PART 1  GENERAL

1.1 WORK INCLUDED

A. Dry-type, low-voltage, distribution transformers meeting US Department of Energy proposed Candidate Standard Level (CSL) 3 efficiency, with extremely low no load losses.

1. Transformers shall be designed to an efficiency standard higher than NEMA TP-1, the lowest legal efficiency for the following purposes:
   a. Delivering lowest life cycle cost according to the US Dept. of Energy
   b. Contributing to LEED Energy & Atmosphere Credit 1 (Optimize Energy Performance)
   c. Supporting Stanford’s goals for sustainability.

2. Transformers only designed to the lowest legal efficiency standard, NEMA TP-1, thus not providing the contributions listed above, are not acceptable for meeting the requirements of this specification.

B. Transformers efficiency is the essence of this specification. Therefore, transformers shall meet or exceed the specified performance values. Transformers that are supplied on the project will be tested for conformance with these performance values. Transformers not meeting the specified performance values shall be removed and replaced.

C. 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.

1.2 REFERENCES


B. ANSI/NEMA ST 20 - Dry Type Transformers for General Applications.


E. Metering Standards:
   1. Computational algorithms per IEEE Std 1459-2000
   2. UL 916, UL 61010C-1 CAT III
F. IEEE C57.110-1998 – IEEE Recommended Practice for establishing transformer capability when feeding non-sinusoidal load currents

G. IEEE-1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment


1.3 SUBMITTALS

A. Submit product data including the following:
   1. Copy of ISO 14001: 2004 Certification
   2. Copy of ISO 9001: 2000 Certification
   3. Construction details including enclosure dimensions, kVA rating, primary & secondary nominal voltages, voltage taps, BIL, unit weight
   4. Basic Performance characteristics including insulation class, temperature rise, core and coil materials, impedances and audible noise level, unit weight
   5. Inrush Current (typical 3 cycle recovery)
   6. Short Circuit Current data: Primary (Sym. O/P S/C) & Secondary (L-N/G S/C)
   7. Efficiency Data
      a. No load and full load losses per NEMA ST20
      b. Linear load Efficiency data at 1/6 load
      c. Linear load efficiency data at 1/4, 1/2, 3/4 & full load
      d. Linear Load Efficiency at 35% loading tested per NEMA TP-2.
      e. Efficiency under K7 load profile at 15%, 25%, 50%, 75%, 100% of nameplate rating.
   8. 25 year Product Warranty Certificate
   9. 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.

B. For LEED projects, provide the following additional submittal information:
   1. EA Credit 1: Optimize Energy Performance:
      Provide baseline and proposed performance as defined in LEED-NC 2.2 Submittal Template for this credit.
   2. MR Credit 2.1: Construction Waste Management - Divert 50% from Disposal
      Document packaging contribution to this credit

1.4 PACKAGING FOR SHIPMENT
A. Transformers shall be packaged for shipment using materials that will have the least environmental impact:
   1. Transformer Wrapping
      a. Transformers shall be wrapped for shipment in a film coating that is 100% compostable and bio-degradable.
   2. Transformer Shipping Base
      a. Transformers shall be shipped on a base that uses at least 50% less wood than traditional pallets.
      b. Wood used in the shipping base shall be Forestry Stewardship Council (FSC) certified as having been sustainably harvested.
   3. Shall minimize or eliminate use of materials that are not commonly recycled at the destination.
   4. Shall minimize labor, risk of injury and equipment damage, while handling from initial transportation through to final placement of the transformer.

1.5 DELIVERY, STORAGE AND HANDLING
A. Store and protect products
B. Store in a warm, dry location with uniform temperature. Cover ventilation openings to keep out dust, water and other foreign material.
C. Handle transformers using lifting eyes and/or brackets provided for that purpose. Protect against unfavorable external environment such as rain and snow, during handling.

1.6 WARRANTY
A. Transformer shall carry a 25-year pro-rated warranty, which shall be standard for the product line.

1.7 COMMERCIAL PRODUCT
A. Transformer shall be a standard item in the manufacturer’s catalog.

1.8 FACTORY PRODUCT PERFORMANCE VALIDATION
A. At time of order, the customer may request that the project engineer or other designated customer representative witness the performance testing of one or more of the transformers on the project at the manufacturer’s facility, along with a demonstration of integrated metering option if specified.

1.9 ON-SITE PERFORMANCE VALIDATION
A. To insure that the products shipped to the job site meet this specification, provide on-site revenue class accurate efficiency and harmonic measurements of transformers once installed and operating at customer’s site. Data shall be collected from primary and secondary sides of the transformer simultaneously on a synchronized cycle by cycle basis. The use of two discrete meters that are not synchronized is not acceptable. Upon customer request sampling shall be of 10% of transformers on the project once installed and operating, as selected by customer. Manufacturer support provided.
1.10 INTERNATIONAL STANDARDS ORGANIZATION REGISTRATION

A. Registration to current ISO standard is required.
B. Independent annual audits are conducted.
D. ISO 14001:2004 Registered – Environmental Management System

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCT

A. Powersmiths International Corp. ("eSaver-C3L" Series) and/or manufacturers meeting the Department of Energy CSL3 Efficiency Levels for electronic (non-linear) loads.

   Powersmiths, contact:
   Peter Ouellette, Office (415) 259-5574
   E-mail: petero@powersmiths.com

B. 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 2.3 (below).

C. Failure to provide the required documentation no less than 7 days prior to the bid date will disqualify products from consideration for this project.

2.2 FOR LEED PROJECTS:

A. Full compliance with this specification is required in order to contribute to the following LEED Credits:

   1. EA Credit 1: Optimize Energy Performance:
      a. Transformer efficiency

   2. MR Credit 2.1: Construction Waste Management - Divert 50% from Disposal
      a. Product packaging

2.3 TRANSFORMER SPECIFICATION:

A. Compatibility: This product must facilitate the ability of the electrical system to supply a sinusoidal voltage in order to improve the long-term compatibility of the electrical system with all types of linear and nonlinear connected loads today and in the future. All national and international standards on harmonics and power quality set limits on levels of voltage distortion to maintain compatibility.

B. Copper-wound, 3-phase, common core, ventilated, dry-type, isolation transformer built to NEMA ST20 and relevant NEMA, UL and IEEE standards; 200% rated neutral; 60Hz rated; Transformers 750 kVA and less, 600 volt primary and less, shall be U.L. and CSA
Listed and bear the label. All terminals, including those for changing taps, must be readily accessible by removing a front cover plate. Windings shall be continuous with terminations brazed or welded. 10kV BIL.

C. Insulation System:
1. Shall be NOMEX-based with an Epoxy Co-polymer impregnant for lowest environmental impact, long term reliability and long life expectancy
2. Class: 220ºC
3. Impregnant Properties for low emissions during manufacturing, highest reliability and life expectancy
4. Epoxy co-polymer
5. VOC: less than 1.65 lbs/gal (low emissions during manufacturing)
6. Water absorption (24hrs @ 25ºC): less than 0.05% (superior insulation, longer life)
7. Chemical Resistance: Must have documented excellent performance rating by supplier
8. Dielectric Strength: minimum of 3200 volts/mil dry (for superior stress, overvoltage tolerance)
9. Dissipation Factor: max. 0.02 @ 25ºC to reduce aging of insulation, extending useful life

D. Operating Temperature Rise: 130ºC in a 40ºC maximum ambient

E. UL Listed & Labeled K-Rating: K-7 or higher

F. Noise levels:
1. Per NEMA ST-20
2. Production Test every unit. Data to be available upon request.

G. Maximum No Load Losses shall not exceed:

<table>
<thead>
<tr>
<th>kVA</th>
<th>15</th>
<th>30</th>
<th>45</th>
<th>75</th>
<th>112.5</th>
<th>150</th>
<th>225</th>
<th>300</th>
<th>500</th>
<th>750</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watt</td>
<td>60</td>
<td>99</td>
<td>130</td>
<td>180</td>
<td>260</td>
<td>330</td>
<td>450</td>
<td>560</td>
<td>850</td>
<td>1200</td>
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</table>

H. Efficiency at 1/6 loading shall meet or exceed:

<table>
<thead>
<tr>
<th>kVA</th>
<th>15</th>
<th>30</th>
<th>45</th>
<th>75</th>
<th>112.5</th>
<th>150</th>
<th>225</th>
<th>300</th>
<th>500</th>
<th>750</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>97.0</td>
<td>97.6</td>
<td>97.8</td>
<td>98.3</td>
<td>98.5</td>
<td>98.4</td>
<td>98.6</td>
<td>98.7</td>
<td>98.8</td>
<td>98.9</td>
</tr>
</tbody>
</table>

I. Shall meet or exceed DOE 10 CFR Part 430 CSL 3 Efficiency requirement, tested per NEMA TP-2:

<table>
<thead>
<tr>
<th>kVA</th>
<th>15</th>
<th>30</th>
<th>45</th>
<th>75</th>
<th>112.5</th>
<th>150</th>
<th>225</th>
<th>300</th>
<th>500</th>
<th>750</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>97.6</td>
<td>98.1</td>
<td>98.3</td>
<td>98.6</td>
<td>98.8</td>
<td>98.9</td>
<td>98.9</td>
<td>99.0</td>
<td>99.1</td>
<td>99.2</td>
</tr>
</tbody>
</table>
J. Efficiency under k-7 nonlinear load at 50% of nameplate rating:

<table>
<thead>
<tr>
<th>kVA</th>
<th>15</th>
<th>30</th>
<th>45</th>
<th>75</th>
<th>112.5</th>
<th>150</th>
<th>225</th>
<th>300</th>
<th>500</th>
<th>750</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>97.2</td>
<td>97.7</td>
<td>97.9</td>
<td>98.1</td>
<td>98.5</td>
<td>98.7</td>
<td>98.8</td>
<td>98.8</td>
<td>98.9</td>
<td>99.1</td>
</tr>
</tbody>
</table>

K. Voltage Taps: For transformers 30kVA-300kVA, provide two 2-1/2% full capacity taps above and below nominal primary voltage. For transformers 15kVA and smaller as well as 500kVA and larger provide one 5% full capacity tap above and below nominal primary voltage.

L. Impedance: Between 3.5% and 5.8% unless otherwise noted.

M. Enclosure type: Ventilated NEMA 2, drip-proof [optional NEMA 3R]

N. TRANSFORMER OPTIONS (Highlight in “Bold” applicable options)

1. Electrostatic Shield: Each winding is independently single shielded with a full-width copper electrostatic shield [Double shields or triple shields may also be specified]

2. TVSS: UL 1449 listed, with EMI/RFI Filtering. Rating: 80kA/mode [optional 120kA/mode, 160kA/mode]

3. Lug Kit: Supply with standard screw-type lugs

4. Hinged Door Option; Twin-lockable hinged doors for ease of access, maintenance/infrared testing, etc.

5. Infrared Viewing Port Option: (Front Panel) Two sizes available for ease of Infrared testing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Follow all national, state and local codes with respect to transformer installation.

B. 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.

C. Check for damage and loose connections.

D. Set the transformer plumb and level.

E. Mount transformer on vibration isolation pads suitable for isolating the transformer.

F. Provide Seismic restraints where required.

G. Coordinate all work in this Section with that in other sections.
H. Verify all dimensions in the field.
I. Upon completion of the installation, an infrared scan shall be provided for all bolted connections. Correct any deficiencies.
J. Adjust transformer secondary voltages to provide the required voltage at the loads.
K. Identify non-compliant products to the engineer and replace at no cost to the customer.

END OF SECTION