SECTION 16461 – ENERGY EFFICIENT HARMONIC MITIGATING LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 750 kVA:

1. Distribution transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For testing agency.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

H. Linear load efficiencies at 35% and 50% of full load current rating must be greater than 97%.

I. Non-linear load efficiencies at 35% and 50% of full load current rating must be greater than 97%.

J. Documentation of above section H and I must be made with Performance Validation from a nationally recognized testing facility. Testing to be conducted using three single-phase 120-volt load banks with a personal computer harmonic profile (100% current THD). Non-linear load efficiencies at 35% and 50% of full load current rating must be at or above 97%. This data MUST be provided in the quote stage and the submittal stage of this project.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.5 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers meeting requirements of US Department of Energy proposed Candidate Standard Level (CSL-3) as clarified by NEMA in their whitepaper “Clarifications on the use of Department of Energy Design-Line 6, 7, and 8 transformers contained within 10 CFR 430 and 431, Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards” as well as being Harmonic Mitigating. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Manufacturers and products: The listing of specific manufacturers below does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date. Please contact Power Protection Products, Dan Maxcy for guidance on purchasing these transformers (515-277-5770)

B. Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc
2. Powersmiths
3. Square D

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, Low loss air-cooled units for 60-Hz service designed to an efficiency standard higher than NEMA TP-1

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps with the secondary's wound to provide harmonic cancelation of triplen harmonics (triplen harmonics shall not couple into the primary of the transformer).

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: **Copper**.

D. Third harmonic cancellation though band-rejection filtering (comprised of inductors, capacitors, and/or resistors) connected in series in the neutral conductor shall not be considered acceptable as a replacement, alternate or 'Accepted Manufacturer' to this specification or equipment listed herein.

E. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified, or approved equal.

F. To help meet the environmental responsibilities of electrical equipment manufacturing, the equipment factory shall have in process a system of continual improvement encompassing ISO 14001, VPP (Voluntary Protection Program) and OHSAS 18001. This will ensure that this program goes beyond basic regulatory compliance and shows the manufacture's commitment to providing a comprehensive system that addresses the environmental, safety, security and health impacts of its activities, products and services, beyond mere compliance with the law. This assessment will include both an annual self-assessment and third party assessments. Eaton Corporation's MESH (Management System of Environment, Safety, Security and Health) program fulfills these requirements.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 16 Section "Electrical Supports and Seismic Restraints."

C. Enclosure: **Ventilated**, NEMA 250, Type 1.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Factory color.

E. Taps for Transformers Smaller than 3 kVA: **One 5 percent tap above normal full capacity**.

F. Taps for Transformers 7.5 to 24 kVA: **One 5 percent tap above and one 5 percent tap below normal full capacity**.

G. Taps for Transformers 25 kVA and Larger: **Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity**.

H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of **150** deg C rise above 40 deg C ambient temperature.

I. Contractor shall coordinate with the transformer manufacturer to supply the correct transformers to have 50% of the capacity as 0 degrees phase shift and 50% 30 degrees phase shift.

J. Energy Efficiency for Transformers :

1. Data shall be provided as a submission of efficiency data as follows:
   a. No load and full load losses per NEMA ST20
   b. Linear Load Efficiency at 35% loading tested per NEMA TP-2 and having minimum efficiencies as per the NEMA white paper (referenced above) Table 1.

2. Linear load efficiency measured at 35% of nameplate shall at a minimum be:
   a. 15kVA: 97.97%
   b. 30kVA: 98.29%
   c. 45kVA: 98.45%
   d. 75kVA: 98.64%
   e. 112.5kVA: 98.77%
   f. 150kVA: 98.86%
   g. 225kVA: 98.97%
   h. 300kVA: 99.04%
   i. 500kVA: 99.16%
   j. 750kVA: 99.24%

3. NEMA Premium Transformer efficiencies do not meet minimum efficiency requirements and will not be considered for this project.

4. Non-Linear load efficiency measured at 50% of nameplate with computer load shall at a minimum be:

a. 15kVA: 97.6%
b. 30kVA: 98.0%
c. 45kVA: 98.2%
d. 75kVA: 98.2%
e. 112.5kVA: 98.6%
f. 150kVA: 98.7%
g. 225kVA: 98.8%
h. 300kVA: 98.8%
i. 500kVA: 98.9%
j. 750kVA: 99.1%

K. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

L. Wall Brackets: Manufacturer's standard brackets.

M. Fungus Proofing: Permanent fungicidal treatment for coil and core.

N. The construction of the transformers must be in compliance with the 'American Recovery and Reinvestment Act' (ARRA) of 2009.

O. Neutral conductor shall be copper and rated to carry 200% of normal phase current.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

2.5 WARRANTY

A. Manufacturer shall provide a 10-year pro-rated warranty as standard for transformers included in the scope of this specification.

END OF SECTION 16461