**PART 1 - GENERAL**

* 1. **WORK INCLUDED**
     1. Copper-wound transformer meeting US Department of Energy proposed Candidate Standard Level (CSL) 3 efficiency, with extremely low no load losses.
     2. Load Mix: Transformer shall be UL 1561 Listed to feed a mix of equipment load profiles such as computers without derating or significant degradation of efficiency.
  2. **REFERENCES**
     1. ANSI/IEEE
        1. C57.110-1998 – IEEE Recommended Practice for establishing transformer capability when feeding non-sinusoidal load currents
        2. 1100 – IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
     2. ANSI/NEMA
        1. ST 20 – Dry Type Transformers for General Applications.
        2. TP-1 – Guide for Determining Energy Efficiency for Distribution Transformers
        3. TP-2 – Standard Test Method for Measuring Energy Consumption of Distribution Transformers.
     3. FEDERAL REGISTER – US Department of Energy, Office of Energy Efficiency and Renewable Energy. 10 CFR Part 430. Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Distribution Transformers; Proposed Rule
     4. International Standards Organization (ISO)
        1. ISO 9001:2000 – Quality Management System
        2. ISO 14001:2004 – Environmental Management System
     5. Underwriters Laboratory (UL)
        1. UL 1561 – Dry-Type General Purpose and Power Transformers
  3. **PRIOR APPROVAL AND SUBMITTAL DOCUMENTATION**
     1. Submit product data including the following:
        1. Copy of ISO 9001:2000 Certification of manufacturing operation.
        2. Copy of ISO 14001:2004 Certification of manufacturing operation.
        3. Confirmation that transformer(s) are UL 1561 Listed with a K-7 Rating.
        4. Construction Details including enclosure dimensions, kVA rating, primary & secondary nominal voltages, voltage taps, BIL, unit weight.
        5. Basic Performance characteristics including insulation class, temperature rise, core and coil materials, impedances & audible noise level, unit weight.
        6. Inrush Current (typical 3 cycle recovery)
        7. Short Circuit Current data: Primary (Sym. O/P S/C) & Secondary (L-N/G S/C)
        8. Efficiency Data
           1. No load and full load losses per NEMA ST20.
           2. Linear load Efficiency data @ 1/6 load.
           3. Linear load efficiency data @ 1/4, 1/2, 3/4 & full load.
           4. Linear Load Efficiency @ 35% loading tested per NEMA TP-2.
           5. Efficiency data under 80% current THD load profile at 15%, 25%, 50%, 75%, 100% of nameplate rating.
        9. Copy of Factory ISO 9001 documentation describing nonlinear load test program with meter and CT details including model, accuracy, serial numbers and calibration information.
        10. Copy of Linear & Nonlinear load test report for a representative 75kVA transformer.
        11. 25 Year Product Warranty Certificate.
        12. Documentation that materials used for shipment packaging meet the environmental requirements identified in section 1.4 below. Provide a representative picture of the packaging materials.
     2. Description of manufacturer’s factory nonlinear load test program.
        1. Transformers shall be tested under nonlinear load representative of a real world load mix. Transformers that have not been subject to testing under nonlinear load will not be considered for this project due to the uncertainty related to their real world performance.
        2. Manufacturer shall have a nonlinear Load Test Program operating in the production environment that is audited and documented per quality standard ISO 9001.
        3. The nonlinear load bank shall consist of a phase-neutral loading with a K-7 profile, representative of a mix of typical commercial equipment.
        4. Meters and CTs shall both be revenue class accurate.
           1. CTs shall be operated within their approved accuracy loading range. Dual meters shall gather simultaneous primary and secondary energy and harmonic data.
           2. Meter and CT details including model, accuracy, serial numbers and calibration information.
        5. Efficiency:
           1. Measurements shall be taken at multiple load levels and plotted to show compliance with specification and correlation to the designed efficiency curve.
           2. Efficiency shall be determined purely by measurements using method and instrumentation per NEMA TP-2 Standard. Other methods are not acceptable.
        6. Harmonic data including current and Voltage THD at the different load levels shall be included with the test report.
  4. **PACKAGING FOR SHIPMENT**
     1. Transformers shall be packaged for shipment using materials that will have the least environmental impact.
        1. Transformer Wrapping
           1. Transformers shall be wrapped for shipment in a film coating that is 100% compostable and biodegradable.
        2. Transformer Shipping Base
           1. Transformers shall be shipped on a base that uses at least 50% less wood than traditional pallets.
           2. Wood used in the shipping base shall be Forestry Stewardship Council (FSC) certified as having been sustainably harvested.
  5. **DELIVERY, STORAGE AND HANDLING**
     1. Store and protect products
     2. Store in a warm, dry location with uniform temperature. Cover ventilation openings to keep out dust, water and other foreign material.
     3. Handle transformers using lifting eyes and/or brackets provided for that purpose. Protect against unfavorable external environment such as rain and snow, during handling.
  6. **WARRANTY**
     1. Transformer shall carry a 25-year pro-rated warranty with standard limited liability.
  7. **COMMERCIAL PRODUCT**
     1. Transformer shall be a standard item in the manufacturer’s catalog.

**PART 2 - PRODUCTS**

* 1. **BASIS OF DESIGN**
     1. Transformers shall be designed to an efficiency standard higher than the lowest legal standard, i.e., NEMA TP-1, for the purpose of contributing to LEED Energy & Atmosphere Credit 1 (Optimize Energy Performance) and Utility Rebates.
     2. Transformers designed to the lowest legal efficiency standard, thus not providing the contributions listed above, are not acceptable for meeting the requirements of this specification.
  2. **ACCEPTABLE MANUFACTURERS/PRODUCTS**
     1. Powersmiths International Corp. (“eSaver-C3L” Series) 800-747-9627
  3. **Southern California Office: 888-306-9222 PTSI**
     1. Manufacturers wishing to have products evaluated for acceptability and conformance with the performance requirements of this specification, shall provide detailed compliance and/or exception statements, along with the documentation identified in Section 1.3 (above) and test documentation, signed by an engineer, that confirms that the transformer(s) meet the no load losses and efficiency levels identified in Section 2.3C-F (below).
     2. Failure to provide the required documentation no less than 7 days prior to the bid date will disqualify products from consideration for this project.
  4. **PRODUCT**
     1. The transformer shall be UL 1561 Listed and Labeled with a K-7 Rating or higher.
     2. Construction
        1. Windings shall be copper and continuous with brazed or welded terminations.
        2. Insulation & Varnish Systems: 220 degree C class; Epoxy Polyester impregnation.
        3. Operating Temperature Rise: 130 degree C in a 40 degree C maximum ambient.
        4. All terminals, including those for changing taps, must be readily accessible by removing a front cover plate.
        5. The transformer shall have a 10kV BIL.
        6. The transformer shall have a 200% rated neutral.
        7. Voltage Taps:
           1. For transformers 30kVA-300kVA, provide two 2-1/2% full capacity taps above and below nominal primary voltage.
           2. For transformers 15kVA and smaller as well as 500kVA and larger provide one 5% full capacity tap above and below nominal primary voltage.
        8. Impedance shall be between 3.0% and 5.8% unless otherwise noted.
     3. No load losses shall not exceed the following values:

1. 15 kVA: 55 W
2. 30 kVA: 90 W
3. 45 kVA: 125 W
4. 75 kVA: 170 W
5. 112.5kVA: 236 W
6. 150kVA: 298 W
7. 225kVA: 447 W
8. 300kVA: 577 W
9. 500 kVA: 757 W
10. 750 kVA: 1088 W
    * 1. Transformer efficiency at low load (1/6 of transformer capacity) shall be:
11. 15 kVA: 97.0%
12. 30 kVA: 97.6%
13. 45 kVA: 97.8%
14. 75 kVA: 98.2%
15. 112.5kVA: 98.4%
16. 150kVA: 98.4%
17. 225kVA: 98.4%
18. 300kVA: 98.5%
19. 500 kVA: 98.8%
20. 750 kVA: 98.9%
    * 1. Transformer efficiency shall meet the DOE 10 CFR Part 430 CSL-3 requirement (tested at 35% of the nameplate rating, per NEMA TP-2); i.e., the efficiency shall be:
21. 15 kVA: 97.6%
22. 30 kVA: 98.1%
23. 45 kVA: 98.3%
24. 75 kVA: 98.6%
25. 112.5kVA: 98.8%
26. 150kVA: 98.9%
27. 225kVA: 98.9%
28. 300kVA: 99.0%
29. 500 kVA: 99.1%
30. 750 kVA: 99.2%
    * 1. Transformer efficiency at K-7 nonlinear load profile at 50% of nameplate rating shall be:
31. 15 kVA: 97.2%
32. 30 kVA: 97.7%
33. 45 kVA: 97.9%
34. 75 kVA: 98.3%
35. 112.5kVA: 98.6%
36. 150kVA: 98.7%
37. 225kVA: 98.8%
38. 300kVA: 98.8%
39. 500 kVA: 98.9%
40. 750 kVA: 99.1%
    * 1. Enclosure type shall be NEMA 1 or as indicated on the drawings. Maximum Footprint for NEMA 1 enclosure and 130 degree C rise shall be no more than as follows:
41. 15 kVA: 17” Wide x 17” Deep
42. 30 kVA: 26” Wide x 18” Deep
43. 45 kVA: 26” Wide x 18” Deep
44. 75 kVA: 33” Wide x 22” Deep
45. 112.5kVA: 33” Wide x 22” Deep
46. 150 kVA: 38” Wide x 28” Deep
47. 225kVA: 38” Wide x 32” Deep
48. 300 kVA: 38” Wide x 32” Deep
49. 500 kVA: 52” Wide x 38” Deep
50. 750 kVA: 64” Wide x 47” Deep
    * 1. The manufacturer shall be registered to the following current ISO standards:
         1. ISO 9001:2000 - Quality Management System.
         2. ISO 14001:2004 - Environmental Management System.
    1. **OPTIONS**
       1. Electrostatic Shield: Each transformer winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitiance.
          1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
          2. Include special terminal for grounding the shield.
       2. TVSS: Provide factory installed, UL 1449 listed 70kA/Mode TVSS module with EMI/RFI Filtering.
       3. Production Testing
          1. Linear: Basic transformer tests shall be performed in accordance with NEMA ST-20.
          2. Nonlinear: Transformers shall be tested per factory nonlinear load test program description to ISO 9001 standard. Nonlinear load testing shall be integrated with the standard production process for continuous proof of performance. Energy efficiency testing shall use synchronized measurement of primary and secondary with revenue class accuracy. Energy and harmonic test data shall be provided upon shipment.
       4. Factory Witness Testing
          1. The owner’s representative/engineer shall witness the testing of one transformer of each size required for this project.
          2. This witness test shall be performed at the factory, prior to shipment, to confirm compliance with the energy performance required by this specification.
       5. On-Site Testing
          1. For each transformer, provide on-site revenue class efficiency and harmonic measurements of transformer once installed and operating at customer's site using the transformer's integrated metering port. Primary and secondary readings shall to be synchronized to ensure accuracy. A performance report shall be issued by a licensed professional engineer.
          2. Products not meeting the required level of performance shall be replaced and retested to prove compliance.
       6. Integrated metering package to validate transformer performance shall be mounted on the top of the enclosure to provide simultaneous external access to the transformer primary and secondary voltages and currents, operating temperature, and TVSS status without opening the transformer enclosure, eliminating the risk to personnel and potential downtime associated with working on live exposed electrical connections. Primary and secondary current transformers (CT) shall be revenue-class to enable accurate determination of transformer efficiency. Accurate temperature data shall be provided via thermistors located in each leg of the transformer. System design shall incorporate safety circuit to prevent damage from unintentional open-circuiting of CTs. Manual lock-outs are not permitted.
       7. Continuous Energy and Environmental Equivalent Monitoring/Display: The system of transformers shall include an interface from at least one of the transformers into a digital display which will communicate through a networked computer to identify the savings in kWh and dollars annually and cumulatively and calculate and display the environmental equivalent of homes heated, car emissions, trees planted and noxious gas reductions.

**PART 3 - EXECUTION**

* 1. **INSTALLATION**
     1. Follow all national, state and local codes with respect to transformer installation.
     2. Perform the following installation checks:
        1. Where sound level may be of concern, utilize the services of a recognized and established Acoustical Consultant to provide the proper installation environment to minimize noise and vibration.
        2. Check for damage and loose connections.
        3. Set the transformer plumb and level.
        4. Mount transformer on vibration isolation pads suitable for isolating the transformer.
        5. Provide Seismic restraints where required.
        6. Coordinate all work in this Section with that in other sections.
        7. Verify all dimensions in the field.
        8. Upon completion of the installation, an infrared scan shall be provided for all bolted connections. Correct any deficiencies.
        9. Adjust transformer secondary voltages to provide the required voltage at the loads.

# END OF SECTION