279	Radiator Trap	Chase School/Basement/Boys Restroom	Along Wall, 0-5'	Manual Control Valve	3/4"
136289	Radiator Trap	Chase School/Basement/Girls Restroom	Back Wall, 0-5'	Manual Control Valve	3/4"
136278	Radiator Trap	Chase School/Basement/Guidance Councilor's Office	Under Window, 0-5'	Pneumatic Control Valve	3/4"
136266	Radiator Trap	Chase School/Basement/Hallway	Outside B110, 0-5'	Thermostatic Control Valve	11/4"
136275	Radiator Trap	Chase School/Basement/Nurses Office	Under Window, 0-5'	Pneumatic Control Valve	3/4"
136270	Radiator Trap	Chase School/Basement/Stairwell	Landing Between Basement and 1st Floor, 0-5'	Manual Control Valve	

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Comments Radiator Valve Size	Manual Control Valve 11/2"	Manual Control Valve
Trap Location/Elevation	Landing Between Basement and 1st Floor, 0-5'	Landing Between Basement and 1st Floor, 0-5
Building/Floor/Room	Radiator Trap Chase School/Basement/Stairwell B	Radiator Trap Chase School/Basement/Stairwell B
Application	Radiator Trap	Radiator Trap
Trap Tag #	136290	136291

Table 24: Driggs School Control Valve Audit Sorted by Trap Tag Number

Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
156189	Radiator Trap	Driggs/1st/Copy Rm	Back Left, 0-5'	Manual Control Valve	=
156199	Radiator Trap	Driggs/1st/F102	Left Side of Window, 0-5'	Manual Control Valve	E
156190	Radiator Trap	Driggs/1st/F105	Back Left Corner, 0-5'	Manual Control Valve	
156191	Radiator Trap	Driggs/1st/F106	Back Left, 0-5'	Manual Control Valve	
156193	Radiator Trap	Driggs/1st/F107	Back Left, 0-5'	Manual Control Valve	
156194	Radiator Trap	Driggs/1st/F109	Right Corner Behind Tan Cabinet, 0-5'	Manual Control Valve	
143307	Radiator Trap	Driggs/1st/F112	Left Wall, Left Corner, 0-5'	Manual Control Valve	=_
143303	Radiator Trap	Driggs/1st/F115	Back Left; 0-5'	Manual Control Valve	
143309	Radiator Trap	Driggs/1st/Girl's Bathroom Outside F112 and F111	Under Window, 0-5'	Manual Control Valve	
156195	Radiator Trap	Driggs/1st/Gymnasium	Stage, 0-51	Manual Control Valve	Section 2015
156192	Radiator Trap	Driggs/1st/Hallway	Across from F106, 0-5'	Manual Control Valve	
143305	Radiator Trap	Driggs/1st/Hallway Outside F114	Under Wi-Fi Router, 0-5'	Manual Control Valve	1
143301	Radiator Trap	Driggs/1st/Main Office	Under Window, Right Side, 0-5'	Manual Control Valve	
156200	Radiator Trap	Driggs/1st/Men's Bathroom Main Office	Under Window, 0-5'	Manual Control Valve	E .
143302	Radiator Trap	Driggs/1st/Parent Liaison Office	Back Left Corner, 0-5'	Manual Control Valve	21 T 1
156198	Radiator Trap	Driggs/1st/Stairwell Behind Gymnasium	Under Window, 0-5	Manual Control Valve	and the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of t



Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
149030	Radiator Trap	Driggs/2nd/Hallway	Across from S115, 0-5'	Manual Control Valve	3/4"
149036	Radiator Trap	Driggs/2nd/Men's Restroom By S112	Under Window, 0-5	Manual Control Valve	3/4"
149043	Radiator Trap	Driggs/2nd/S104	Under Window, 0-5'	Manual Control Valve	
149044	Radiator Trap	Driggs/2nd/S106	Back Right Corner, 0-51	Thermostatic Control Valve	1/4
149046	Radiator Trap	Driggs/2nd/S107	Back Right Corner, 0-5'	Thermostatic Control Valve	11/4"
149047	Radiator Trap	Driggs/2nd/S108	Under Window, 0-5'	Manual Control Valve	
149048	Radiator Trap	Driggs/2nd/S109	Back Right Corner, 0-5'	Manual Control Valve	-
149037	Radiator Trap	Driggs/2nd/5111	Behind Computers, 0-5'	No Components	X
149049	Radiator Trap	Driggs/2nd/S113	Back Left Corner, 0-5'	Manual Control Valve	ΝΑ
149039	Radiator Trap	Driggs/2nd/Women's Restroom By S119	Under Window, 0-5	Manual Control Valve	3/4"
149033	Radiator Trap	Driggs/Basement/8110	Above Entrance, 5-10'	Check Valve	11/2"
149031	Radiator Trap	Driggs/Basement/Men's Restroom at Bottom of Stairs	Back Left Corner, 5-10'	No Components	11/2"
149032	Radiator Trap	Driggs/Basement/Men's Restroom at Bottom of Stairs	Above Urinals in Corner, 5-10'	No Components	11/4"
149025	Radiator Trap	Driggs/Basement/Restroom By Sprinkler Area	Back Left Corner, 5-10'	No Components	17/4"
149023	Radiator Trap	Driggs/Basement/Sprinkler Valve Area	Next to Sprinkler Valves, 5-10'	No Components	11/2"

Table 25: Generali School Control Valve Audit Sorted by Trap Tag Number

Comments Radiator Valve Size	Pneumatic Control Valve 1"	Pneumatic Control Valve 1"	Pneumatic Control Valve 1"
Trap Location/Elevation	Under Window, 0-5'	Right Wall, 0-51	Under Window, 0-5'
Building/Floor/Room	Radiator Trap Generali/2nd/Boy's Bathroom	Radiator Trap   Generall/2nd/Boy's Bathroom	Radiator Trap   Generali/2nd/Girl's Bathroom
Application	Radiator Trap	Radiator Trap	Radiator Trap
Trap Tag #	143232	143242	143241

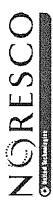


#Ağelli devili	# Application	Building/Floor/Room	Trap Location/Elevation	Comments	valve Size
143243	Radiator Trap	Generali/2nd/Hallway	Across from S107, 0-5	Pneumatic Control Valve	-
143233	Radiator Trap	Generali/2nd/S104, Right Door	Left Windows, 0-5'	Pneumatic Control Valve	<b>.</b>
143234	Radiator Trap	Generali/2nd/S104, Right Door	Across from Door, Under Window, 0-5'	Pneumatic Control Valve	
143235	Radiator Trap	Generali/2nd/S105	Back Left, 0-5'	Pneumatic Control Valve	
143236	Radiator Trap	Generali/2nd/S106	Back Left, 0-5'	Pneumatic Control Valve	
143237	Radiator Trap	Generali/2nd/S107	Back Left, 0-5'	Pneumatic Control Valve	
143240	Radiator Trap	Generali/2nd/5108	Back Left, 0-5'	Pneumatic Control Valve	
143239	Radiator Trap	Generali/2nd/S109	Back Right, 0-5'	Pneumatic Control Valve	
143238	Radiator Trap	Generali/2nd/S110	Back Right, 0-5'	Pneumatic Control Valve	

Table 26: Hopeville School Control Valve Audit Sorted by Trap Tag Number

Trap Tag #	# Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
143	Radiator Trap	Hopeville/1st/Boy's Bathroom	Near F106, 0-5'	Pneumatic Control Valve	
143229	Radiator Trap	Hopeville/1st/F104	Back Right, 0-5'	Pneumatic Control Valve	
143230	Radiator Trap	Hopeville/1st/F105	Back Right, 0-5'	Pneumatic Control Valve	
143228	Radiator Trap	Hopeville/1st/F107	Back Left, 0-5'	Pheumatic Control Valve	
143227	Radiator Trap	Hopeville/1st/Girl's Bathroom	Under Window, 0-5'	Pneumatic Control Valve	2
143392	Radiator Trap	Hopeville/1st/Main Corridor	Outside F114, 0-5'	Manual Control Valve	=
143393	Radiator Trap	Hopeville/1st/Main Entrance	Right Side, 0-5'	Manual Control Valve	=
143394	Radiator Trap	Hopeville/1st/Main Entrance	Left Side, 0-5'	Manual Control Valve	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
143390	Radiator Trap	Hopeville/1st/Rear Stairwell	Across from F106, 0-5'	Manual Control Valve	
143397	Radiator Trap	Hopeville/1st/Stairwell Across from F114	Right Wall, 0-5'	Manual Control Valve	
143231	Radiator Trap	Hopeville/1st/Teacher Lounge	Under Window, 0-5'	Pneumatic Control Valve	-
143225	Radiator Trap	Hopeville/2nd/F106	Back Right, 0-5'	Pneumatic Control Valve	

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Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
143223	Radiator Trap	Hopeville/2nd/F108	Back Right, 0-5'	Pneumatic Control Valve	=
14326	Radiator Trap	Hopeville/2nd/F109A	Left Window, 0-5'	Pneumatic Control Valve	=
143224	Radiator Trap	Hopeville/2nd/F109B	2nd Window from Right, 0-5'	Pneumatic Control Valve	
143220	Radiator Trap	Hopeville/2nd/F113	Back Right, 0-51	Pneumatic Control Valve	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
143218	Radiator Trap	Hopeville/2nd/F114	Back Left, 0-5'	Pneumatic Control Valve	
143209	Radiator Trap	Hopeville/2nd/Girl's Bathroom	Under Window, 0-5'	Pneumatic Control Valve	2
143201	Radiator Trap	Hopeville/2nd/Hall	Outside S114, 0-5'	Manual Control Valve	
143203	Radiator Trap	Hopeville/2nd/Hall	Outside Girl's Bathroom, 0-5	Manual Control Valve	and the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of t
143204	Radiator Trap	Hopeville/2nd/Hall	Outside S101, 0-5'	Manual Control Valve	<u> </u>
143221	Radiator Trap	Hopeville/2nd/Main Office	Back Right; 0-5'	Pneumatic Control Valve	= [
143222	Radiator Trap	Hopeville/2nd/Main Office Bathroom	Under Window, 0-5'	Pneumatic Control Valve	-
143219	Radiator Trap	Hopeville/2nd/Principal's Office	Under Window, 0-5'	Pneumatic Control Valve	a control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la Control de la
143208	Radiator Trap	Hopeville/2nd/S100	Back Left, 0-5'	Pneumatic Control Valve	-
143205	Radiator Trap	Hopeville/2nd/S101	Under Window, 0-5'	Pneumatic Control Valve	
143207	Radiator Trap	Hopeville/2nd/S102	Back Right, 0-5'	Pneumatic Control Valve	=
143206	Radiator Trap	Hopeville/2nd/S103	Back Right, 0-5†	Pheumatic Control Valve	and the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second s
143211	Radiator Trap	Hopeville/2nd/S104	Back Right, 0-5'	Pneumatic Control Valve	=
143210	Radiator Trap	Hopeville/2nd/S105	Back Left; 0-5'	Pneumatic Control Valve	F.
143212	Radiator Trap	Hopeville/2nd/S106	Back Left, 0-5'	Pneumatic Control Valve	-
143216	Radiator Trap	Hopeville/2nd/S107	Back Right, 0-51	Pneumatic Control Valve	And the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of t
143213	Radiator Trap	Hopeville/2nd/S108	Back Right, 0-5'	Manual Control Valve	***
143	Radiator Trap	Hopeville/2nd/S109	Back Left, 0-5'	Manual Control Valve	
143215	Radiator Trap	Hopeville/2nd/S111	Back Left, 0-5'	Pneumatic Control Valve	
143214	Radiator Trap	Hopeville/2nd/S113	Back Right, 0-5'	Pneumatic Control Valve	A Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Comp
143400	Radiator Trap	Hopeville/2nd/S114	Left of Window, 0-5'	Pneumatic Control Valve	



Radiator Valve Size	-	<u> </u>	and the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second 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second second second second second second second second second second second second second second second second second second second second second second second se		=	#		<u>.</u>
Comments	Manual Control Valve	Manual Control Valve	Manual Control Valve	No Components	Manual Control Valve	Manual Control Valve	Manual Control Valve	No Components	Manual Control Valve	Manual Control Valve	Manual Control Valve	Manual Control Vaive	Manual Control Valve	Manual Control Valve
Trap Location/Elevation	Top of Stairs, 0-5'	Right Side, 0-5'	Over Stall, 5-10'	Windows, 5-10'	In Private Stall, 5-10'	Over Stall, 5-10'	Across from B102, 0-5'	Back Left, Window, 5-10'	Right of Doors, 5-10'	Right of Windows, 5-10'	Left Wall, 0-5'	Right Wall, 0-5'	Left Side, 0-5"	Right, 0-5'
Building/Floor/Room	Hopeville/2nd/Stairwell Across from S104	Hopeville/2nd/Stairwell Across from 5114	Hopeville/Basement/Boy's Bathroom	Hopeville/Basement/Cafe	Hopeville/Basement/Girl's Bathroom	Hopeville/Basement/Girl's Bathroom	Hopeville/Basement/Hallway	Hopeville/Basement/Paper Storage	Hopeville/Basement/Rear Entrance to Cafe	Hopeville/Basement/Stairwell Outside Library	Hopeville/Between 1st and Basement/Left Entrance	Hopeville/Between 1st and Basement/Left Entrance	Hopeville/Between 1st and Basement/Stairwell to Gym Balcony	Hopeville/Between 1st and Gymnasium Balcony/Stairwell
Application	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap
Trap Tag#	143217	143399	143383	143376	143	143384	143386	143375	143389	143398	143	143387	143395	143



Table 27: Kennedy High School Control Valve Audit Sorted by Trap Tag Number

Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
155239	Radiator Trap	Kennedy/1st/Bathroom	Along Left Wall, 5-10'	Pneumatic Radiator Valve	3/4"
155344	Radiator Trap	Kennedy/2nd/Rm 150	Under Window, Right Side, 0-5'	Pneumatic Radiator Valve	
155345	Radiator Trap	Kennedy/2nd/Rm 151	Under Window, Far Left Side, 0-5'	Pneumatic Radiator Valve	-
155346	Radiator Trap	Kennedy/2nd/Rm 152	Under Window, Left Side, 0-5	Pheumatic Radiator Valve	3/4"
155348	Radiator Trap	Kennedy/2nd/Rm 153	Back Wall, Left Side, 0-5'	Pneumatic Radiator Valve	3/4"
155350	Radiator Trap	Kennedy/2nd/Rm 153	Storage Rm to Left of 153, 5-10'	Pneumatic Radiator Valve	3/4"
155351	Radiator Trap	Kennedy/2nd/Rm 154	Under Window, Right Side, 0-5'	Pneumatic Radiator Valve	3/4"
155353	Radiator Trap	Kennedy/2nd/Rm 155	Under Window, Left Side, 0-5'	Pneumatic Radiator Valve	3/4"
155352	Radiator Trap	Kennedy/2nd/Rm 156	Under Window, Left Side, 0-5'	Pneumatic Radiator Valve	3/4"
155355	Radiator Trap	Kennedy/2nd/Rm157	Under Window, Left Side, 0-5	Pneumatic Radiator Valve	3/4"
155354	Radiator Trap	Kennedy/2nd/Rm 158	Under Window, Right Side, 0-5'	Pneumatic Radiator Valve	3/4"
155356	Radiator Trap	Kennedy/2nd/Rm at End of Hallway Next to Rm 155	Above Outside Doors, 5-10'	Pneumatic Radiator Valve	3/4"
155357	Radiator Trap	Kennedy/2nd/Staircase Next to Rm 158	Next to Outside Doors, 0-5'	Pneumatic Radiator Valve	1/2"
155370	Radiator Trap	Kennedy/3rd/Auditorium	Back Wall of Stage, 0-5'	Pneumatic Radiator Valve	3/4"
155375	Radiator Trap	Kennedy/3rd/Bathroom to Right of Athletic Directors Office	Back Wall, 0-5'	Pneumatic Radiator Valve	1/2"
155369	Radiator Trap	Kennedy/3rd/Boy's Bathroom	Under Window, 0-5'	Pneumatic Radiator Valve	3/4"
155373	Radiator Trap	Kennedy/3rd/Boy's Bathroom Near Cafeteria	Back Wall, 5-10'	Pneumatic Radiator Valve	1/2"
155377	Radiator Trap	Kennedy/3rd/Boy's Bathroom Near Rm 131	Back Wall, 0-5'	Pneumatic Radiator Valve	1/2"
155364	Radiator Trap	Kennedy/3rd/Faculty Cafeteria	Along Wall, 0-5'	Pneumatic Radiator Valve	1/2"
155368	Radiator Trap	Kennedy/3rd/Girl's Bathroom	Under Window, 0-5'	Pneumatic Radiator Valve	1/2"
155374	Radiator Trap	Kennedy/3rd/Girl's Bathroom Near	Back Wall, 0-5'	Pneumatic Radiator Valve	1/2"



Thap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Соттент	Radiator Valve Size
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155376	Radiator Trap	Kennedy/3rd/Girl's Bathroom Near Rm 131	Back Wall, 0-5'	Pneumatic Radiator Valve	1/2"
155337	Radiator Trap	Kennedy/3rd/Hallway	to Right of Media Center Entrance, 0-5'	Pneumatic Radiator Valve	-
155338	Radiator Trap	Kennedy/3rd/Hallway	By Stairs Near Rm 123, 0-5'	Pneumatic Radiator Valve	1/2"
155339	Radiator Trap	Kennedy/3rd/Hallway	Next to Outside Doors Near Rm 123, 0-5'	Pneumatic Radiator Valve	1/2"
155340	Radiator Trap	Kennedy/3rd/Hallway	Across from Support Services, 0-5'	Pneumatic Radiator Valve	3/4"
155341	Radiator Trap	Kennedy/3rd/Hallway	Stairwell Next to Rm 120, 0-5'	Pneumatic Radiator Valve	1/2"
155342	Radiator Trap	Kennedy/3rd/Hallway	Stairwell Next to Rm 110, 0-5'	Pneumatic Radiator Valve	1/2"
155343	Radiator Trap	Kennedy/3rd/Hallway	Near Entrance to Pool, 0-5'	Pneumatic Radiator Valve	1/2"
155367	Radiator Trap	Kennedy/3rd/Rm 105	Under Window, 0-5'	Pneumatic Radiator Valve	3/4"
155334	Radiator Trap	Kennedy/3rd/Rm 107	Under Window, Left Side, 0-5'	Pneumatic Radiator Valve	3/4"
155332	Radiator Trap	Kennedy/3rd/Rm 109	Under Window, Left Side, 0-5'	Pneumatic Radiator Valve	3/4"
155336	Radiator Trap	Kennedy/3rd/Rm 110	Under Window, Left Side, 0-5'	Pneumatic Radiator Valve	3/4"
155330	Radiator Trap	Kennedy/3rd/Rm 111	Under Window, Left Side, 0-5	Pneumatic Radiator Valve	design of the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second se
155335	Radiator Trap	Kennedy/3rd/Rm 112	Under Window, Left Side, 0-5'	Pneumatic Radiator Valve	<u>-</u>
155333	Radiator Trap	Kennedy/3rd/Rm 114	Under Window, Left Side, 0-5	Pneumatic Radiator Valve	3/4"
155331	Radiator Trap	Kennedy/3rd/Rm 116	Under Window, Left Side, 0-5'	Pneumatic Radiator Valve	3/4"
155329	Radiator Trap	Kennedy/3rd/Rm 118	Under Window, 0-5'	Pneumatic Radiator Valve	3/4"
155328	Radiator Trap	Kennedy/3rd/Rm 120	Under Window, 0-5'	Pneumatic Radiator Valve	3/4"
155366	Radiator Trap	Kennedy/3rd/Rm 121	Social Worker Office, 0-5'	Pneumatic Radiator Valve	3/4"
155325	Radiator Trap	Kennedy/3rd/Rm 122	Back Left Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155323	Radiator Trap	Kennedy/3rd/Rm 123	Back Left Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155324	Radiator Trap	Kennedy/3rd/Rm 123	Middle Left of Back Wall, 0-5'	Pneumatic Radiator Valve	-
155321	Radiator Trap	Kennedy/3rd/Rm 124	Back Right Corner, 0-5'	Pneumatic Radiator Valve	3/4"



Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Соттенть	Radiator Valve Size
155322	Radiator Trap	Kennedy/3rd/Rm 124	Back Left Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155320	Radiator Trap	Kennedy/3rd/Rm 125	Back Right Corner, 0-51	Pneumatic Radiator Valve	3/4"
155310	Radiator Trap	Kennedy/3rd/Rm 130	Under Window, 0-5'	Pneumatic Radiator Valve	3/4"
155311	Radiator Trap	Kennedy/3rd/Rm 131A	Middle of Back Wall, Right Radiator, 0-5'	Pheumatic Radiator Valve	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
155327	Radiator Trap	Kennedy/3rd/Rm 131A	Under Window, Left of Middle, 0-5'	Pneumatic Radiator Valve	3/4"
155312	Radiator Trap	Kennedy/3rd/Rm 132	Back Left Corner, 0-5'	Pneumatic Radiator Valve	
155316	Radiator Trap	Kennedy/3rd/Rm 133	Back Left Corner, 0-5'	Pneumatic Radiator Valve	<b>2</b>
155314	Radiator Trap	Kennedy/3rd/Rm 134	Back Left Corner, 0-5'	Pneumatic Radiator Valve	
155315	Radiator Trap	Kennedy/3rd/Rm 134	Middle of Back Wall, Toward Left Side, 0-5'	Pneumatic Radiator Valve	
155313	Radiator Trap	Kennedy/3rd/Rm 135	Back Left Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155317	Radiator Trap	Kennedy/3rd/Rm 136	Back Right Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155318	Radiator Trap	Kennedy/3rd/Rm 137	Back Left Corner, 0-5	Pneumatic Radiator Valve	
155319	Radiator Trap	Kennedy/3rd/Rm 139	8ack Left Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155326	Radiator Trap	Kennedy/3rd/Rm 140	Under Window, 0-5'	Pneumatic Radiator Valve	3/4"
55358	Radiator Trap	Kennedy/3rd/Stairwell Next to Rm 125	Down Stairs Next to Outside Doors, 0-5'	Pneumatic Radiator Valve	1/2"
155361	Radiator Trap	Kennedy/4th/Hallway	Near Rm 250, 0-5'	Pneumatic Radiator Valve	_
155362	Radiator Trap	Kennedy/4th/Hallway	Near Rm 256, 0-5'	Pneumatic Radiator Valve	Į.
155363	Radiator Trap	Kennedy/4th/Hallway	Near Rm 250 at End of Hallway, 0-5'	Pneumatic Radiator Valve	3/4"
155360	Radiator Trap	Kennedy/4th/Hallway Next to Rm 226	Zone 11, Next to Stairs, 0-5'	Pneumatic Radiator Valve	1/2"
155359	Radiator Trap	Kennedy/4th/Rm 226	Under Window, Right Side, 0-5'	Manual Control Valve	1/2"
155306	Radiator Trap	Kennedy/4th/Rm 250	Back Left Corner, 0-5'	Pneumatic Radiator Valve	-
155308	Radiator Trap	Kennedy/4th/Rm 254	Back Right Corner Under Window, 0-5'	Pneumatic Radiator Valve	1.
155309	Radiator Trap	Kennedy/4th/Rm 254	Back Rm on Left, 0-5'	Pneumatic Radiator Valve	3/4"
155307	Radiator Trap	Kennedy/4th/Rm 256	Back Left Corner, 0-5'	Pneumatic Radiator Valve	14



Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
155302	Radiator Trap	Kennedy/5th/Boy's Bathroom	Under Window, 0-5'	Pneumatic Radiator Valve	1/2"
155287	Radiator Trap	Kennedy/5th/Faculty Men's Bathroom	Under Window, 0-5'	Pneumatic Radiator Valve	1/2"
155303	Radiator Trap	Kennedy/5th/Faculty Men's Bathroom	Along Wall, 0-5'	Pneumatic Radiator Valve	1/2"
155304	Radiator Trap	Kennedy/5th/Faculty Women's Bathroom	Under Window, 0-5'	Pneumatic Radiator Valve	1/2"
155298	Radiator Trap	Kennedy/5th/Girl's Bathroom	Radiator Under Window, 0-5'	Pneumatic Radiator Valve	3/4"
155292	Radiator Trap	Kennedy/5th/Hallway	Radiator Next to Rm 242, 0-5'	Pneumatic Radiator Valve	1/2"
155293	Radiator Trap	Kennedy/5th/Hallway	Top of Zone 5 Stairs, 0-5'	Pneumatic Radiator Valve	3/4"
155294	Radiator Trap	Kennedy/5th/Hallway	Radiator Near Zone 7 Stairs, 0-5'	Pneumatic Radiator Valve	
155295	Radiator Trap	Kennedy/5th/Hallway	Radiator Near Zone 7 Stairs, 0-5'	Pneumatic Radiator Valve	1/2"
155296	Radiator Trap	Kennedy/5th/Hallway	Radiator Near Rm 208, 0-5'	Pneumatic Radiator Valve	1/2"
155297	Radiator Trap	Kennedy/5th/Hallway	Radiator Near Zone 6 Stairs, 0-5'	Pneumatic Radiator Valve	-
155290	Radiator Trap	Kennedy/5th/Hallway By Rm Access	Radiator Along Wall, 0-5'	Pneumatic Radiator Valve	-
155291	Radiator Trap	Kennedy/5th/Hallway Near Elevator	Radiator Along Wall, 0-5'	Pneumatic Radiator Valve	3/4"
155286	Radiator Trap	Kennedy/5th/Rm 200A	Under Window, Left Corner, 0-5	Pneumatic Radiator Valve	
155284	Radiator Trap	Kennedy/5th/Rm 200B	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	=
155289	Radiator Trap	Kennedy/5th/Rm 201	Under Window, Left Corner, 0-5	Pneumatic Radiator Valve	
155288	Radiator Trap	Kennedy/5th/Rm 203	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155281	Radiator Trap	Kennedy/5th/Rm 205	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	No. 20 Section 1985 in company (Appelle) agreement (Appelle)
155305	Radiator Trap	Kennedy/5th/Rm 206	Back Left Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155279	Radiator Trap	Kennedy/5th/Rm 207	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	
155283	Radiator Trap	Kennedy/5th/Rm 208	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155282	Radiator Trap	Kennedy/5th/Rm 210	Under Window, Right Corner, 0-51	Pneumatic Radiator Valve	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
155274	Radiator Trap	Kennedy/5th/Rm 211	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	1
155277	Radiator Trap	Kennedy/5th/Rm 211	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155280	Radiator Trap	Kennedy/5th/Rm 212	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	a L

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Trap Tag #	. Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Value size
155278	Radiator Trap	Kennedy/5th/Rm 214	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	Valive Dide
155276	Radiator Trap	Kennedy/5th/Rm 216	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155275	Radiator Trap	Kennedy/5th/Rm 220	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155273	Radiator Trap	Kennedy/5th/Rm 221	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155272	Radiator Trap	Kennedy/5th/Rm 222	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155301	Radiator Trap	Kennedy/5th/Rm 223	Back Left Corner, 0-5'	Pneumatic Radiator Valve	<b>-</b>
155300	Radiator Trap	Kennedy/5th/Rm 224	Back Left Corner, 0-5'	Pneumatic Radiator Valve	
155299	Radiator Trap	Kennedy/5th/Rm 225	Back Left Corner, 0-5'	Pneumatic Radiator Valve	
155262	Radiator Trap	Kennedy/5th/Rm 231A	Under Window, Left Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155263	Radiator Trap	Kennedy/5th/Rm 231B	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155265	Radiator Trap	Kennedy/5th/Rm 232	Under Window, Right Corner, 0-51	Pneumatic Radiator Valve	3/4"
155264	Radiator Trap	Kennedy/5th/Rm 233	Under Window, 0-5'	Pneumatic Radiator Valve	1/2"
155266	Radiator Trap	Kennedy/5th/Rm 234	Under Window, Right Corner, 0-51	Pneumatic Radiator Valve	3/4"
155267	Radiator Trap	Kennedy/5th/Rm 235	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155268	Radiator Trap	Kennedy/5th/Rm 236	Under Window, Right Corner, 0-51	Pneumatic Radiator Valve	3/4"
155269	Radiator Trap	Kennedy/5th/Rm 237	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	
155271	Radiator Trap	Kennedy/5th/Rm 238	Under Window, Left Corner, 0-5'	Pneumatic Radiator Valve	1 1 1
155270	Radiator Trap	Kennedy/5th/Rm 239	Under Window, Right Corner, 0-5'	Pneumatic Radiator Valve	# # T
155260	Radiator Trap	Kennedy/5th/Rm 241	Under Window, 0-5'	Pneumatic Radiator Valve	3/4"
155259	Radiator Trap	Kennedy/5th/Rm 242	Back Right Corner, 0-5'	Pneumatic Radiator Valve	3/4"
155285	Radiator Trap	Kennedy/5th/World Language Center	Under Window, 0-5'	Pneumatic Radiator Valve	1/2"
155261	Radiator Trap	Kennedy/5th/World Language Office	Under Window, 0-5'	Pneumatic Radiator Valve	3/4"



Table 28: Kingsbury Elementary School Control Valve Audit Sorted by Trap Tag Number

Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
143284	Radiator Trap	Kingsbury/1st/Boy's Bathroom	By Window, 0-5'	Pneumatic Control Valve 1	1.
143259	Radiator Trap	Kingsbury/1st/F101	Back Left, 0-5'	Pneumatic Control Valve 1	
143258	Radiator Trap	Kingsbury/1st/F103	Middle of Windows, 0-5'	Pneumatic Control Valve   1'	-
143255	Radiator Trap	Kingsbury/1st/F107	Back Left, 0-5'	Pneumatic Control Valve 1:	
143254	Radiator Trap	Kingsbury/1st/F109	Back, 0-5'	Pneumatic Control Valve 1'	± ±
143251	Radiator Trap	Kingsbury/1st/F111	Back Left, 0-5:	Manual Control Valve	an est addition resume the state below as a distant
143252	Radiator Trap	Kingsbury/1st/F112	Back Right, 0-5'	Pneumatic Control Valve   1'	=
143253	Radiator Trap	Kingsbury/1st/F112	Back Left, 0-5'	Pneumatic Control Valve 1	
143285	Radiator Trap	Kingsbury/1st/Girl's Bathroom	Back Left, 0-5'	Pneumatic Control Valve 1	-
143257	Radiator Trap	Kingsbury/1st/Hall	Outside F103, 0-5'	Pneumatic Control Valve	T. C. C. C. C. C. C. C. C. C. C. C. C. C.
143263	Radiator Trap	Kingsbury/1st/Main Entrance	Just Before Stairs, 0-5'	Pneumatic Control Valve 1'	-
143264	Radiator Trap	Kingsbury/1st/Main Entrance	Right Side, O-5'	Pneumatic Control Valve 1	7
143265	Radiator Trap	Kingsbury/1st/Main Entrance	Left Side, 0-5'	Pneumatic Control Valve 1	
143256	Radiator Trap	Kingsbury/1st/Nurse	Back Right, 0-5'	Pneumatic Control Valve	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
143260	Radiator Trap	Kingsbury/1st/Vice Principal	Right, 0-5'	Pneumatic Control Valve 1'	=
143262	Radiator Trap	Kingsbury/1st/Vice Principal	Back, 0-5'	Pneumatic Control Valve	
143267	Radiator Trap	Kingsbury/2nd/Boy's Bathroom	Back Right, 0-5'	Pneumatic Control Valve 1	-
143268	Radiator Trap	Kingsbury/2nd/Girl's Bathroom	Back Left, 0-5'	Pneumatic Control Valve	Processing and the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of the contract of
143272	Radiator Trap	Kingsbury/2nd/Hallway	Outside S103, 0-5'	Pneumatic Control Valve 1'	
143273	Radiator Trap	Kingsbury/2nd/Hallway	Outside S110, 0-5'	Pneumatic Control Valve 1	
143281	Radiator Trap	Kingsbury/2nd/S101	Under Window, 0-5'	Pneumatic Control Valve 1	
143282	Radiator Trap	Kingsbury/2nd/S103	Middle, Right, 0-5'	Pneumatic Control Valve	and the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of th
143283	Radiator Trap	Kingsbury/2nd/S103	Middle Left, 0-5'	Pneumatic Control Valve 1"	100
143280	Radiator Trap	Kingsbury/2nd/S106	Back Right, Under American Flag. 0-5'	Pneumatic Control Valve 1"	



Radiator Valve Size	=		=		=		**************************************	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s		•	-	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon	<b>-</b>
Comments	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve	Manual Control Valve	Pneumatic Control Valve	Manual Control Valve
Trap Location/Elevation	Back Right, 0-5'	Back Right, 0-5'	Back Right, 0-5'	Back Left, 0-5'	Back Left, 0-5'	Back Right, 0-5'	Back Left, 0-5'	Back Left; 0-5'	Back Right, 0-5'	Near Window, 0-5'	Left Side of Exit, 0-5'	Left Entrance, 0-5'	Right Side of Exit, 0-5'
Building/Floor/Room	Kingsbury/2nd/S107	Kingsbury/2nd/5108	Kingsbury/2nd/S109	Kingsbury/2nd/5110	Kingsbury/2nd/S111	Kingsbury/2nd/5115	Kingsbury/2nd/S116	Kingsbury/2nd/5117	Kingsbury/2nd/Teacher Lounge	Kingsbury/Between 1st and 2nd/Stairwell Across from S110	Kingsbury/Between 1st and Basement/Stairwell	Kingsbury/Between 1st and Basement/Stairwell	Kingsbury/Between 1st and Basement/Stairwell Outside F114
Application	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap
Trap Tag #	143270	143279	143269	143278	143277	143276	143275	143274	143271	143266	143250	143261	143249

Table 29: Sprague School Control Valve Audit Sorted by Trap Tag Number

Trap Tag#	Trap Tag # Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
156539	Radiator Trap	Sprague/1st/Coat Rm Between F101 and Pre K	Next to Door, 0-5'	Pneumatic Control Valve	3/4"
156537	Radiator Trap	Radiator Trap Sprague/1st/F101	at Door, 0-5	Pneumatic Control Valve	The Carlotte Acceptance and the design of the design of the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and the Carlotte Acceptance and th
156538	Radiator Trap	Radiator Trap Sprague/1st/F101	Left Wall Under Cubbies, 0-5'	Pneumatic Control Valve	
156541	Radiator Trap	Radiator Trap   Sprague/1st/F102	Back Right, 0-5'	Pneumatic Control Valve	



Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
156543	Radiator Trap	Sprague/1st/F103	Left Wall, Midway, 0-5'	Pneumatic Control Valve	=
156542	Radiator Trap	Sprague/1st/F104	Back Left, 0-5	Pneumatic Control Valve	
156544	Radiator Trap	Sprague/1st/F109	Back Left, 0-5'	Pneumatic Control Valve	=
156545	Radiator Trap	Sprague/1st/F113	Back Left, 0-5:	Pneumatic Control Valve	
156532	Radiator Trap	Sprague/1st/Hallway	Across from F109, 0-5'	Manual Control Valve	
156535	Radiator Trap	Sprague/1st/Hallway	Outside F101, 0-5'	Manual Control Valve	
156536	Radiator Trap	Sprague/1st/Hallway	Main Entrance, 0-5'	Pneumatic Control Valve	# I
156546	Radiator Trap	Sprague/1st/Hallway	Behind Stairwell Near F113, 0-5'	Pneumatic Control Valve	
156548	Radiator Trap	Sprague/1st/Hallway	Between Old and New Bldg, 0-5'	Pneumatic Control Valve	=
156567	Radiator Trap	Sprague/1st/Main Office	Right Rm, Right of Window, 0-5'	Pneumatic Control Valve	3
156547	Radiator Trap	Sprague/1st/Men's Rm	Across from F116, 0-5'	Pneumatic Control Valve	-
156540	Radiator Trap	Sprague/1st/Pre K	at Door, 0-5'	Pneumatic Control Valve	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
156534	Radiator Trap	Sprague/1st/Teacher Bathroom	Next to Lounge, 0-5'	Manual Control Valve	**************************************
156533	Radiator Trap	Sprague/1st/Teacher Lounge	Behind Oven, 0-5	Pneumatic Control Valve	-
156552	Radiator Trap	Sprague/2nd/Boy's Bathroom	Next to Custodian Closet, 0-5'	Pneumatic Control Valve	-
156566	Radiator Trap	Sprague/2nd/Girl's Bathroom	Left of Window, 0-5'	Pneumatic Control Valve	1
156554	Radiator Trap	Sprague/2nd/Hallway	Outside S111, 0-5'	Manual Control Valve	*
156556	Radiator Trap	Sprague/2nd/Main Office	Across from S109, 0-5'	Pneumatic Control Valve	
156562	Radiator Trap	Sprague/2nd/Nurse	Back Right, 0-5'	Pneumatic Control Valve	-
156561	Radiator Trap	Sprague/2nd/S101	Back Left, 0-5'	Pneumatic Control Valve	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s
156563	Radiator Trap	Sprague/2nd/S104	Right of Smart Board, 0-5'	Pneumatic Control Valve	<b>1</b>
156560	Radiator Trap	Sprague/2nd/S105	Back Right, 0-5'	Pneumatic Control Valve	
156564	Radiator Trap	Sprague/2nd/S106	Back Right, 0-5'	Pneumatic Control Valve	
156565	Radiator Trap	Sprague/2nd/S108	Back Right, 0-51	Pneumatic Control Valve	11
156555	Radiator Trap	Sprague/2nd/S109	Back Left, 0-5'	Pneumatic Control Valve	The Age of the Late of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charles Age of the Charl

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Comments Radiator Valve Size	Pneumatic Control Valve 1"	Pneumatic Control Valve 1"	Pneumatic Control Valve 1"	Pneumatic Control Valve 1"	Pneumatic Control Valve 1"	Pneumatic Control Valve 1"	Pneumatic Control Valve 1"	Inlet Isolation 1"	Inlet isolation 1"	Inlet Isolation 1"	The first the second of the process of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the s	Inlet Isolation
Trap Location/Elevation	Between Windows, 0-5'	Back Right, 0-5'	Back Right, 0-5!	Back Right, 0-5'	Back Left, 0-5'	Back Right, 0-5'	Back Right, 0-5'	Back Wall, 5-10'	Above Green Bookcases, 5-10'	Above Coffee Table, 5-10'	The second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of th	Left Corner, 5-10'
Building/Floor/Room	Sprague/2nd/S110 - Principal	Sprague/2nd/S111	Sprague/2nd/S114	Sprague/2nd/S115	Sprague/2nd/S118	Sprague/2nd/S119	Sprague/2nd/S207	Sprague/Basement/B104	Sprague/Basement/Basement Offices	Sprague/Basement/Teacher Lounge	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon	Sprague/Basement/Teacher Lounge
Application	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap	Radiator Trap		Radiator Trap
Trap Tag #	156557	156559	156553	156551	156550	27285	156558	156531	156530	156528		156529

Table 30: Tinker School Control Valve Audit Sorted by Trap Tag Number

Trap Tag #	Trap Tag # Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
145435	Radiator Trap	Tinker/2nd/Stairwell	Landing Between 1st and 2nd Floors, O-5'	Pneumatic Control Valve	3/4"
145433	Radiator Trap	Tinker/2nd/5105	Left Radiator, 0-5'	Pneumatic Control Valve	And the property of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state o
155434	Radiator Trap	Tinker/2nd/5105	Right Radiator, 0-5'	Pneumatic Control Valve	
145437	Radiator Trap	Tinker/2nd/S104	Left Radiator; 0-5'	Pneumatic Control Valve	3/4"
145438	Radiator Trap	Tinker/2nd/S104	Right Radiator, 0-5'	Pneumatic Control Valve	3/4"
145419	Radiator Trap	Tinker/2nd/S102	Behind Teachers Desk, 0-5'	Pneumatic Control Valve	3/4"
145431	Radiator Trap	Tinker/2nd/S110	Behind Bookshelves Under Left Window, 0-5'	Pneumatic Control Valve	3/4"



Trap Тав #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
145430	Radiator Trap	Tinker/2nd/S109	Under Right Window, 0-5'	Pneumatic Control Valve	3/4"
145429	Radiator Trap	Tinker/2nd/S112	Middle of Rm, 0-5'	Pneumatic Control Valve	3/4"
145428	Radiator Trap	Tinker/2nd/S113	Behind Computers, 0-5'	Pneumatic Control Valve	3/4"
145427	Radiator Trap	Tinker/2nd/S114	Behind Teachers Desk, 0-5'	Pneumatic Control Valve	11/4"
145426	Radiator Trap	Tinker/2nd/S117	Behind Teachers Desk, 0-5'	Pneumatic Control Valve	
145425	Radiator Trap	Tinker/2nd/5118	Middle of Rm Left Radiator, 0-5'	Pneumatic Control Valve	=
145424	Radiator Trap	Tinker/2nd/5118	Middle of Rm Right Radiator, 0-5'	Pneumatic Control Valve	
145423	Radiator Trap	Tinker/2nd/S119	Behind Teachers Desk, 0-5'	Pneumatic Control Valve	<b>E</b>
145422	Radiator Trap	Tinker/2nd/S116	Right Wall, 0-5'	Pneumatic Control Valve	3/4"
145421	Radiator Trap	/B1	Above Teachers Desk, 10-15'	Pneumatic Control Valve	3/4"
145420	Radiator Trap	Tinker/Basement/8112	Above Computers, 0-5'	Pneumatic Control Valve	3/4"
145417	Radiator Trap	Tinker/Basement/B109 Girls Rm	Under Window, 0-5'	Pneumatic Control Valve	3/4"
145416	Radiator Trap	Tinker/Basement/B109 Boys Rm	Back Wall, 0-5'	Pneumatic Control Valve	3/4"
145415	Radiator Trap	Tinker/Basement/B109	Back Left Corner, 0-5'	Pneumatic Control Valve	=
145414	Radiator Trap	Tinker/Basement/B110	Left Side of Rm. 10-15"	Pneumatic Control Valve	3/4"
145413	Radiator Trap	Tinker/Basement/8110	Middle of Rm, 10-15'	Pneumatic Control Valve	3/4"
145412	Radiator Trap	Tinker/Basement/B101	Next to Teachers Desk, 0-5'	Pneumatic Control Valve	3/4"
145411	Radiator Trap	Tinker/Basement/8103	Above Teachers Desk, 10-15'	Manual Control Valve	3/4"
145404	Radiator Trap	Tinker/Basement/Girls Restroom	Middle of Rm, 10-15'	Manual Control Valve	11/4"
145403	Radiator Trap	Tinker/1st/Stairwell 2	Landing Between 1st and Basement, 5- 10'	Pneumatic Control Valve	3/4"
145402	Radiator Trap	Tinker/1st/F107	Under Right Window, 0-5'	Pneumatic Control Valve	3/4"
145401	Radiator Trap	Tinker/1st/F105	Right of Window, 0-5'	Pneumatic Control Valve	3/4"
154976	Radiator Trap	Tinker/1st/F107	Left Radiator, 0-5'	Pneumatic Control Valve	
149097	Radiator Trap	Tinker/1st/F107	Right Radiator, 0-5'	Pneumatic Control Valve	
149100	Radiator Trap	Tinker/1st/F103	Left Radiator Behind Teachers Desk, O-	Pneumatic Control Valve	Proprietable and the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the

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Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
			2.		
149099	Radiator Trap	Tinker/1st/F103	Under Window, 0-5'	Pneumatic Control Valve	
149098	Radiator Trap	Tinker/1st/F101	Back Right Corner, 0-5'	Pneumatic Control Valve	
149096	Radiator Trap	Tinker/1st/Girls Restroom	Under Window, 0-5'	Pneumatic Control Valve	3/4"
149095	Radiator Trap	Tinker/1st/F108	Radiator Behind Desk, 0-5'	Pneumatic Control Valve	1"
149094	Radiator Trap	Tinker/1st/Teacher's Lounge	Under Window, 0-5'	Pneumatic Control Valve	3/4"
149093	Radiator Trap	Tinker/1st/F112	Under Right Window, 0-5'	Pheumatic Control Valve	3/4"
149092	Radiator Trap	Tinker/1st/F113	Left Radiator Under Window, 0-5'	Pheumatic Control Valve	
149091	Radiator Trap	Tinker/1st/F113	Right Radiator Behind Desk, 0-51	Pneumatic Control Valve	·
149090	Radiator Trap	Tinker/1st/F114	Under Window Left Side, 0-5'	Pneumatic Control Valve	3/4"
149089	Radiator Trap	Tinker/1st/F111	Left Radiator Under Window, 0-5'	Pneumatic Control Valve	3/4"
149088	Radiator Trap	Tinker/1st/F111	Roght Radiator Under Window, 0-5'	Pneumatic Control Valve	3/4"
149087	Radiator Trap	Tinker/1st/F109	Under Window Down Right Side, 0-5'	Pneumatic Control Valve	3/4"
149086	Radiator Trap	Tinker/1st/F110	Under Window, 0-5'	Pneumatic Control Valve	3/4"
149085	Radiator Trap	Tinker/Ground/Men's Restroom	Under Window, 0-5'	Pneumatic Control Valve	1/2"
149084	Radiator Trap	Tinker/Ground/G101	Back Left Corner, 0-5'	Pneumatic Control Valve	3/4"
149083	Radiator Trap	Tinker/Ground/Main Gym Bldg Entrance	Right If Entrance, 0-5	Manual Control Valve	
149083	Radiator Trap	Tinker/Ground/Cafeteria	Under Window Left Side, 0-5'	Pneumatic Control Valve	3/4"
149081	Radiator Trap	Tinker/Ground/Cafeteria	Under Window Left Side, 0-5'	Pneumatic Control Valve	3/4"
149080	Radiator Trap	Tinker/Ground/Gym Bldg, Hallway	By Courtyard Entrance at Bottom of Stairs, 0-5'	Manual Control Valve	3/4"
149079	Radiator Trap	Tinker/1st/Walkway to Gym	Street Side, 0-5'	Manual Control Valve	3/4"
149077	Radiator Trap	Tinker/1st/Walkway to Gym	Courtyard Side, 0-5'	Pneumatic Control Valve	
149076	Radiator Trap	Tinker/1st/Boys Restroom By F119	Under Window, 0-5'	Pneumatic Control Valve	1/2"
149075	Radiator Trap	Tinker/1st/Vice Principal's Office	Under Window, 0-5'	Manual Control Valve	11/4"
149074	Radiator Trap	Tinker/1st/Main Office	Under Window, 0-5'	Pneumatic Control Valve	3/4"

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Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
149073	Radiator Trap	Tinker/2nd/S111	Under Window, 0-5'	Pneumatic Control Valve	3/4"
149072	Radiator Trap	Tinker/2nd/Boys Restroom By 5119	Under Window, 0-5'	Pneumatic Control Valve	1/2"
149078	Radiator Trap	Tinker/2nd/S120	Left Wall, 0-5'	Pneumatic Control Valve	1/2"
149071	Radiator Trap	Tinker/2nd/Nurses Office	Under Window, 0-5'	Pneumatic Control Valve	3/4"
149070	Radiator Trap	Tinker/2nd/S101	Right Wall, 0-5'	Pneumatic Control Valve	3/4"
149069	Radiator Trap	Tinker/2nd/Hallway	Outside S113, 0-5:	Pneumatic Control Valve	3/4"
149068	Radiator Trap	Tinker/1st/Stairwell	Landing Between 1st and 2nd Floors, O-5'	Pneumatic Control Valve	3/4"
149067	Radiator Trap	Tinker/1st/Hallway	Across from F101, 0-5'	Pneumatic Control Valve	3/4"
149066	Radiator Trap	Tinker/1st/Hallway	Main Entrance Right Side, 5-10'	Pneumatic Control Valve	3/4"
149065	Radiator Trap	Tinker/1st/Hallway	Main Entrance Left Side, 5-10'	Pneumatic Control Valve	3/4"
149064	Radiator Trap	Tinker/1st/Hallway	Outside F112, 0-5'	Pneumatic Control Valve	3/4"
149063	Radiator Trap	Tinker/Basement/Basement Stairwell	First Landing, 5-10'	Pneumatic Control Valve	3/4"
149062	Radiator Trap	Tinker/Basement/Boys Restroom	Above Urinals, 5-10'	No Components	

Table 31: Walsh School Control Valve Audit Sorted by Trap Tag Number

Trap Tag #	Trap Tag # Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
145486	Radiator Trap	Walsh/1st/Boy's Restroom	Under Window, 0-5'	Pneumatic Control Valve	3/4"
145483	Radiator Trap	Walsh/1st/F11	Right Radiator, O-5'	Pneumatic Control Valve	3/4"
145484	Radiator Trap	Walsh/1st/F11	Left Radiator, 0-5'	Pneumatic Control Valve	3/4"
145487	Radiator Trap	Radiator Trap Walsh/1st/F112	Back Left Corner, 0-51	Pneumatic Control Valve	3/4"
145488	Radiator Trap	Walsh/1st/F13	Back Left Corner, 0-5'	Pneumatic Control Valve	3/4"
145470	Radiator Trap	Radiator Trap Walsh/1st/F7	Right Wall, 0-5'	Pneumatic Control Valve	1/2"
145481	Radiator Trap	Walsh/1st/F7	Left Wall, 0-5'	Pneumatic Control Valve	1/2"



Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
145485	Radiator Trap	Walsh/1st/Girls Restroom	Under Window, 0-5'	Pneumatic Control Valve	3/4"
145492	Radiator Trap	Walsh/1st/Hallway Next to Gym	Entrance to Custodian Storage, 0-5'	Pneumatic Control Valve	3/4"
145491	Radiator Trap	Walsh/1st/Main Office	Behind Front Desk, 0-5'	Pneumatic Control Valve	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon
145500	Radiator Trap	Walsh/1st/Nurses Office	Under Window, Left Side, 0-5'	Pneumatic Control Valve	3/4"
145480	Radiator Trap	Walsh/1st/Principal's Office	Behind Computer, 0-5'	Pneumatic Control Valve	3/4"
145489	Radiator Trap	Walsh/1st/Stairwell 2	Landing Between 1st and Basement, Right Side, 0-5'	Pneumatic Control Valve	1/2"
145490	Radiator Trap	Walsh/1st/Stairwell 2	Landing Between 1st and Basement, Left Side, 0-5'	Pneumatic Control Valve	1/2"
145482	Radiator Trap	Walsh/1st/Vice Principal's Office	Under Window, 0-5'	Pneumatic Control Valve	3/4"
145503	Radiator Trap	Walsh/2nd/Art/Music	Back Left Corner, 0-5'	Pneumatic Control Valve	3/4"
145493	Radiator Trap	Walsh/2nd/Boy's Restroom	Under Window, 0-5'	Pneumatic Control Valve	3/4"
145496	Radiator Trap	Walsh/2nd/Girls Restroom	Next to Sinks, 0-5'	Pneumatic Control Valve	1/2"
145519	Radiator Trap	Walsh/2nd/Hallway	By S1, 0-5'	Pneumatic Control Valve	1/2"
145509	Radiator Trap	Walsh/2nd/S1	Under Window, 0-5'	Pneumatic Control Valve	3/4"
145521	Radiator Trap	Walsh/2nd/S10	Right Radiator, 0-5'	Pneumatic Control Valve	3/4"
145522	Radiator Trap	Walsh/2nd/S10	Left Radiator, 0-5'	Pneumatic Control Valve	3/4"
145523	Radiator Trap	Walsh/2nd/S12	Back Left Corner, 0-5'	Pneumatic Control Valve	3/4"
145497	Radiator Trap	Walsh/2nd/513	Right Radiator, 0-5'	Pneumatic Control Valve	3/4"
145502	Radiator Trap	Walsh/2nd/S13	Left Radiator, 0-5'	Pneumatic Control Valve	3/4"
145524	Radiator Trap	Walsh/2nd/S14	Back Left Corner, 0-5	Pneumatic Control Valve	3/4"
145495	Radiator Trap	Walsh/2nd/S15	Back Left Corner, 0-5'	Pneumatic Control Valve	3/4"
145494	Radiator Trap	Walsh/2nd/S17	Under Right Window, 0-5'	Pneumatic Control Valve	3/4"
145512	Radiator Trap	Walsh/2nd/S2	Left Radiator, 0-5'	Pneumatic Control Valve	1/2"
145513	Radiator Trap	Walsh/2nd/S2	Right Radiator, 0-5'	Pneumatic Control Valve	1/2"
145507	Radiator Trap	Walsh/2nd/S3	Right Radiator, 0-5'	Pneumatic Control Valve	3/4"

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Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
145508	Radiator Trap	Walsh/2nd/S3	Left Radiator, 0-5'	Pneumatic Control Valve	3/4"
145510	Radiator Trap	Walsh/2nd/S4	Right Radiator, 0-5'	Pneumatic Control Valve	3/4"
145514	Radiator Trap	Walsh/2nd/S4	Left Radiator, 0-5'	Pneumatic Control Valve	3/4"
145506	Radiator Trap	Walsh/2nd/S5	Back Right Corner, 0-5'	Pneumatic Control Valve	1/2"
145515	Radiator Trap	Walsh/2nd/S6	Left Radiator, 0-5'	Pneumatic Control Valve	3/4"
145516	Radiator Trap	Walsh/2nd/S6	Right Radiator, 0-5'	Pneumatic Control Valve	3/4"
145501	Radiator Trap	Walsh/2nd/S7	Left Radiator, 0-5'	Pneumatic Control Valve	3/4"
145505	Radiator Trap	Walsh/2nd/S7	Right Radiator, 0-5'	Pneumatic Control Valve	3/4"
145518	Radiator Trap	Walsh/2nd/S8	Left Radiator, 0-5'	Pneumatic Control Valve	3/4"
145520	Radiator Trap	Walsh/2nd/S8	Right Radiator, 0-5'	Pneumatic Control Valve	3/4"
145504	Radiator Trap	Walsh/2nd/Special Services	Back Right Corner, 0-5'	Pneumatic Control Valve	1/2"
145511	Radiator Trap	Walsh/2nd/Stairwell	Landing Between 2nd and 1st Floors, 0-5'	Pneumatic Control Valve	1/2"
145469	Radiator Trap	Walsh/Basement/B11	Left Radiator, 0-5	Pneumatic Control Valve	3/4"
145479	Radiator Trap	Walsh/Basement/B11	Under Windows, 0-5'	Pneumatic Control Valve	3/4"
145471	Radiator Trap	Walsh/Basement/Hallway	Exit Across from B11, 0-5'	No Components	3/4"
145526	Radiator Trap	Walsh/Basement/Mech Rm	Back Wall, 0-5'	No Components	3/4"
145478	Radiator Trap	Walsh/Basement/Stairwell 1	Landing Between 1st and Basement, 0-5	No Components	3/4"

# Table 32: Wendell Cross School Control Valve Audit Sorted by Trap Tag Number

Radiator Valve Size	1/2"	3/4"	3/4"
Comments	Pneumatic Control Valve	Pneumatic Control Valve	Pneumatic Control Valve
Trap Location/Elevation	Bathroom to Right of Rm, 0-5'	Back Left Radiator, 0-5'	Back Right Radiator, 0-5'
Building/Floor/Room	Radiator Trap Wendell Cross/1st/Back of Stage in Gym Bathroom to Right of Rm, 0-5'	Radiator Trap Wendell Cross/1st/Back of Stage in Gym Back Left Radiator, 0-5'	Radiator Trap Wendell Cross/1st/Back of Stage in Gym Back Right Radiator, 0-5'
Application	Radiator Trap	Radiator Trap	Radiator Trap
Trap Tag #	155227	155228	155229



Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
155214	Radiator Trap	Wendell Cross/1st/Boy's Bathroom	Right Wall, 0-5'	Pneumatic Control Valve	1/2"
155225	Radiator Trap	Wendell Cross/1st/ESL Rm to Left of Stage in Gym	Left of Entrance, 0-5'	Pneumatic Control Valve	1/2"
155226	Radiator Trap	Wendell Cross/1st/ESL Rm to Left of Stage in Gym	Back Bathroom, 0-5'	Pneumatic Control Valve	1/2"
155206	Radiator Trap	Wendell Cross/1st/F101	Left Corner of Left Wall, 0-5'	Pneumatic Control Valve	3/4"
155207	Radiator Trap	Wendell Cross/1st/F101	Right Corner of Back Wall, 0-5'	Pneumatic Control Valve	3/4"
155210	Radiator Trap	Wendell Cross/1st/F103	Right Corner of Back Wall, 0-5'	Pneumatic Control Valve	3/4"
155209	Radiator Trap	Wendell Cross/1st/F105	Right Corner of Back Wall, 0-5'	Pneumatic Control Valve	3/4"
155208	Radiator Trap	Wendell Cross/1st/F107	Right Corner of Back Wall, 0-5'	Pneumatic Control Valve	3/4"
155219	Radiator Trap	Wendell Cross/1st/F108	Left Corner of Back Wall, 0-5'	Pneumatic Control Valve	3/4"
152486	Radiator Trap	Wendell Cross/1st/F109	Right Corner of Back Wall, 0-5'	Pneumatic Control Valve	3/4"
152487	Radiator Trap	Wendell Cross/1st/F109	Back Corner of Right Wall, 0-5	Pheumatic Control Valve	3/4"
152488	Radiator Trap	Wendell Cross/1st/F109	Left Corner Under Window, 0-5'	Pneumatic Control Valve	3/4"
155211	Radiator Trap	Wendell Cross/1st/F110	Left Corner of Back Wall, 0-5'	Pneumatic Control Valve	3/4"
152485	Radiator Trap	Wendell Cross/1st/F111	Right Corner Under Window, 0-5'	Pneumatic Control Valve	3/4"
155212	Radiator Trap	Wendell Cross/1st/F112	Left Corner of Back Wall, 0-5'	Pneumatic Control Valve	3/4"
152483	Radiator Trap	Wendell Cross/1st/F113	Left Corner Under Window, 0-5'	Pneumatic Control Valve	3/4"
152484	Radiator Trap	Wendell Cross/1st/F116	Left Corner Under Window, 0-5'	Pneumatic Control Valve	3/4"
152482	Radiator Trap	Wendell Cross/1st/F118	Right Corner Under Window, 0-5'	Pneumatic Control Valve	3/4"
155215	Radiator Trap	Wendell Cross/1st/Girl's Bathroom	Left Wall, 0-5'	Pneumatic Control Valve	1/2"
155213	Radiator Trap	Wendell Cross/1st/Hallway	Left of F111, 0-5'	Pneumatic Control Valve	1/2"
155216	Radiator Trap	Wendell Cross/1st/Hallway	Left of F101, 0-5'	Manual Control Valve	3/4"
155217	Radiator Trap	Wendell Cross/1st/Hallway	Right of Library, 0-5'	Manual Control Valve	3/4"
155220	Radiator Trap	Wendell Cross/1st/Hallway	Along Hallway Toward Gym, 0-5'	Pneumatic Control Valve	1/2"
155221	Radiator Trap	Wendell Cross/1st/Hallway	Next to Outside Doors Before Gym, 0-5'	Pneumatic Control Valve	1/2"

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Trap Tag #	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
155222	Radiator Trap	Wendell Cross/1st/Hallway	Next to Outside Doors Before Gym, 0-5'	Pneumatic Control Valve	1/2"
155223	Radiator Trap	Wendell Cross/1st/Hallway	Next to Outside Doors Before Gym, 0-5'	Pneumatic Control Valve	1/2"
155224	Radiator Trap	Wendell Cross/1st/Hallway	Next to Outside Doors Before Gym, 0-5'	Pneumatic Control Valve	1/2"
155231	Radiator Trap	Wendell Cross/1st/Library	Left Corner of Left Wall, 0-5'	Pneumatic Control Valve	3/4"
155205	Radiator Trap	Wendell Cross/1st/Main Office F106	Right Corner Under Window., 0-5'	Pneumatic Control Valve	3/4"
155218	Radiator Trap	Wendell Cross/1st/Nurses Office	Left Corner of Back Wall, 0-5'	Pneumatic Control Valve	3/4"
155230	Radiator Trap	Wendell Cross/1st/Sports Equipment Rm to Right of Stage in Gym	Under Radiator Cover, 0-5'	Pneumatic Control Valve	1/2"
152497	Radiator Trap	Wendell Cross/Basement/B101	Right Corner Under Window, 0-5'	Pheumatic Control Valve	3/4"
152494	Radiator Trap	Wendell Cross/Basement/B102	Right Corner Under Window, 0-5'	Pneumatic Control Valve	3/4"
152493	Radiator Trap	Wendell Cross/Basement/B104	Right Corner Under Window, 0-5'	Pneumatic Control Valve	3/4"
152492	Radiator Trap	Wendell Cross/Basement/B105	Left Corner Under Window, 0-5'	Pneumatic Control Valve	3/4"
152490	Radiator Trap	Wendell Cross/Basement/B106	Left Corner Under Window, 0-5'	Pneumatic Control Valve	3/4"
152489	Radiator Trap	Wendell Cross/Basement/B107	Left Corner Under Window, 0-5	Pneumatic Control Valve	3/4"
152495	Radiator Trap	Wendell Cross/Basement/Boy's Bathroom	Along Right Wall, 0-5'	Pneumatic Control Valve	1/2"
152496	Radiator Trap	Wendell Cross/Basement/Girl's Bathroom	Along Left Wall, 0-5'	Pneumatic Control Valve	1/2"
155201	Radiator Trap	Wendell Cross/Basement/Hallway	To Right of Janitorial Office, 0-5'	Pneumatic Control Valve	3/4"
155202	Radiator Trap	Wendell Cross/Basement/Hallway	To Right of B105, 0-5'	Pneumatic Control Valve	1/2"
155203	Radiator Trap	Wendell Cross/Basement/Hallway	To Right of Reading Rm, 0-5'	Pneumatic Control Valve	3/4"
155204	Radiator Trap	Wendell Cross/Basement/Janitorial Office	Along Right Wall, 0-5'	Pneumatic Control Valve	3/4"
152491	Radiator Trap	Wendell Cross/8asement/Reading Rm	Back Side of Right Wall, 0-5'	Pneumatic Control Valve	3/4"



Table 33: Wilson School Control Valve Audit Sorted by Trap Tag Number

Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
145590	Radiator Trap	Wilson/1st/Cafeteria	Back Left Corner, Behind Access Panel, 0-5'	Pneumatic Control Valve	
145591	Radiator Trap	Wilson/1st/ESL Rm	Back Right Corner, Behind Access Panel, 0-5'	Pneumatic Control Valve	3/4"
145569	Radiator Trap	Wilson/1st/Hallway	Front Entrance, Right Wall, 0-5'	Manual Control Valve	3/4"
145570	Radiator Trap	Wilson/1st/Hallway	Front Entrance, Right Wall, 0-5"	Manual Control Valve	3/4"
145571	Radiator Trap	Wilson/1st/Hallway	Front Entrance, Left Wall, 0-5'	Manual Control Valve	3/4"
145572	Radiator Trap	Wilson/1st/Hallway	Parking Lot Entrance Left Wall, 0-5'	Manual Control Valve	3/4"
145573	Radiator Trap	Wilson/1st/Hallway	Parking Lot Entrance, Right Wall, 0-5'	Manual Control Valve	3/4"
145574	Radiator Trap	Wilson/1st/Hallway	Radiator By Main Office, 0-5	Pneumatic Control Valve	3/4"
145588	Radiator Trap	Wilson/1st/Music Rm	Back Left Corner, Behind Access Panel, 0-5'	Pneumatic Control Valve	3/4"
145589	Radiator Trap	Wilson/1st/Music Rm	Back Left Corner Behind Access Panel, 0-5'	Pheumatic Control Valve	3/4"
145581	Radiator Trap	Wilson/1st/Nurses Restroom	Right Wall, 0-5'	Manual Control Valve	3/4"
145559	Radiator Trap	Wilson/1st/Stairwell	1st Floor Landing, 0-5'	Manual Control Valve	3/4"
145563	Radiator Trap	Wilson/1st/Stairwell 2	1st Floor Landing, 0-5'	Manual Control Valve	3/4"
145564	Radiator Trap	Wilson/1st/Stairwell 2	Landing Between 1st and Basement, 0-5'	Manual Control Valve	3/4"
145565	Radiator Trap	Wilson/1st/Stairwell 2	Landing Between 1st and Basement, 0-5'	Manual Control Valve	3/4"
145561	Radiator Trap	Wilson/Znd/Hallway	Radiator at Top of Basement Stairs, 0-5'	Pneumatic Control Valve	The control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the co
145560	Radiator Trap	Wilson/2nd/Stairwell	2nd Floor Landing, 0-5'	Manual Control Valve	3/4"
145562	Radiator Trap	Wilson/2nd/Stairwell 2	2nd Floor Landing, 0-5	Manual Control Valve	3/4"
145587	Radiator Trap	Wilson/Basement/Bdlc Rm Near Boiler Rm	Above Teachers Desk, 10-15'	Valved Out	11/4"
145547	Radiator Trap	Wilson/Basement/Boiler Rm Shower	Middle of Rm, 10-15	Manual Control Valve	3,4"



Trap Tag#	Application	Building/Floor/Room	Trap Location/Elevation	Comments	Radiator Valve Size
		Area			
145554	Radiator Trap	Wilson/Basement/Hallway	Above Printer, 10-15'	Valved Out	11/4"
145556	Radiator Trap	Wilson/Basement/Hallway	Above Crawlspace Entrance, 10-15'	Valved Out	17.4"
145566	Radiator Trap	Wilson/Basement/Large Rm	Along Right Wall, Middle of Wall, 10-15'	Pneumatic Control Valve	11/4"
145553	Radiator Trap	Wilson/Basement/Restroom	Above Door, 5-10'	No Components	11/4"
145550	Radiator Trap	Wilson/Basement/ Sprinkler Valve Rm	Back Right Corner, Above 15'	Manual Control Valve	3/4"
145557	Radiator Trap	Wilson/Basement/Stairwell	Landing Between Basement and 1st, 5-10'	Manual Control Valve	3/4"
145558	Radiator Trap	Wilson/Basement/Stairwell	Landing Between Basement and 1st, 5-	Manual Control Valve	3/4"
145545	Radiator Trap	Wilson/Basement/Storage Left of Boiler Rm Entrance	Above Entrance, 10-15'	No Components	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon



### Interface with Existing Systems and Operations

### Maintenance Procedures

The new steam traps and thermostatic radiator valves will require annual blowdowns and inspections. These blowdowns and inspections can be performed by the existing school maintenance staff as part of the heating system startup each year.

### **Special Operating Requirements**

There are no special operating requirements.

### **Equipment Information**

### Manufacturer and Type

NORESCO will install conventional mechanical steam traps and repair components manufactured by Tunstall Corporation or approved equal.

 Tunstall Corporation, 118 Exchange Street, Chicopee, MA 01013, 800-423-5578, www.tunstall-inc.com

NORESCO will install thermostatic radiator valves manufactured by Honeywell or approved equal.

 Honeywell International, 101 Columbia Road, Morristown NJ 07960, 973-455-2000, www.honeywell.com

### **Savings Calculations**

To quantify energy savings associated with the new steam traps, NORESCO developed a spreadsheet model that calculates steam energy loss through the trap orifice. The dimensionless Grashof Number uses the steam trap orifice size, which is directly related to the size and type of steam trap, and the steam operating pressure to calculate the steam flow rate loss. Pre- and post-retrofit steam, or thermal, losses are calculated using the following formula as its basis:

•  $q = h \times l \times q$ 

Where:

q = Thermal Heat Loss (lb steam)

h = Operating Hours (hrs)

f = Failure Rate (%)

q = Grashof Number (dimensionless)



For energy savings associated with the thermostatic radiator valves, NORESCO uses site specific parameters and the following formula to calculate steam energy loss through the existing failed control valves.

•  $q = A \times P \times H \times I \times FR \times h / (103,000 \text{ Btu/CCF} \times \text{System efficiency})$ 

### Where:

q = Thermal Heat Loss (lb steam) A = Average radiator area (sq. in.)

P = Steam Rate (lbs/hr) H = Annual Heating Hours

= Idle Time (estimated new radiator valves let steam into radiators and

convectors XX% of the time)

FR = Failure Rate (estimated existing radiator valve failure rate)

h = Energy Content (Btu) in 1 lb of steam



### **ESM 9:** PLUG LOAD CONTROLS



### **ESM 9: Plug Load Controls**

**Benefits:** This measure will achieve energy savings from the automatic turning on/off of equipment that would not be in use during unoccupied hours of the night and weekends. The measure will also be a clear demonstration of the City's commitment to energy efficiency to its building occupants.

Buildings: Bucks Hill School Bunker Hill School

Carrington School Chase Building

Chase School Crosby-Wallace Complex

Driggs School Duggan School

Enlightenment School Generali School

Gilmartin School Hopeville School

Kennedy High School Kingsbury School

Reed School Regan School

Rotella School Sprague School

Tinker School Walsh School

Washington School Waterbury Arts Magnet School

Waterbury Career Academy School Wendell Cross

West Side School Wilby-North End Complex

Wilson School

**Summary:** NORESCO will install plug load management technology to provide additional energy savings during unoccupied hours and weekends. The installation includes controllable electrical receptacles, building controllers, and a web-based application and software suite for programming, analytics, reporting, and a user-interface dashboard.

Implementation Cost: \$176,855

Energy Cost Savings: \$27,543

Annual Energy Reduction: 201,247 kWh

M&V Protocol: Option A



### **Detailed Description**

### **Existing Description**

Printers, vending machines, small appliances (e.g., water coolers, air conditioners), and other plug loads consume 15% to 20% of total commercial electricity. In a school environment, faculty, staff, and students have equipment and devices that are part of normal day for administering and teaching students. Short of unplugging devices when unneeded, energy is being drawn out even when power strips are being used.

### Recommended Improvements

NORESCO recommends implementing smart power receptacles that remove the need to unplug devices from the wall when the equipment is not in use. The system recommended by NORESCO uses a cloud-based software application to control whether the new smart receptacles will allow electrical power to be provided to the plugged in device, as well as measure the power when it is being used. The web-based software will communicate with the smart receptacles via building controllers and the existing City LAN infrastructure and WiFi in the buildings. The deployment of the equipment will be dependent upon the function, use, and occupant base of the buildings noted above.

The information on plug load use is provided to the building users in an interactive visual format. This feedback helps spread energy awareness to the building occupants and provides a sense of ownership as to how efficiently the building is operated.

### Scope of Work

NORESCO will install plug load equipment for equipment as listed in Table 1.

Table 1: Table Plug Load Equipment Summary

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	4		14		Tris in			
	us.	Fd E	4		, see al	4	<u> </u>	
Bucks Hill	5	<b>5</b>	<b>                                     </b>		2	<b>1</b> 5		4
Bunker Hill		25	4		2	The Wilder Wilder	- 1	
Carrington		43	4		-	and a second second second second second second second second second second second second second second second		Management of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of th
Chase Building	14	42	20	7	4		1	
Chase School	-	4	2		2	-	1	2
Crosby-Wallace	28	106	10	-	7	72	4	18
Driggs	3	23	4	-	2	_	-	•
Duggan	8	5	3		9			1
Enlightenment	2	34	4	1	1		1	2
Generali	5	4	3	-	2		_	1



	Small Printers	Medium Printers	Large Printers	Water Fountains, Dispensers, Coffee Machines	Vending Machines	Amplifiers	TV /Printer Monitors	Mobile Device Charging Stations
Gilmartin	7	7	4	_	<u>-</u> :	-	3 .	-
Hopeville	8	- 3	3	_20	2			2
Kennedy	8	7	1	and the second section of the second section of the second section of the second section of the second section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section	13	3	4	4
Kingsbury	-	17	2	7	1			
Reed		37	3	**************************************	2 .	-	2	-
Regan		13	4			3	-	1
Rotella	11	13	1		2	8	3	4
Sprague		.26	2	1	1	7		2
Tinker	3	1	2		1			1
Walsh		31	2	-	1			4
Washington	4	1	2	2	1	**	_	2
Waterbury Arts		41	4	1	4	<u> </u>	4	6
Waterbury Career	41	4	3	·	6	_	1	3
Wendell Cross	3	4	2		1	3		1
West Side		22	3	-	2	4	1	2
Wilby-North End	19	40	17	3	1	31	7	2
Wilson	-	20	3	-	1	-	_	2
Total	169	575	1113	<b>15</b>	771	146	28	66

### City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. Customer shall relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or otherwise interfere with the ESM implementation and installation process.

### Hazardous Materials Abatement Allowance

The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of



hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.

### Interface with Existing Systems & Operations

### Maintenance Procedures

The controllers will require no additional maintenance.

### **Special Operating Requirements**

There are no special operating requirements with the retrofitted receptacles. The software schedules and reports will need to be coordinated and set up with the City's input.

### **Equipment Information**

### Manufacturer & Type

NORESCO will install plug load controls provided by Best Energy Reduction Technologies, or approved equal.

 Best Energy Reduction Technologies, LLC, 840 1st Avenue, Suite 300, King of Prussia, PA 19406 www.bertbrain.com

### **Savings Calculations**

Below is the calculation methodology or formulae.

- Baseline Usage (kWh/yr) = Device kW × Operating Hours × % Load
- Estimated Usage (kWh/yr) = Device kW × Proposed Operating Hours × % Load
- Savings (kWh/yr) = Baseline Energy Usage Estimated Energy Usage



### **ESM 10:**

WALK-IN COOLER CONTROLS



### ESM 10: Walk-in Cooler Controls

**Benefits:** This measure will decrease energy consumption and increase reliability through reduced equipment run time.

Buildings: Chase School Crosby-Wallace Complex

Duggan School Generali School

Maloney School Rotella School

Sprague School Walsh School

Waterbury Arts Magnet School West Side School

Wilby-North End Complex Wilson School

**Summary:** NORESCO will install advanced controls and equipment on the walk-in coolers and freezers in the City's kitchens. The controls and equipment will optimize evaporator fan, door heater, compressor, and condensing unit operation. NORESCO will also replace low-efficiency fractional horsepower evaporator fan motors with high-efficiency electronically commutated motors.

Implementation Cost: \$147,462

Energy Cost Savings: \$13,115

Annual Energy Reduction: 97,771 kWh

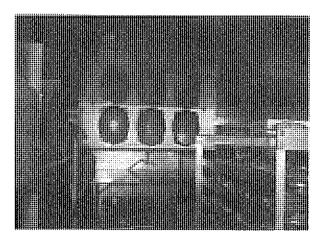
M&V Protocol: Option A

### **Detailed Description**

### Existing Description

The walk-in refrigeration units at twelve (12) of the school buildings have standard efficiency evaporator fans which are original to the units. These fans and the units' door heaters operate continuously, regardless of the load or conditions.

The fans are inside the walk-in units, and they draw air over the cooler evaporators to assist in heat transfer. The fans also maintain air movement to keep walk-in temperatures



Existing walk-in cooler evaporator and fans at Crosby-Wallace.

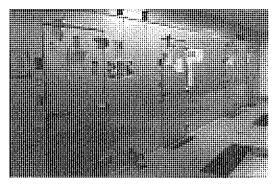
uniform. Typical fan motors are inefficient and add heat to the refrigerated spaces which, in turn, cause the refrigeration systems to work harder. The door heaters prevent frost build-up and potential



freezing up of the units' doors, which is likely to occur when humidity levels in the surrounding space are high.

### Recommended Improvements

NORESCO will add advanced controls and fan motors to the walk-in coolers and freezers in the selected kitchens. The controls will monitor the load in the walk-ins and regulate the operation of the evaporator fans and condensing units to match the load. Evaporator fans will no longer operate continuously, nor will the door heaters, which will be controlled based on the dew point temperatures in the surrounding storerooms. The controls also incorporate improved strategies for defrost cycles that will further reduce the energy consumption



The walk-in refrigeration units, like the ones at Waterbury Arts Magnet, will be more efficient with advanced controls and ECM fan motors.

associated with the walk-in units. Where the existing evaporator fan motors are standard efficiency, they will be replaced with super-efficient electronically commutated motors (ECM), which will use less power than standard efficiency motors and will reduce the ancillary cooling load in the walk-ins.

### Scope of Work

The proposed scope of work includes the installation of new evaporator fan controller(s), electronically commutated fan motor(s), and door heater(s) to control the refrigeration systems and door heaters on the walk-in cooler(s) and freezer(s) in each building, as noted in Table 1.

Table 1: Walk-in Cooler and Freezer Controls Summary

	Evaporator Fan Controls	New Electronically Commutated Motors	Door Heater Controls
Chase	2	2	1
Crosby-Wallace	5	12	1
Duggan		-	2
Generali	2	5	
Maloney	2	6	2
Rotella	2	4	2
Sprague	2	2	-
Walsh	2	2	
Waterbury Arts	4	8	4
West Side	3	5	3
Wilby-North End	4	9	1
Wilson	1	2	1
Total	<u>29</u>	<b>5</b> 7	17



### City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. Customer shall relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or otherwise interfere with the ESM implementation and installation process.

### Hazardous Materials Abatement Allowance

The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.

### Interface with Existing Systems & Operations

### Maintenance Procedures

The reduced runtimes should add to the life of this equipment, potentially delaying future replacement costs. The controllers and new motors will require no additional maintenance than the existing cooler and freezer equipment.

### Special Operating Requirements

There are no special operating requirements.

### **Equipment Information**

### Manufacturer & Type

NORESCO will install CoolTrol® Cooler Control Systems, EC motors, and CoolTrol® Anti-Sweat Door Heater Controllers as summarized in Table 1, or approved equal.

 National Resource Management, 480 Neponset Street, Building 2, Canton, MA 02021, 800-377-8877, www.nrminc.com

### Savings Calculations

The primary sources of energy savings are the improved efficiency of the evaporator fans and motors, the reduced run-time of these fans, and the reduced operation of the door heaters. The affected energy use is calculated by multiplying evaporator fan run hours by the total fan kW and multiplying the door heater operating hours by the door heater kW. Savings are the difference between the current and proposed fan and door heater kWh.



Savings were calculated based on the following key assumptions:

- Evaporator fan and door heater electrical consumption
- Evaporator fan motor efficiency
- Evaporator fans and door heaters currently operate continuously
- Evaporator fan and door heater reduced operating hours

Electric savings were calculated as follows:

- Existing kWh = [(Existing Fan HP × 0.746 × Load) × Existing Fan Run Hours] + (Door Heater kW × Existing Heater Run Hours)
- Proposed kWh = [(Proposed Fan HP × 0.746 × Load) × Proposed Fan Run Hours] + (Door Heater kW × Proposed Heater Run Hours)
- kWh Savings = Existing kWh Proposed kWh



## ESM 11: STEAM BOILERS



### ESM 11: Steam Boilers

**Benefits:** This measure will increase the building's heating system reliability by replacing equipment that is past its useful life and provide redundancy in cases where the lead boiler has failed. New boilers have a smaller footprint than the existing boilers and will increase space in the mechanical rooms for more efficient equipment servicing. The new heating equipment will reduce natural gas consumption due to higher seasonal operating efficiencies, and current maintenance and service costs will be significantly reduced.

Buildings: Barnard Adult Education Bunker Hill School

Chase Building Chase School
Generali School Sprague School

Wilson School

**Summary:** NORESCO will install fourteen (14) new natural gas-fired steam boilers and ancillary heating system equipment in seven (7) buildings. The boilers will be equipped with high-efficiency natural gas burners and modulating controls. This new equipment will serve the buildings' current steam loads, as well provide a degree of redundancy if one of the boilers is down for service. Control of the new boilers will be integrated through the new energy management system (EMS) and provide web-accessible control and monitoring of the buildings' heating plants to facilities staff.

Implementation Cost: \$5,985,553

Energy Cost Savings: \$69,948

Annual Energy Reduction: 29,645 CCF

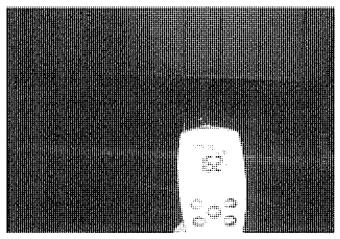
M&V Protocol: Option B

### **Detailed Description**

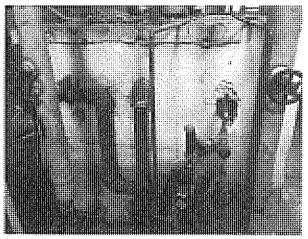
### Existing Description

The majority of the existing low pressure, natural gas-fired steam boilers in the buildings were installed thirty or more years ago and have reached or exceeded the end of their useful lives. The boilers are all cast iron sectional designs, manufactured by HB Smith or Weil-McLain. In each building, the existing boiler capacity exceeds the heating demand, and the burners have limited load matching or turn down capability, resulting in higher natural gas consumption due to low seasonal efficiency (high frequency of boiler cycling).





Old, un-insulated steam boiler at Bunker Hill School will be removed and replaced with new equipment.



Old, ACM containing condensate receiver and feed water tank at the Chase Building will be abated, removed and replaced with new equipment.

**Table 1: Summary of Existing Steam Boilers** 

	Number of Existing Boilers	Total Boiler Capacity (MBH)	Description
Barnard	2	5,733	One (1) HB Smith Mills 450 and one (1) HB Smith Series 28 cast iron sectional (not running), with 3,753 MBH and 2,000 MBH gas Power Flame burners, respectively
Bunker Hill	2	7,506	Two (2) HB Smith Mills 450 cast iron sectionals with 3,753 MBH gas Power Flame burners/each
Chase Building	1	4,200	One (1) HB Smith Mills 450 boiler with recently repaired/replaced sections with 4,200 MBH dual fuel Dunham Bush burner
Chase School	2	6,206	Two (2) HB Smith Series 28 cast iron sectionals with 3,103 Power Flame gas burners/each; one (1) boiler was pouring water out likely from a cracked or failed section(s)
Generali	2	6,206	One (1) HB Smith Series 28 and one (1) Weil Mc-Lain cast iron sectionals, with 3,103 MBH dual fuel Power Flame burners/each
Sprague	2	6,206	Two (2)Weil-McLain cast iron sectionals, with 3,103 MBH dual fuel Power Flame burners/each
Wilson	2	7,506	Two (2) HB Smith Series 28 cast iron sectionals with 3,753 Power Flame gas burners/each



### Recommended Improvements

NORESCO's approach to redesigning the boiler systems is to provide the most energy-efficient equipment while maintaining operational flexibility. To accomplish this, NORESCO will install new boilers with modulating burners, and auxiliaries such as new condensate receiver/feed water pump units, and chemical treatment systems. The boiler systems will be designed with equipment redundancy to provide heating load and operational reliability. Detailed design drawings of the scope of work, including equipment schedules and specifications are included in *Appendix 2: 35% Drawings*.

Table 2: Summary of New Boilers

	Number of New Boilers	Total New Boiler Capacity (MBH)	Description
Barnard	2	7,662	Two (2) new HB Smith Series 28HE steam boilers with high- efficiency modulating Power Flame burners with EMS control and Shipco/DMC dual pump feedwater/condensate receiver
Bunker Hill	2	7,662	Two (2) new HB Smith Series 28HE steam boilers with high- efficiency modulating Power Flame burners with EMS control and Shipco/DMC dual pump feedwater/condensate receiver
Chase Building	2	4,498	Two (2) new HB Smith Series 28HE steam boilers with high- efficiency modulating Power Flame burners with EMS control and Shipco/DMC dual pump feedwater/condensate receiver
Chase School	2	6,080	Two (2) new HB Smith Series 28HE steam boilers with high- efficiency modulating Power Flame burners with EMS control and Shipco/DMC dual pump feedwater/condensate receiver
Generali	2	6,080	Two (2) new HB Smith Series 28HE steam boilers with high- efficiency modulating Power Flame burners with EMS control and Shipco/DMC dual pump feedwater/condensate receiver
Sprague	2	4,498	Two (2) new HB Smith Series 28HE steam boilers with high- efficiency modulating Power Flame burners with EMS control and Shipco/DMC dual pump feedwater/condensate receiver
Wilson	2	7,662	Two (2) new HB Smith Series 28HE steam boilers with high- efficiency modulating Power Flame burners with EMS control and Shipco/DMC dual pump feedwater/condensate receiver

### Scope of Work

### Barnard

- Demolish and remove two (2) existing cast iron low pressure steam boilers, feedwater/ condensate receiver, vent line, surge tank, and associated piping, wiring, and accessories.
- Demolish and remove exhaust breeching back to the main header.



- Furnish and install two (2) new HB Smith model 28HE-S-15 low pressure steam boiler with modulating Power Flame natural gas burner.
- Furnish and install new condensate receiver and feedwater pump set, including new vent pipe.
- Furnish and install new boiler vent and connect to existing breeching.
- Furnish and install new outside air fan for combustion air, including ductwork and damper, and new steam heating coil in the combustion air duct.
- Furnish and install new exhaust air fan, including ductwork and damper.
- Furnish and install new electrical, natural gas line, steam and condensate piping, feed water piping to existing, and new EMS controls.
- Provide system startup, testing, commissioning, and owner training.

### Bunker Hill

- Demolish and remove two (2) existing cast iron low pressure steam boilers, feedwater/ condensate receiver, vent line, surge tank, and associated piping, wiring, and accessories.
- Demolish and remove exhaust breeching back to the main header.
- Furnish and install two (2) new HB Smith model 28HE-S-15 low pressure steam boiler with modulating Power Flame natural gas burner.
- Furnish and install new condensate receiver and feedwater pump set, including new vent pipe.
- Furnish and install new boiler vent and connect to existing breeching.
- Furnish and install new outside air fan for combustion air, including ductwork and damper, and new steam heating coil in the combustion air duct.
- Furnish and install new exhaust air fan, including ductwork and damper.
- Furnish and install new electrical, natural gas line, steam and condensate piping, feed water piping to existing, and new EMS controls.
- Provide system startup, testing, commissioning, and owner training.

### Chase Building

- Demolish and remove two (2) existing cast iron low pressure steam boilers, feedwater tank and pumps, vent line, and associated piping, wiring, and accessories.
- Demolish and remove exhaust breeching back to the main header.
- Furnish and install two (2) new HB Smith model 28HE-S-12 low pressure steam boiler with modulating Power Flame natural gas burner.
- Furnish and install new feedwater tank and dual pump set.
- Furnish and install new boiler vent and connect to existing breeching.
- Furnish and install new outside air fan for combustion air, including ductwork and damper.
- Furnish and install new electrical, natural gas line, steam and condensate piping, feed water piping to existing, and new EMS controls.
- Provide system startup, testing, commissioning, and owner training.



### Chase School

- Demolish and remove two (2) existing cast iron low pressure steam boilers, feedwater/ condensate receiver, vent line, surge tank, and associated piping, wiring, and accessories.
- Demolish and remove exhaust breeching back to the main header.
- Furnish and install two (2) new HB Smith model 28HE-S-12 low pressure steam boiler with modulating Power Flame natural gas burner.
- Furnish and install new condensate receiver and dual pump set, including new vent pipe.
- Furnish and install new feedwater tank and dual pump set.
- Furnish and install new boiler vent and connect to existing breeching.
- Furnish and install new outside air fan for combustion air, including ductwork and damper.
- Furnish and install (2) new horizontal steam unit heaters, including piping and electrical.
- Furnish and install new exhaust air fan, including ductwork and damper.
- Furnish and install new electrical, natural gas line, steam and condensate piping, feed water piping to existing, and new EMS controls.
- Provide system startup, testing, commissioning, and owner training.

### Generali

- Demolish and remove two (2) existing cast iron low pressure steam boilers, feedwater/ condensate receiver, vent line, surge tank, and associated piping, wiring, and accessories.
- Demolish and remove exhaust breeching back to the main header.
- Furnish and install two (2) new HB Smith model 28HE-S-9 low pressure steam boiler with modulating Power Flame natural gas burner.
- Furnish and install new condensate receiver and feedwater pump set, including new vent pipe.
- Furnish and install new boiler vent and connect to existing breeching.
- Furnish and install new outside air fan for combustion air, including ductwork and damper.
- Furnish and install new exhaust air fan, including ductwork and damper.
- Furnish and install new electrical, natural gas line, steam and condensate piping, feed water piping to existing, and new EMS controls.
- Provide system startup, testing, commissioning, and owner training.

### Sprague

- Demolish and remove two (2) existing cast iron low pressure steam boilers, feedwater/ condensate receiver, vent line, surge tank, and associated piping, wiring, and accessories.
- Demolish and remove exhaust breeching back to the main header.
- Furnish and install two (2) new HB Smith model 28HE-S-12 low pressure steam boiler with modulating Power Flame natural gas burner.
- Furnish and install new condensate receiver and feedwater pump set, including new vent pipe.
- Furnish and install new boiler vent and connect to existing breeching.
- Furnish and install new outside air fan for combustion air, including ductwork and damper, and new steam heating coil in the combustion air duct.
- Furnish and install new exhaust air fan, including ductwork and damper.



- Furnish and install new electrical, natural gas line, steam and condensate piping, feed water piping to existing, and new EMS controls.
- Provide system startup, testing, commissioning, and owner training.

### Wilson

- Demolish and remove two (2) existing cast iron low pressure steam boilers, feedwater/ condensate receiver, vent line, surge tank, and associated piping, wiring, and accessories.
- Demolish and remove exhaust breeching back to the main header.
- Furnish and install two (2) new HB Smith model 28HE-S-15 low pressure steam boiler with modulating Power Flame natural gas burner.
- Furnish and install new condensate receiver and feedwater pump set, including new vent pipe.
- Furnish and install new boiler vent and connect to existing breeching.
- Furnish and install new outside air fan for combustion air, including ductwork and damper, and new steam heating coil in the combustion air duct.
- Furnish and install new exhaust air fan, including ductwork and damper.
- Furnish and install new electrical, natural gas line, steam and condensate piping, feed water piping to existing, and new EMS controls.
- Provide system startup, testing, commissioning, and owner training.

### City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. Customer shall relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or otherwise interfere with the ESM implementation and installation process.

### Hazardous Materials Abatement Allowance

The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.



### Interface with Existing Systems & Operations

### Maintenance Procedures

The replacement of the existing boilers with new boilers and accessories will significantly reduce maintenance, service, and repair efforts and costs by removing equipment that is near the end or past its useful service life.

### **Special Operating Requirements**

There are no special operating or maintenance activities required for the new boilers that are not already required of the maintenance staff for the existing equipment, other than the addition of the chemical treatment systems, which will need to be regularly monitored and maintained.

### **Equipment Information**

### Manufacturer & Type

NORESCO will install boilers from the following manufacturer:

• HB Smith, 260 North Elm Street, Westfield, MA 01085, 413-562-9631, www.smithboiler.com

### **Savings Calculations**

The calculations for the savings from this boiler replacement ESM were based on calculations of building loads and heating system usage at various outside air temperatures over the course of a year. A simple approximation of the formulae used for this calculation is shown below.

- Heating Savings (for each hour of the year) = Hours × Heating Load × (1/Proposed Heating Efficiency - 1/Existing Heating Efficiency)
- Existing Heating Efficiency = 100% Existing Combustion Efficiency Existing Thermal
   Efficiency
- Proposed Heating Efficiency = Existing Boiler Efficiency = 100% Proposed Combustion
   Efficiency Proposed Thermal Efficiency



# **ESM 12:**

HOT WATER BOILERS & POOL HEATING SYSTEMS



# ESM 12: Hot Water Boilers & Pool Heating Systems

**Benefits:** This measure will improve the heating system reliability by replacing equipment that is past its useful life and provide redundancy in cases where the lead boiler is down for service or repairs. New boilers have a smaller footprint than the existing boilers and will increase space in the mechanical rooms for more efficient equipment servicing. The new heating systems will significantly reduce natural gas consumption due to higher seasonal operating efficiencies. With the addition of new hot water boilers, the steam boilers will no longer need to operate year round, thus extending their operating life as well as creating extended periods to perform routine preventative maintenance.

**Buildings:** Crosby-Wallace Complex Kennedy High School

West Side School Wilby-North End Complex

**Summary:** NORESCO will install a total of seven (7) gas steam boilers, seven (7) gas hot water boilers, two (2) gas pool heaters, one (1) pool heat exchanger, two (2) hot water heat exchangers, three (3) domestic hot water heat exchangers, pumps, feedwater tanks, and other ancillary heating system equipment in the four buildings listed. Heating systems will be redesigned and modernized to allow for high-efficiency condensing boilers and pool heaters to be incorporated with new steam boilers to provide optimized operations and efficiencies. The boilers will be a combination of high-efficiency condensing hot water boilers and steam boilers with high-efficiency natural gas burners and electronic combustion trim and  $O_2$  controls. This new equipment will serve the building space, domestic, and pool heating loads. Control of the new boilers will be integrated with the upgraded and expanded energy management system (EMS) and provide web-accessible monitoring and control of the buildings' heating plants to facilities personnel.

Implementation Cost: \$7,409,455

Energy Cost Savings: \$153,827

Annual Energy Reduction: 127,380 CCF

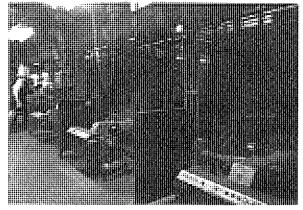
M&V Protocol: Option B

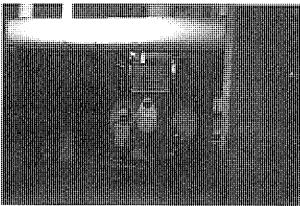
### **Detailed Description**

### **Existing Description**

The existing low pressure, natural gas-fired steam boilers were installed thirty (30) or more years ago and have reached the end of their useful life, and many have required recent expensive service and repairs to continue running. Some of the boilers are no longer operational. The boilers are a mix of fire tube and cast iron sectional designs. These boilers provide direct steam service to a variety of space heating systems in each building, as well as heating, domestic hot water (DHW), and pool water steam-to-hot water heat exchangers.







Sectional steam boilers at West Side Middle School

Fire-tube steam boiler at Wilby-North End Complex

As a result, these boilers need to operate year round. In each building, the existing boiler capacity exceeds the combined heating demands, and the burners have limited load matching and turn down capabilities, resulting in higher natural gas consumption due to low seasonal efficiency (high frequency of boiler cycling) during the non-heating season.

Table 1: Summary of Existing Steam Boiler, Pool, DHW, Perimeter Heating Systems

	Existing Steam Boilers	Total Boiler Capacity (MBH)	Hot Water Heating	Pool Heating	DHW Heating	Steam Boiler Data
Crosby-Wallace	3	31,380	НХ	НХ	НХ	Three (3) Cleaver Brooks CB600-250 fire-tube steam boilers with dual fuel CB burners
Wilby-North End	3	18,831	НХ	Gas	НΧ	Three (3) Cleaver Brooks CB600-150 fire-tube steam boilers with dual fuel CB burners
West Side	3	21,213	нх	НХ	НХ	Three (3) HB Smith Mills 4500 steam sectional boilers with dual fuel 7,071 MBH gas Power Flame burners
Kennedy	2	9,526	N/A	нх	Gas	One (1) new Weil-McLain Model 88 Series 2 steam boiler and one (1) old Weil- McLain sectional steam boiler each with 4,763 gas PowerFlame burners



### Recommended Improvements

NORESCO's approach to redesigning the boiler systems is to provide the most energy-efficient equipment while maintaining and improving operational flexibility. To accomplish this, NORESCO will install modulating, condensing hot water boilers in buildings where it is practical to do so. Many systems will be converted from using steam indirectly to hot water; however, the air handlers will continue to use steam from the steam boilers to allow the existing heating coils to remain in use and continue providing heat and freeze protection. The steam and hot water systems will be designed with sufficient capacity to ensure a degree of redundancy to provide operational assurance.

Condensing hot water boilers offer unparalleled energy efficiency with combustion efficiencies between 92% and 98%. Condensing boilers operate efficiently at part loads, so efficient operation will be maintained in the fall and spring as well as the winter. New steam boilers will include high-efficiency, modulating natural gas burners providing higher operating efficiencies across all heating loads, but will be designed to also maintain peak heating loads on design days in the winter.

The schools with both perimeter hot water systems and steam coils in the air handling units will receive both new heating hot water boilers and new steam boilers. This design allows hot water systems to be served by the high-efficiency condensing hot water boilers while maintaining steam boilers to serve the air handling unit heating coils. Kennedy and West Side will receive new gas-fired pool heaters, and West Side, Crosby-Wallace and Wilby-North End will receive new instantaneous indirect-fired domestic hot water heat exchangers. Crosby-Wallace will also have two (2) new steam-to-hot water heat exchangers installed in the building's "wing" pump rooms. As a result of all this work, the steam boilers will now only need to operate during the winter months, thus allowing for extended equipment life, optimized load matching and system efficiencies, and critical additional time for scheduled preventative maintenance and service during the summer months. In all four buildings, one existing steam boiler will remain to serve as an emergency backup in the unlikely scenario that the new boilers are down for repairs during the heating season.

In addition to the new steam and hot water boilers, instantaneous heat exchangers and pool heaters, the new heating systems will include new associated equipment such as feedwater tank and pump sets, heating/DHW/pool pumps, chemical treatment, combustion makeup air units and exhaust air fans, valving, piping, insulating, wiring, concrete slabs, and direct digital controls (DDC) integrated with the upgraded and expanded energy management system (EMS). Detailed design drawings of the scope of work, including equipment schedules and specifications are included in *Appendix 2: 35% Drawings*.

### City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. Customer shall relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or otherwise interfere with the ESM implementation and installation process.



### Hazardous Materials Abatement Allowance

The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.



Table 2: Summary of New Steam Boiler, Pool, DHW, and Perimeter Heating Systems

	Remaining Steam Bollers	New Steam Boilers	New Hot Water Boilers	Pool Heating	DHW Heating	New Equipment Data
Crosby-Wallace	<b>,</b>	72	2	ІРЕЖН	IDFWH	NORESCO to provide two (2) new low-pressure, gas-fired Cleaver-Brooks CBLE-250 steam boilers each rated for 8,369 MBH; two (2) new high-efficiency, gas-fired Aerco BMK condensing hot water boilers rated for 2,500 MBH/ea. to serve the perimeter heating load; one (1) 2,750 MBH DHW and one (1) 338 MBH Pool indirect-fired hot water heat exchangers.
Wilby-North End	-	2	3	Gas	IDFWH	NORESCO to provide two (2) new low-pressure, gas-fired Cleaver-Brooks CBLE-125 steam boilers each rated for 4,184 MBH; three (3) new high-efficiency, gas-fired Aerco BMK condensing hot water bollers rated for 3,000 MBH/ea. to serve the perimeter load; one (1) 2,750 MBH DHW indirect-fired hot water heat exchanger.
West Side		2	~	Gas	IDFWH	NORESCO to provide two (2) new low-pressure, gas-fired HB Smith 28HE-S18 high-efficiency steam boilers each rated for 5,553 MBH; two (2) new high-efficiency, gas-fired Aerco BMK condensing hot water boilers rated at 2,000 MBH/ea. to serve the perimeter load; one (1) 1,250 MBH DHW indirect-fired hot water heat exchanger; one (1) Lochinvar EnergyRite Model ERN402-A pool heater rated for 400 MBH.
Kermedy	÷	<u>-</u>	X	gs	G as s	NORESCO to provide one (1) new low-pressure, gas-fired HB Smith 28HE-S18 steam boiler rated for 5,553 MBH; one (1) high-efficiency, gas-fired Lochinvar EnergyRite Model ERN402-A pool heater rated for 400 MBH.

Note: IDFWH (Indirect-fired Instantaneous Water Heater) supplied by new hot water condensing boilers.



### Scope of Work

NORESCO will install two (2) new low-pressure, gas-fired Cleaver-Brooks fire tube steam boilers in each complex to serve the steam-fired air handler systems and other steam-fired systems. Additionally, two new high-efficiency, gas-fired Aerco condensing hot water boilers will be installed in each complex to serve the perimeter hot water and DHW loads. Crosby-Wallace will also receive a new high-efficiency, gas-fired Lochinvar pool heater similar to the boiler currently installed at Wilby-North End. New hot water piping and associated hot water pumps would be provided to connect the hot water boilers to the existing hot water distribution systems. New steam-to-hot water heat exchangers will be installed at Crosby-Wallace for the "wing" perimeter hot water loads. Gas, steam, condensate, and hot water piping will be provided to make the systems operational. Control of the new systems will be provided by the newly upgraded DDC EMS. A summary of the scope of work includes:

### Crosby-Wallace

- Demolish and remove two (2) existing Cleaver-Brooks CB-600-250 low pressure steam boilers and natural gas burners, feedwater tank and pump set, vent line, surge tank, and associated piping, wiring, and accessories.
- Demolish and remove exhaust breeching for the two boilers back to the main header.
- Demolish and remove one (1) perimeter hot water heat exchanger in the main boiler room, including piping back to the main steam header, condensate return, and hot water piping.
- Demolish and remove two (2) perimeter hot water exchangers in storage rooms A162 and E140.
- Demolish and remove existing makeup air unit, including piping back to the steam header.
- Abandon in place (2) main boiler room DHW heat exchangers, cutting back piping to facilitate new DHW heat exchanger installation.
- Abandon in place one (1) existing pool heat exchanger, valving off the steam at the isolation valve at the main steam header.
- Furnish and install two (2) new Cleaver-Brooks CBLE-250 low pressure steam boilers with integral burners. Install the new boilers on the existing boiler housekeeping pads and connect to existing electrical, natural gas lines, steam header, condensate piping, feed water piping, and new EMS controls.
- Furnish and install new boiler venting and connect to existing breeching.
- Furnish and install new feedwater tank and pump set.
- Furnish and install new blowdown separator tank and aftercooler, including water connection and vent piping to atmosphere.
- Furnish and install new water chemical treatment system.
- Furnish and install two (2) new perimeter hot water exchangers in storage rooms A162 and E140.
- Furnish and install two (2) new Aerco BMK2500 high-efficiency condensing hot water boilers, including 4" concrete housekeeping pads, including a 250-gallon buffer tank on a new 4" concrete housekeeping pad and insulated piping and valving to connect to existing piping.



- Connect to existing electrical, natural gas lines, existing boiler room perimeter hot water supply and return piping via a new primary loop hot water pump, and new EMS controls.
   Provide sealed combustion and breaching per manufacturer's specifications.
- Furnish and install one (1) new Aerco SP-150 2,750 MBH indirect-fired water heat exchanger with DDC and EMS interface for the domestic hot water heating and connect to existing piping, including new 4' concrete housekeeping pad.
- Furnish and install one (1) new plate and frame heat exchanger in the pool mechanical room, including new pump and supply/return piping from the main boiler room to the pool equipment room.
- Provide system startup, testing, commissioning, and owner training.

### Wilby-North End

- Demolish and remove two (2) existing Cleaver-Brooks CB-600-150 low pressure steam boilers and natural gas burners, feedwater tank and pump set, vent line, surge tank, and associated piping, wiring, and accessories.
- Demolish and remove exhaust breeching for the two boilers back to the main header.
- Abandon in place one (1) perimeter hot water heat exchanger in the main boiler room, cutting piping back to the main steam header, condensate return, and hot water piping to facilitate new hot water boiler installations.
- Demolish and remove existing makeup air unit, including piping back to the steam header.
- Abandon in place two (2) main boiler room DHW heat exchangers, cutting back piping to facilitate new DHW heat exchanger installation.
- Furnish and install two (2) new Cleaver-Brooks CBLE-125 low pressure steam boilers with integral burners. Install the new boilers on the existing boiler housekeeping pads and connect to existing electrical, natural gas lines, steam header, condensate piping, feed water piping, and new EMS controls.
- Furnish and install new boiler venting and connect to existing breeching.
- Furnish and install new feedwater tank and pump set.
- Furnish and install new blowdown separator tank and aftercooler, including water connection and vent piping to atmosphere.
- Furnish and install new water chemical treatment system.
- Furnish and install new makeup air unit, including piping back to the steam header.
- Furnish and install three (3) new Aerco BMK3000 high-efficiency condensing hot water boilers, including 4" concrete housekeeping pads, including a 250-gallon buffer tank on a new 4" concrete housekeeping pad and insulated piping and valving to connect to existing piping.
- Connect to existing electrical, natural gas lines, existing boiler room perimeter hot water supply and return piping via a new primary loop hot water pump, and new EMS controls.
   Provide sealed combustion and breaching per manufacturer's specifications.
- Furnish and install one (1) new Aerco SP-150 2,750 MBH indirect-fired water heat exchanger with DDC and EMS interface for the domestic hot water heating and connect to existing piping, including new 4" concrete housekeeping pad.



Provide system startup, testing, commissioning, and owner training.

### West Side and Kennedy

NORESCO will install one (1) new low-pressure, gas-fired HB Smith sectional steam boiler at Kennedy and two (2) new HB Smith sectional steam boilers at West Side to serve the steam-fired heating systems, complete with modulating Power Flame burners. For West Side, new high-efficiency, gas-fired Aerco condensing hot water boilers will be installed to serve perimeter and DHW hot water loads. West Side and Kennedy will also receive a new high-efficiency, gas-fired Lochinvar condensing hot water boiler to heat the pool. New hot water piping and associated hot water pumps will be provided to connect the hot water boilers to the existing hot water distribution systems. Existing steam-to-hot water heat exchangers will be repurposed to serve as a backups for the perimeter and DHW loads. Gas, steam, and hot water piping will be provided to make the system operational. Control of the boiler system will be provided by the new DDC EMS.

### West Side

- Demolish and remove two (2) existing cast iron low pressure steam boilers, feedwater/ condensate receiver, vent line, and associated piping, wiring, and accessories.
- Demolish and remove exhaust breeching back to the main header.
- Furnish and install two (2) new HB Smith model 28HE-S-18 low pressure steam boilers with modulating Power Flame natural gas burner.
- Install the new boiler on the existing boiler housekeeping pads and connect to existing electrical, natural gas line, steam header, condensate piping, and feed water piping.
- Furnish and install new feedwater tank and pump set, including new vent pipe.
- Furnish and install new Type "B" boiler vent and connect to existing breeching.
- Furnish and install new electrical, natural gas line, steam and condensate piping, feed water piping to existing, and new EMS controls.
- Furnish and install new water chemical treatment system.
- Furnish and install two (2) new Aerco BMK2000 high-efficiency condensing hot water boilers, including 4" concrete housekeeping pads, including a 250-gallon buffer tank on a new 4" concrete housekeeping pad and insulated piping and valving to connect to existing piping.
- Connect to existing electrical, natural gas lines, existing boiler room perimeter hot water supply and return piping via two (2) new primary loop hot water pump, and new EMS controls. Provide sealed combustion and breaching per manufacturer's specifications.
- Furnish and install one (1) new Aerco SP-150 2,750 MBH indirect-fired water heat exchanger with DDC and EMS interface for the domestic hot water heating and connect to existing piping, including new 4" concrete housekeeping pad.
- Furnish and install one (1) new Lochinvar EnergyRite Model ERN402-A pool water heater in pool mechanical room. Provide new housekeeping pad, electric service, gas piping, sealed combustion, and breaching per manufacturer's specifications.
- Provide system startup, testing, commissioning, and owner training.



### Kennedy

- Demolish and remove one (1) existing Weil-McLain cast iron low-pressure steam boiler and Power Flame burner.
- Demolish and remove exhaust breeching back to the main header.
- Furnish and install one (1) new HB Smith model 28HE-S-18 low pressure steam boiler with modulating Power Flame natural gas.
- Install the new boiler on the existing boiler housekeeping pads and connect to existing electrical, natural gas line, steam header, condensate piping, and feed water piping.
- Furnish and install new Type "B" boiler vent and connect to existing breeching.
- Furnish and install new electrical, natural gas line, steam and condensate piping, feed water piping to existing, and new EMS controls.
- Furnish and install new water chemical treatment system.
- Furnish and install one (1) new Lochinvar EnergyRite Model ERN402-A pool water heater in pool mechanical room, and connect to existing pool water pump set. Provide new housekeeping pad, electric service, gas piping, sealed combustion, and breaching per manufacturer's specifications.
- Provide system startup, testing, commissioning, and owner training.

### **Interface with Existing Systems & Operations**

### Maintenance Procedures

The new boilers and associated equipment will significantly reduce maintenance, service, and repair efforts and costs by removing equipment that is near the end or past its useful service life.

### Special Operating Requirements

There are no special operating or maintenance activities required for the new boilers that are not already required of the maintenance staff for existing equipment, other than the addition of the chemical treatment systems, which will need to be regularly monitored and maintained.

### **Equipment Information**

### Manufacturer & Type

NORESCO will install the following equipment:

- AERCO International, Inc., 100 Oritani Drive, Blauvelt, NY 10913, 845-580-8000, www.aerco.com
- Cleaver-Brooks, 221 Law Street, Thomasville, GA 31792, 800-250-5883, www.cleaverbrooks.com
- HB Smith, 260 North Elm Street, Westfield, MA 01085, 413-562-9631, www.smithboiler.com



### **Savings Calculations**

The calculations for the savings from this boiler replacement ESM were based on calculations of building loads and heating system usage at various outside air temperatures over the course of a year. A simple approximation of the formulae used for this calculation is shown below.

- Heating Savings (for each hour of the year) = Hours × Heating Load × (1/Proposed Heating Efficiency – 1/Existing Heating Efficiency)
- Existing Heating Efficiency = 100% Combustion Losses Radiant Jacket Losses Existing
   Distribution Losses
- Proposed Heating Efficiency = Existing Boiler Efficiency = 100% Proposed Combustion
   Losses Proposed Radiant Jacket Losses Proposed Distribution Losses



# **ESM 13:** SOLAR PHOTOVOLTAICS



### ESM 13: Solar Photovoltaics

**Benefits:** This measure will generate electricity from a renewable resource and offset a portion of the purchased electric consumption and peak demand. Solar photovoltaic (PV) systems will provide a visible source of renewable energy that demonstrates Waterbury's commitment to green technologies, sustainability, and environmental stewardship.

Buildings: Duggan School Police Headquarters

**Summary:** NORESCO will install solar PV array systems on the roofs of the two buildings listed above. The PV systems will include solar panels, racks, mounts, inverters, disconnects, and all cabling, wiring, and controls. Roofs on all buildings were evaluated, and the two buildings listed are included because the roofs are only a few years old or will be replaced by the time this project goes to construction.

Implementation Cost: \$305,489

Energy Cost Savings: \$27,863

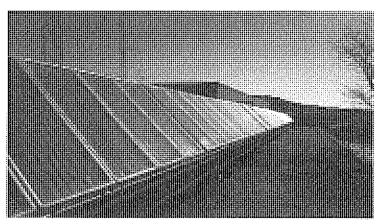
Annual Energy Reduction: 136,116 kWh

M&V Protocol: Option B

### **Detailed Description**

### **Existing Description**

The City of Waterbury has a 75-kilowatt (kW) solar photovoltaic (PV) array installed on the roof of the Gilmartin School. The Police Headquarters has a solar thermal heating system that has long since been decommissioned and abandoned in place, and has since been removed during the recent replacement of the roof.



Abandoned solar thermal panels will be replaced with solar photovoltaic arrays at Waterbury Police Headquarters.

### Recommended Improvements

The PV array systems will generate electricity from a renewable resource and offset a portion of the purchased electric consumption and peak demand for the City's facilities. The PV systems will reduce electricity purchased from Eversource while providing a visible source of renewable energy that



demonstrates the City's commitment to green technologies, sustainability, and environmental stewardship.

The PV systems will be eligible for Connecticut's Zero Emissions Renewable Energy Credit (ZREC) program through the utility, Eversource. This program allows qualified zero emissions generation projects to generate Class I renewable energy certificates (RECs) that can provide a revenue stream over 15 years for the project. The RECs would be bid during the IGEA and the price locked in with Eversource for 15 years; removing any risk of the REC value changing over the project repayment term. The proposed systems would all be classified under the small (< 100 kW) ZREC program.

### Scope of Work

This ESM involves direct current (DC), fixed PV systems to be mounted on the roofs. NORESCO will provide complete turnkey installation of the PV array systems. The PV systems will also include the DC to alternating current (AC) inverters, combiner boxes, AC and DC disconnects, metering, isolation transformers (if required), protective relays, grounding system, PV racking, automated controls, overcurrent protection, lightning protection, interconnecting wiring and conduits, display kiosks for each building lobby, and network connections. With the exception of the array at the Police Headquarters, which will utilize the existing structural steel previously used for the demolished solar thermal system, the systems will be installed using ballasted racking systems, which do not require any roof penetrations and will maintain the existing roof warranties.

Table 1: Solar Photovoltaics Installation

	fdirestrar of Parada	walkaning	Amay Capacita GMADCO	Acray Capacity Child ACI
Sizer	216	2	75	46
Prace III.	123	3	38	34
	***************************************			

### The scope of work includes:

- The proposed PV system designs are based on using Trina Solar TSM-PD14 305W72 cell
  multicrystalline PV modules. PV panels shall be independently certified to meet IEEE 1262 and
  UL 1703 Standards.
- Furnish and install the individual PV array panels for a nominal system size as detailed in Table 1 above (based on Standard Test Conditions, STC rating of modules).
- The PV systems shall be interconnected to existing distribution panel located in the buildings'
  main electrical rooms. NORESCO shall furnish and install required equipment and materials to
  connect to existing distribution panel(s).
- New circuit breakers shall be provided with the proper available interrupting current rating and trip settings required by the national electric code if the existing circuit breaker(s) are not reverse feed rated. Provide new reverse feed circuit breakers to the extent required to ensure the upstream overcurrent protection device(s) will trip during a fault.



- Furnish and install new conductors from the inverters to the existing distribution panels.
   Provide weatherproof penetration into each building. Electrical metallic tubing (EMT) may be used to route from buildings' entrances to the distribution panel.
- Furnish and install steel racking to mount the PV systems. Racking will be located to maximize solar collection. The metal racking will be electrically grounded.
- Installations will use mounting, racking systems, and hardware specifically designed for use with PV, incorporating rust and corrosion-resistant components and appropriately engineered to withstand anticipated structural, environmental, and wind loading conditions.
- Furnish and install solidly grounded systems in compliance with the National Electrical Code to include: bonded AC and DC grounding electrodes, bonding connections, bonding jumpers, grounded conductors, and equipment grounding straps.
- Furnish and install solar PV inverters and associated equipment. Inverters shall be selected appropriate to the PV array size and to match maximum efficiency with selected PV modules. Inverter shall be installed inside power plant and will be a NEMA 1 enclosure.
- The PV systems shall be interconnected to the buildings' electrical distribution systems. The
  PV systems will comply with current guidelines governing interconnection with the electrical
  distribution system, and any subsequent revisions to these guidelines.
- NORESCO will coordinate with Eversource and the City of Waterbury to submit the Interconnection Application and coordinate any required utility metering upgrades or installations required by the CL&P, including additional fees and equipment installation.
- Furnish and install lockable, utility-accessible AC disconnects as required per Eversource interconnection requirements.
- NORESCO will assist the City to obtain available Eversource and State of Connecticut renewable energy credits. This will include but not be limited to the following:
  - Submitting a Zero Emissions Renewable Energy Credit (ZREC) application to the local utility company (CL&P).
  - Administering documentation of system production to receive the ZREC credits for the term of the ZREC credit contract.
  - Sizing calculations, preliminary single line and other required drawings, inverter and transformer data, and other technical data required for submission of the Interconnect Application to the electric utility and Proof of Project Advancement Documentation necessary to formally reserve the energy credit funds with the rebate Program Administrator.
  - Provide warranty information on PV modules, inverters, and balance of system required to submit the ZREC claim documentation at completion of project.
  - Provide building department inspection report and any required breakdown cost documentation required to submit the ZREC claim documentation at completion of project.
  - Design, plans, drawings, general specifications, detail specifications, and modifications of standard designs and equipment.



- Complete bill of materials including, but not limited to, the complete PV arrays, inverters, array support structures and concrete footings, balance of systems, wire, and conduit.
- Component manufacturer and materials warranties.
- The overall PV systems' design and components will comply with relevant American Society for Testing and Materials (ASTM) standards, the Institute of Electrical and Electronics (IEEE) PV standards, the International Engineering Consortium (IEC) standards, Underwriters Laboratories (UL) standards, National Fire Protection Association (NFPA) and National Electrical Code (NEC) standards, the National Electrical Safety Code, Federal Communications Commission (FCC) electromagnetic interference standards, Connecticut State and Local Building Codes, and American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) guidelines.
- The PV modules shall be UL listed and fire rated Class C or better if stand-alone or rack mounted systems.
- The electrical design will comply with the National Electrical Code (NEC) Article 690 and Article 705.
- The electrical design will comply with IEEE Standards 929-2000 Recommended Practice for Utility Interface of Photovoltaic (PV) Systems interconnection requirements.
- Electrical materials will be Underwriters' Laboratories listed.
- The electrical homeruns from the PV arrays will take the most direct and visually acceptable route to the interconnection point with the minimum disruption to surrounding structures.
- The PV systems Eversource interconnection will have isolation transformers, manuals, and lockable disconnects.
- The PV system inverters' electrical outputs at the Eversource connection points will be pure sine wave, 60 Hz, and match the Eversource voltage and phase.
- AC power and signal wires and conductors will be copper in rigid galvanized conduit and/or electrical metallic tubing (EMT) above grade.
- The systems will be earth-grounded and will have appropriate lightning and ground fault protection and other safety devices as necessary.

### City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. Customer shall relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or otherwise interfere with the ESM implementation and installation process.

### Hazardous Materials Abatement Allowance

The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required



for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.

### Interface with Existing Systems & Operations

### Maintenance Procedures

The PV panels will require minimal maintenance from the City. The arrays should be cleaned and inspected as per the manufacturer's recommendations. The inverters, breakers, and balance of the systems should be inspected as per manufacturer's operation and maintenance (O&M) specifications.

### **Special Operating Requirements**

There are no special operating requirements.

### **Equipment Information**

### Manufacturer & Type

NORESCO will provide PV arrays manufactured by the following:

Trina Solar Limited through Greenskies Renewable Energy, LLC, 10 Main Street Extension,
 Suite E, Middletown, CT 06457, 860-398-5408, www.greenskies.com

### Savings Calculations

Solar photovoltaic system energy calculations were performed using the U.S. Department of Energy's National Renewable Energy Laboratory's (NREL) online software calculator, PV Watts®, to determine the individual PV system's output. The following data and assumptions were used to perform the calculations:

### Location and Station Identification

Reguested Location: Waterbury, Connecticut

Weather Data Source: HARTFORD BRAINARD FD, CT (TMY3)

Latitude: 41.93° NLongitude: 72.68° W

### PV System Specifications

DC Rating: Various kW

System Losses: 14%

Inverter Efficiency: 96%

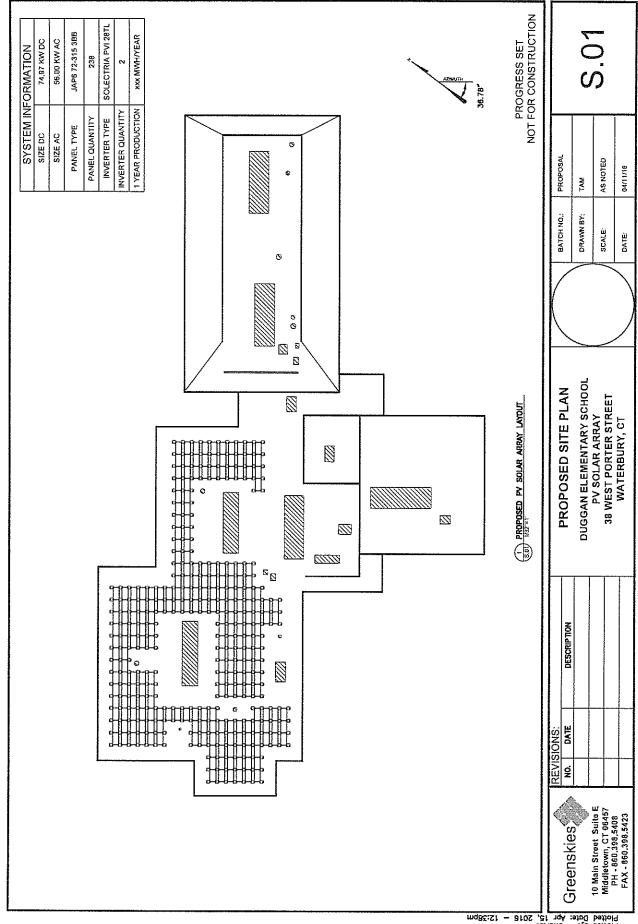
Array Type: Fixed (open rack)

Array Tilt: 5° (20° at Police Station which reuses solar thermal racking)

Array Azimuth: 180°



# ESM 13: PROPOSED SITE PLAN





Site Address

Waterbury Police Department, 255 East Main Street, Waterbury, CT

Type of Solar Array

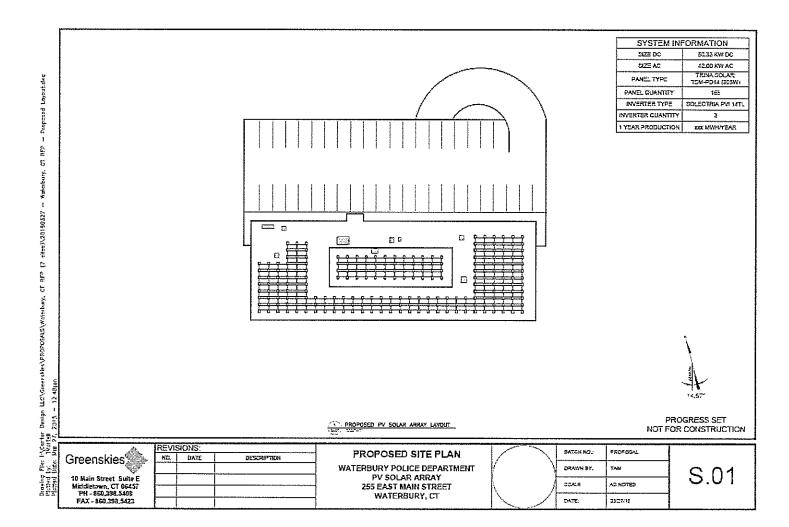
Roof Mount

Array Size

50.33 kW (DC)

kW/hour Production

61,347 kW Hours





# ESM 14:

NEW ELECTRICAL SWITCHGEAR & BACKUP POWER GENERATION



# ESM 14: New Electrical Switchgear & Backup Power Generation

**Benefits:** This measure will increase the electrical reliability and safety in the Chase Building, while ensuring critical electrical services are provided without interruption. The new switchgear will bring the equipment up to the latest electrical code requirements and provide an additional 30 years of service.

Buildings:

Chase Building

**Summary:** NORESCO will install new electrical switchgear, backup emergency generator, and additional electrical infrastructure in the Chase Building to provide emergency power to the building's IT data center loads, and the fourth floor Emergency Operations Center (EOC).

Implementation Cost:

\$1,255,855

**Energy Cost Savings:** 

N/A

**Annual Energy Reduction:** 

N/A

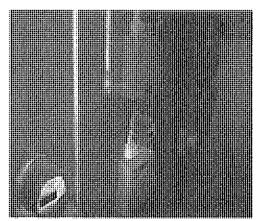
M&V Protocol:

N/A

### **Detailed Description**

### Existing Description

The electrical switchgear at the Chase Building was installed more than 30 years ago and is at the end of its useful service life. In this building, nothing operates without a reliable flow of electricity. Over time, a combination of water, dust, high humidity levels, and vibration caused a degradation of the building's switchgear. Moisture and dust combine to form an insulating layer on surfaces, reducing heat transfer from the components and increasing component operating temperatures. Similarly, moisture and dust coat components, restricting their movement and causing excessive wear.

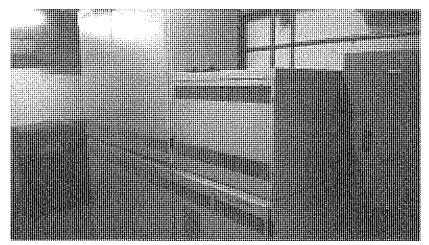


Multiple electric service meters will be consolidated into a single service meter

Annual cleaning and inspection of the switchgear is needed to maintain this equipment, and the switchgear in the Chase Building is long overdue for this maintenance, as confirmed with City Electrical Shop Foreman Tony Cicchiello. Additionally, in the Chase Building, there are actually two separate



utility service connections, each located at opposite ends of the building. As a result of the age of the building and its varied use over the years, the building presently has seven (7) utility meters.



Emergency lighting battery storage and inverter system will no longer need to be replaced every 5 years resulting in significant maintenance savings

### Recommended Improvements

NORESCO will replace the main switchgear in the Chase Building with a new 3000A, 208/120V switchboard; remove a 1200A fused distribution panel in the main electrical room and rewire the loads directly to the newly installed switchboard; remove the existing 800A secondary service meter (7th meter) and its panel board in East Basement; and install a new 800A panelboard and connect it into the new main switchboard. The switchgear will have the conductors disconnected and then reconnected when the new equipment is installed. The installation of the new switchgear is expected to occur over one weekend to minimize disruption to the facility.

NORESCO recommends installing a new 200 kW (actual installed capacity to be determined during final design), natural gas standby/emergency generator in an outdoor enclosure. This generator will provide backup power for emergency lights, IT equipment in the main IT room and the IDF room on the third floor, and other critical loads to be identified during final design. The generator will also backup the building's Waterbury Fire Department's Emergency Operation Center (EOC) area on the fourth floor.

Detailed design drawings of the scope of work, including equipment schedules and specifications, are included in *Appendix 2: 35% Drawings* (see drawings E-001, EA-101 and EA-201 dated June 1, 2016).

Page | 2



### Scope of Work

NORESCO will furnish and install new 60 hertz, 3-phase, 4-wire switchgear, as noted in Table 1.

### Table 1: Scope of Work for the Chase Building

Voltage	Amperes
120/208V	3,000A

### General Conditions

- NORESCO will field verify existing site conditions prior to conducting electrical demolition and installation. A licensed professional engineer licensed in the state of Connecticut will produce completed signed and sealed electrical drawings and specifications of the demolition, coordination and new installation per scope of work outlined in this document.
- An installation phasing plan and provisions to provide additional backup generation as required by the facility during the construction phase will be provided.

### New Switchgear Installation

- Disconnect existing feeders serving main switchboard. Disconnect the feeders served by the main switchboards serving the existing connected loads. Existing conductors will be retained for reconnection to replacement electrical equipment.
- Remove the existing 3000A, 208/120V main switchboard and associated six (6) utility meters.
- Dispose of the existing switchboard. NORESCO will rearrange existing conduit stub outs as required to match new electrical cabinet configuration.
- New switchgear will be rated to withstand expected short circuit current based on short circuit analysis.
- Provide and install a new 3000A, 208/120V main switchboard and one (1) single revenue meter.
- Existing conductors will be reconnected to serve the switchboard and existing loads. Damaged conductors will be replaced with new conductors of same size and type. Existing conduits will be reused.
- Remove existing 1200A fused distribution panelboard in main electrical room and wire directly into new main switchboard.
- Remove existing 800A secondary service meter (7th meter) and its panel board in East Basement.
- Provide and install a new 800A panelboard and connect into new main switchboard.

### Back Up Generation

- Provide a 208V/120V, natural gas fired standby/emergency generator, in a packaged sound attenuated, outdoor enclosure (installed capacity to be determined during final design).
- Provide concrete foundation for the new generator.



- Provide two (2) automatic transfer switches:
  - One (1) 400 A for essential IT loads, IT room air conditioning units in the IT room on the third floor, IDF room on the third floor, the boilers, and the Fire Department EOC area on the fourth floor
  - One (1) 100 A for emergency lights, replacing the existing battery-powered inverter system
- Remove existing emergency lighting inverter system in the basement.
- For the Fire Department EOC area, individual branch circuits will have to be field verified and wired to designated emergency power panel-3 on the fourth floor.
- Consolidate existing IT room circuits in new panelboards as indicated on EA-101, replacing existing panelboards in the backroom of the IT area on third floor.
- NORESCO will provide and install required grounding system per the National Electric Code, including but not limited to equipment grounding conductors, grounding electrodes, and ground bonding.

### City's Responsibilities

City shall be responsible for the removal or relocation of stored items in occupied spaces and mechanical rooms that interfere with work and staging areas. Customer shall clean mechanical room floors prior to start of work to assure they are free of oil, grease or other chemicals. Customer shall relocate furniture, file cabinets, or other obstructions in order to facilitate safe, unimpeded access to areas and equipment or otherwise interfere with the ESM implementation and installation process.

### Hazardous Materials Abatement Allowance

The scope of work (SOW) includes a project allowance in the amount of \$890,000 for testing and abatement of hazardous materials that may be encountered, including the abatement of lead and asbestos that may be encountered with this ESM. NORESCO may use this allowance for abatement at its discretion during the construction period. Any hazardous materials testing or abatement required for the completion of the SOW in excess of this allowance shall be the sole responsibility of the City. NORESCO makes no representations or warranties with respect to the amount or character of hazardous materials that may be encountered in the SOW. NORESCO will provide the City with an accounting of this allowance prior to Final Acceptance of the project. Any funds remaining in the allowance may be allocated to additional work through execution of a change order or remitted to the City.

### Design Allowance

The SOW Sum includes a design allowance in the amount of \$50,000 for ESM 14 that may be used to add additional scope to that measure after execution of the Contract at the request of the City. Use of this allowance will be authorized by execution of a change order by both Parties. Any funds remaining in the allowance may also be allocated to additional work at the City's request through execution of a change order or remitted to the City at the end of the Interim Period.



### Interface with Existing Systems & Operations

### Maintenance Procedures

There are no special maintenance procedures for the new electrical equipment.

### **Special Operating Requirements**

The new systems offer a high level of control but will operate simply and effectively. Following installation, NORESCO will provide a review of the system controls and features, explaining and demonstrating their use. It should be quickly realized that the units work much better than the old ones and without any special operating requirements.

### **Equipment Information**

### Manufacturer & Type

Switchgear and circuit breakers will be from the appropriate product lines of Eaton Cutler Hammer, Schneider Electric, or equal. The actual equipment selected will depend upon detailed design requirements and product availability.

- Eaton Cutler Hammer, 1111 Superior Avenue, Cleveland, OH 44114, 216-523-5000 www.eaton.com
- Schneider Electric, 1415 Roselle Road, Palatine, IL 60067, 847-397-2600, www.squared.com

### **Savings Calculations**

Not applicable for this ESM.



# **SECTION D:**

MEASUREMENT & VERIFICATION



## D. MEASUREMENT AND VERIFICATION

NORESCO develops measurement and verification (M&V) plans based on International Performance Measurement and Verification Protocol (IPMVP) and standards established by the Federal Energy Management Program (FEMP) of the U.S. Department of Energy. NORESCO's approach to development of M&V plans minimizes risk and maximizes return through a cost-benefit analysis that dictates which ESMs will employ more labor-intensive and costly methods and those ESMs that can be measured and verified using less costly methods. Table E-1 is a summary of the M&V protocols offered by NORESCO.

Table E-1: Summary of Measurement and Verification Protocols

Option	Description	How Savings Are Calculated
: <b>A</b>	Performance factors are determined with spot or short-term measurements and operational factors are stipulated based on analysis of historical data or spot/short-term measurements. Performance factors and proper operation are measured or checked annually.	Engineering calculations using spot or short-term measurements, computer simulations, and/or historical data.
В	Savings are determined by short-term or continuous measurements taken throughout the term of the contract at the device or system level. Both performance and operations factors are monitored.	Engineering calculations using metered data.
С	After project completion, savings are determined at the "whole-building" or facility level using current year and historical utility meter or submeter data.	Analysis of utility meter (or sub-meter) data using techniques from simple comparison to multivariate (hourly or monthly) regression analysis.
D	Savings are determined through simulation of facility components and/or the whole facility.	Calibrated energy simulation/modeling; calibrated with utility billing data and/or end-use metering.

NORESCO offers the following firm annual savings guarantee for each ESM, as noted in Table E-2. Table E-3, which follows, includes the M&V summary plan for this project.



Table E-2: M&V Option and Annual Savings Guarantee for Each Energy Savings Measure

Energy Savings Measures	M&V Option	Guaranteed Electric (kW) Savings	Guaranteed Electric (KVA) Savings	Guaranteed Electric (kWh) Savings	Guaranteed Natural Gas (CCF) Savings	Total Anticipated Energy Costs Savings	Additional Anticipated O&M Costs Savings	Total Anticipated Annual Cost Savings
Interior Lighting Improvements & Controls	A	3,723	2,769	1,632,263	(17,522)	\$328,590	\$15,818	\$344,408
Exterior Lighting Improvements	A	421	0	881,676	0	\$118,342	\$9,113	\$127,455
Variable Speed Chillers & Pumps	< <	0	404	116,829	0	\$21,355	\$21,794	\$43,149
Air Handling Unit Damper Refurbishments	Α,	0	597	153,414	0	\$29,038	\$0	\$29,038
Energy Management System Upgrades & Expansion	æ	0	0	2,603,237	215,990	\$532,897	\$88,270	\$621,167
Building Weatherization	A	0	O	13,417	40,828	\$47,528		\$47,528
Pipe & Fitting Insulation	¥	0	0	0	76,824	\$79,239	\$0	\$79,239
Steam Traps & Thermostatic Radiator Valves	Α	0	0	0	77,878	\$83,348	\$10,072	\$93,420
Plug Load Controls	<	0	0	201,247	0	\$27,543	\$0	\$27,543
Walk-In Cooler Controls	٧	0	0	177,77	0	\$13,115	\$0	\$13,115
Steam Boilers	æ	0	0	0	29,645	\$31,412	\$38,536	\$69,948
Hot Water Boilers & Pool Heating Systems	В	0	0	0	127,380	\$115,659	\$38,168	\$153,827
Solar Photovoltaics	В	0	0	136,116	0	\$20,377	\$7,486	\$27,863
New Electric Switchgear & Backup Power Generation	1	•	•	1	1	1	я	•
Totals		क्षात्र ।	6,77,0	0/46/998/9	220/195	8/74/8/443	\$229,257	\$1,677,700

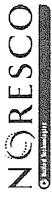


Table E-3: Measurement and Verification Plan Summary for Energy Savings Measures

Contractually Agreed Upon Variables	Fixture power, operating schedule, and HVAC system efficiency	Fixture kW and operating schedule
Performance Period M&V	For first five years, visually inspect a sample of fixtures during the annual inspection to verify that proper replacements are being used and that the fixtures are operating as intended for duration of the contract. Survey maintenance stock and maintenance records to confirm that proper materials are being inventoried.	For first five years, visually inspect a sample of the installed fixtures annually to verify that they are operating as intended. Survey maintenance stock and maintenance records to confirm that proper materials are being inventoried.
Post-Installation M&V	Measure fixture wattage of a statistically representative sample of each selected lamp-ballast combination. Verified electric energy savings will reflect final as-built quantities and pre- and post-retrofit fixture wattage measurements. Post-retrofit operating hours will be based on agreed-upon occupancy hours.	Post-installation lighting kW will be based on manufacturer's specifications, and hours of operation consistent with baseline hours.
Baseline M&V	Establish facility lighting kW utilizing instantaneous kW measurements of a statistically representative sample of common lamp-ballast combinations, and established hours of operation through deployment of data loggers and via interviews with facility personnel.	Establish baseline based on manufacturer's specifications, and establish hours of operation through based on site observations and discussions with facility personnel.
Energy Savings Units	kwh, kw, kvA, Ccf	KWh KW
M&V Option	∢	Ą
ESM Description	Interior Lighting Improvements & Controls	Exterior Lighting Improvements
ESM	-	2



Kwh, Cef	œ
	Ö



Contractually Agreed Upon Variables	Weather data, building heating and cooling loads, occupancy and operating schedules, space temperature setpoints	Weather data, heating system loads, hours of operation, system operating temperature, and pipe and insulation thermal conductivity	Weather data, steam system loads, hours of operation, steam operating temperature
Performance Period M&V	Inspect annually for first five years to verify that envelope improvements are in good condition and capable of achieving expected energy savings.	Inspect annually for first five years to verify that insulation is in good condition and capable of achieving expected energy savings.	Visually inspect sample of traps annually for first five years and discuss maintenance and operation with city personnel.
Post-Installation M&V	Verify proper installation of weatherization materials during commissioning period. Expected energy savings will be determined using design specifications and manufacturers' performance data.	Verify proper installation of new insulation during commissioning period. Expected energy savings will be based on design specifications and manufacturer's information.	Verify proper installation of new steam traps during commissioning period. Calculate expected energy savings using design specifications and manufacturer's information.
Baseline M&V	Determine baseline energy consumption using information obtained from building drawings, manufacturers' data, interviews with facility staff, and site audits to determine current condition of existing weatherization.	Determine baseline energy use through a facility-wide audit of heating system insulation in the scope of this measure. The audit will be used to characterize the insulation condition and losses.	Baseline calculated based on audit inventory, trap failure rates, and hours of operation.
Energy Savings Units	Ccf Ccf	روط	ۯۣڗٳ
M&V Option	≺	∢	۷
ESM Description	Building Weatherization	Pipe & Fitting Insulation	Steam Traps & Thermostatic Radiator Valves
ESIM	V	_	<b>©</b>



Contractually	Agreed Upon Variables	Equipment electric use, and hours of operation	Equipment efficiency, system design, and temperature setpoints	Weather data, building heating loads, occupancy schedule, temperature set points	Weather data, heating loads, occupancy schedule, temperature set points, and boiler combustion efficiency
	Pertormance Period M&V	Inspect annually for first five years to verify controls remain in place, in good condition and capable of achieving expected energy savings.	Perform onsite inspections annually for first five years to verify that equipment is in good condition and capable of achieving expected energy savings.	For first five years, inspect annually to verify boilers remain in place, in good condition and capable of achieving expected energy savings. In addition, perform combustion efficiency measurements.	For first five years, inspect annually to verify boilers remain in place, in good condition and capable of achieving expected energy savings. In addition, perform combustion efficiency measurements.
With the Manual Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Control of the Contr	Post-Installation M&V	Verify proper installation during commissioning period. Expected energy savings using design specifications and manufacturer's information.	Verified energy savings for controls will be determined using design specifications and manufacturers' performance data.	Post-installation consumption based on post-retrofit combustion efficiency measurements and operating hours based on post-retrofit heating load.	Post-installation consumption based on post-retrofit combustion efficiency measurements and operating hours based on post-retrofit heating load.
	baseline Mix.V	Baseline calculated based on inventory of equipment, manufacturers' ratings. and agreed-upon hours of operation established through interviews with facility personnel	Determine baseline energy use using manufacturers' data, onsite observations, and interviews with facility personnel.	Baseline calculated based on pre-retrofit combustion efficiency measurements and operating hours based on calculated baseline heating load.	Baseline calculated based on pre-retrofit combustion efficiency measurements and operating hours based on calculated baseline heating load.
Energy	savings Units	kWh	kWh	رط	Cd.
WEV	Option	∢	<b>V</b>	മ	В
Edwin Programme	ESIVI DESCRIPTION	Plug Load Controls	Walk-in Cooler Controls	Steam Boilers	Hot Water Boilers & Pool Heating Systems
) T		٥	0.0	F	12



ξ.	ESM ESM Description M&V Option	M&V Option	Energy Savings Units	Baseline M&V	Post-Installation M&V	Performance Period M&V	Contractually Agreed Upon Variables
33	Solar Photovoltaics	В	kWh	Baseline energy is the amount of electric use to be offset by the PV system.	Post-installation output based on measurements of PV system for two weeks, normalized for standard test conditions.	Verified savings will be based on ongoing metering of electric production normalized to typical year irradiance and temperature data.	N/A
7	New Electrical Switchgear & Backup Power Generation	N/A		There are no energy saving	s associated with this measure	There are no energy savings associated with this measure and, therefore, no M&V Plan.	