

TECHNICAL SPECIFICATIONS

CONVENTIONAL DISTRIBUTION TRANSFORMERS

I. GENERAL REQUIREMENTS

I.1. SPECIFICATIONS

These specifications cover electrical and mechanical features of conventional transformers used on the JEA distribution system. Transformers supplied under this specification shall meet the requirements of the latest revision of the following list of standards and guides established for distribution transformers except where they conflict with JEA specifications, in which case JEA specifications shall apply.

AMERICAN STANDARD TESTING OF MATERIALS (ASTM)
 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 CODE OF FEDERAL REGULATIONS (EPA)
 EDISON ELECTRIC INSTITUTE (EEI)
 FEDERAL LAWS "RCRA" AND "CERCLA" FOR HAZARDOUS WASTE
 INSTITUTE OF ELECTRICAL & ELECTRONICS ENGINEERING (IEEE)
 NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
 NATIONAL ELECTRIC MANUFACTURERS ASSOCIATION (NEMA)
 SOUTHEASTERN ELECTRIC EXCHANGE (SEE)

I.2. ENVIRONMENTAL ACCEPTABILITY

I.2.1. Transformers will be environmentally acceptable and, as of the date of manufacture, shall comply with all laws in effect, pertaining to hazardous chemicals.

I.2.2. No dielectric fluid shall contain commercial chemical products which would be regulated as hazardous waste as defined in list 40 CFR 261 if disposed, or if released into the environment. Nor shall the dielectric fluid contain chemicals in excess of their reportable quantities if released into the environment, according to 40 CFR 302. Finally, a Material Safety Data Sheet shall be provided for any dielectric fluids used in transformers. Upon request, the manufacturer must certify that no transformer contains dielectric fluid with a Polychlorinated Biphenyl concentration in excess of one part per million (1 ppm). Such certification that the dielectric contains less than 1 ppm shall be verified.

I.3. TECHNICAL INQUIRIES

Any inquiry relating to this technical specification shall be directed to the standards engineer:

JEA
 Electric, Water & Sewer Standards
 c/o Henry Hoff
 21 W. Church Street, 10th Floor Tower
 Jacksonville, Florida 32202-3139
 Phone No: (904) 665-4784
 Email: hoffht@jea.com

Bidder's questions may be communicated by telephone or fax. All such questions must be confirmed in writing. If further explanation is deemed necessary, the buyer will notify each bidder by addendum to the solicitation documents.

II. APPROVED MANUFACTURERS

A listing of APPROVED MANUFACTURERS for each specific Distribution Transformer ITEM ID is shown in the JEA "Master Material Catalog – Electric" on jea.com at the following URL. However, the approved manufacturers still must have their drawings pre-approved before providing a quotation as stated in section VII.

<http://externalapps.jea.com/IABReporting/reports/jeaecat1.pdf>

Bidders may sub-contract work to any of these Manufacturers for said ITEM ID's.

III. AMORPHOUS CORE TRANSFORMERS

III.1. Manufacturers may not quote amorphous core transformers.

IV. MATERIAL

Incoming material shall be inspected by qualified Quality Control Personnel at the factory. Material such as transformer oil, primary and secondary conductor, insulation materials, gasket material and core steel shall be checked and tested at regular intervals to insure that quality is uniform throughout and has not deteriorated during storage. Oil compatibility test results will be made available to JEA upon request. New material or design changes, or transformer components, such as bushings, bayonets, latching devices, paint systems, or brackets shall be submitted to JEA for approval prior to inclusion in manufacturing.

IV.1. REPAIR PARTS

A parts list will be furnished, upon request, for repair equipment. Lists will cover items such as gaskets, bushings, tap changers, etc.

IV.2. ELIGIBILITY OF MATERIAL

IV.2.1. Only the manufacturers and catalog numbers listed in the latest revision of the JEA "Master Material Catalog – Electric" may be bid.

IV.2.2. All reasonable efforts will be made by the JEA to eliminate errors in the aforementioned master material catalog which might result in a bidder bidding an item eventually ruled unacceptable by JEA, but such possible occurrence shall not become the basis for any claim for damage or loss.

IV.2.3. All Bidders are hereby advised to bid the item in accordance with the supplied technical data within this specification. The "Brief Description" entered on the Bid Form is used as a reference tool to locate that particular item within the technical specifications and should in no way be used as the basis of pricing.

IV.2.4. Bids submitted by vendors for unapproved manufacturers, or unapproved catalog numbers of approved manufacturers will not be evaluated.

IV.2.5. Bidding and/or supplying products in the past not listed on the JEA master material catalog does not constitute approval.

V. WARRANTY

JEA will pay no freight charges on warranty transformers. Warranty will be one year from date of installation or eighteen months from date of delivery, whichever comes first.

VI. COMPLIANCE WITH SPECIFICATIONS

If a discrepancy exists between the bid description and the approved technical data, the approved technical data will be the deciding and binding factor as to the exact item required. It will be the Contractor's responsibility to accept all additional expenses incurred for correcting material not bid in accordance with the technical specifications.

VII. SUBMITTAL REQUIREMENTS

THE FOLLOWING INFORMATION MUST BE PROVIDED PRIOR TO CONTRACT EXECUTION:

VII.1. Manufacturer must provide general documents about their transformers showing standard features, design standards, product specifications, and key benefits.

THE FOLLOWING INFORMATION MUST BE PROVIDED BY WINNING BIDDER AND BE APPROVED BY THE STANDARDS ENGINEER:

VII.2. Prior to finalizing contract, manufacturer must submit one copy of shop drawings, showing all relevant detail and dimensions, including nameplate information, for each item, specifically listing the item ID. Manufacturer must supply total winding loss as defined by ANSI which includes stray losses, and must list

impedance and efficiency. Data shall be guaranteed for all transformers subject to tolerance stated in ANSI Standard C57.12.00 (latest revision). Approved manufacturer drawings shall be marked approved and signed by the standards engineers and then a copy returned to the manufacturer. Unapproved manufacturer drawings shall be marked by the standards engineer and returned to the manufacturer for re-submittal. No manufacturer will be approved unless their drawings have been approved by the standards engineer.

THE FOLLOWING INFORMATION MUST BE FINALIZED PRIOR TO SHIPMENT OF MATERIAL:

- VII.3. Shop drawings must be approved by the standards engineer prior to shipment of any units to insure there have been no substantial material or design changes. Any changes must be noted by the manufacturer and approved by the appropriate JEA standards engineer.

VIII. CORE AND COIL CONSTRUCTION

VIII.1. COIL

- VIII.1.1. All transformer coils shall be designed to maintain their full nameplate kVA rating throughout the temperature range. All materials used shall be of the 65°C (80°C hot spot) class and be thoroughly tested for compatibility with all transformer components before inserted into design. All insulating paper used as layer insulation in transformer coils shall be coated on both sides with thermosetting adhesive and properly cured prior to oil impregnation to form a uniform effective bond both turn-to-turn and layer-to-layer. Alternate means of bonding of coils that are wound with primary and secondary conductor, including sheet secondary conductors. Margins shall be even and equal on both sides of the coil.
- VIII.1.2. Oil ducts shall be strong enough to withstand full short circuit forces, and resist deformation or collapsing after full oil absorption takes place. They shall run the full width of the coil to prevent cutting insulation. It is recommended that either fiber pressboard sticks permanently glued to the paper or processed hardwood maple sticks be used for oil ducts. No other wood will be accepted.
- VIII.1.3. All primary and secondary windings shall be free of burrs or defects.
- VIII.1.4. All connections to sheet windings shall be metallurgically bonded with conduction in area significantly greater than the area of the coil lead cross section.
- VIII.1.5. When aluminum risers are used, special attention must be called to the connections at the secondary bus. If EC grade aluminum is used, a T6061 hard aluminum pad shall be welded at this junction to insure a good aluminum to copper electrical path, and at the same time "trap" the metal so that no cold flow can occur. All welds shall have a conduction area significantly greater than the cross section of the riser. Only brass nuts, bolts and washers used as current carrying components shall be used at or above the oil level. All bolted connections shall be cleaned with proper solvents and or abrasives prior to assembly. Secondary risers on 120/240 volt units shall be sufficiently long to allow for coil paralleling as needed.
- VIII.1.6. Special attention shall also be given to primary lead connections. If aluminum wire is used, the connector should be of the type that traps the aluminum and cuts through the insulation and oxide. The riser within the coil shall be securely anchored to prevent the lead from being pulled out during assembly, shipment or repair.
- VIII.1.7. The completed coil should have a neat, clean appearance free from rips or ragged insulation.

VIII.2. CORE

- VIII.2.1. Silicon steel core(s) shall be manufactured from grain oriented steel laminations, and coated with a glass-hard insulation. The core(s) shall be fully annealed to relieve stresses incurred during manufacturing process.
- VIII.2.2. The core(s) shall be deburred and free from defect to prevent sheet-to-sheet shorting.

VIII.3. CORE-COIL ASSEMBLY

- VIII.3.1. The core(s) and coil(s), after assembly, shall be mounted in a rigid steel frame, constructed in such a way as to hold the coil(s) within the core window without placing undue stress on the core(s) or short circuit the laminations at any point. The frame shall include steel channel plates at top and bottom and be connected by bars, bolts or banding straps.
- VIII.3.2. Wood may be used as blocking between core, coil or steel channels only if said wood is completely constrained and cannot move during shipping, operation or short circuiting. The wood, if used, shall be fully dried and processed prior to its installation. Only fully cured hardwood shall be used. Alternative materials (for example, hardwood particles with resin) require approval prior to manufacture.
- VIII.3.3. The core-coil assembly shall be thoroughly dried by baking in an oven and then secured with bolts in the transformer tank and covered with non-contaminated deaerated oil. Special provisions shall be taken to prevent re-entrance of moisture into the core-coil assembly prior to being covered with oil. Oil filling shall take place while unit is under vacuum.
- VIII.3.4. Primary and secondary leads shall be mounted and connected in such a manner as to prevent pulling away or twisting under short circuit. Fiber pressboard or processed hardwood maple may be used for lead blocking only when said blocks are dried and installed in accordance with paragraph VIII.3.2 above.

IX. TANK CONSTRUCTION

IX.1. TANK

- IX.1.1. All conventional transformer tanks will be of all welded steel construction unless otherwise noted on specific items. Tanks shall be free of rust, welding slag or spatter, and other contamination before entering the finishing process. Tanks shall be shot blasted or treated with appropriate chemicals to prevent corrosion and to insure a good bond with the primer.
- IX.1.2. All tanks shall be designed with the base recessed (bottom of tanks off ground).

IX.2. NAMEPLATE

- IX.2.1. The nameplate shall be attached to the lower mounting bracket on conventional transformers or on a bracket welded to the tank.
- IX.2.2. A durable aluminum or stainless steel nameplate shall be affixed on each transformer tank and shall bear the minimum information specified in ANSI C57.12.00 (latest revision) where applicable. The nameplate for all oil filled transformers must state they certify "NON-PCB" dielectric.
- IX.2.3. Each nameplate shall state the month and year of manufacture.
- IX.2.4. Indication of a stainless steel tank shall be stamped on the nameplate by either SS or stainless steel.
- IX.2.5. Nameplates shall include bar coding information. The information shall be in accordance with EEI and consist of the manufacturer's identification, transformer serial number and JEA item identification number.

IX.3. COVERS

- IX.3.1. Conventional transformer covers shall be clamped or bolted in place by a one-piece band of steel or appropriate bolt clamp, providing an even pressure along the entire sealing surface between tank and cover. The gasket shall be the reusable type, and of a material which will not take a permanent set (Cork is not acceptable). Covers shall be grounded to the tank by an external strap.
- IX.3.2. Covers shall be domed to aid in water run-off with no trough to collect debris or moisture.

IX.4. EXTERIOR FINISH

IX.4.1. Conventional transformer tanks shall be Light Gray Number 70, Munsell Notation 5BG 7.0/0.4 and in accordance with ANSI C57.12.20 (latest revision). Tank covers for conventional transformers shall be supplied with an insulated coating. Dielectric strength of protective covers shall be 12 kV on all transformers. The underside of covers shall be finished to prevent rust. Decals, located below the secondary bushings, shall be a dark or black color to afford a sharp contrast with the tank finish.

IX.5. MOUNTING

IX.5.1. Provisions shall be provided for lifting transformers into place per ANSI C57.12.20 (latest revision).

IX.5.2. Mounting bracket (support lug) for transformers 50kVA and below shall be able to accommodate a 5/8 inch bolt with 12 inch spacing between mounting brackets.

IX.5.3. Mounting bracket (support lug) for transformers 75kVA and above shall be able to accommodate a 3/4 inch bolt with 24 inch spacing between mounting brackets.

X. ACCESSORY EQUIPMENT

X.1. COMPONENTS

All components shall be installed in accordance with component manufacturers' instructions.

X.2. EQUIPMENT

A tank ground provision, lifting lugs, and kVA rating decals or painted stencils shall be supplied as shown in ANSI C57.12.20 (latest revision).

X.3. SAFETY LABELS

Safety labels shall consist of decals and/or painted stencils. Bilingual (English/Spanish) Warning and Danger labels will be attached to individual cabinets of pad mounted single phase, two phase, three phase, and three phase step-down transformers. Labels shall be applied such that no air bubbles will form to cause brittleness and cracking. The manufacturer shall provide, and attach to the transformer, operation warning decals for the following equipment (but not limited to); tap changers, pressure relief devices, switches and bayonet fuses. These warning labels are in addition to specific labels required in the various technical specifications.

X.4. PCB LABELS

All transformers containing dielectric fluid shall have a Non-PCB label on the outside front center visible to the public with letters not less than one inch high.

X.5. PRESSURE RELIEF

All transformers shall be furnished with an automatic pressure relief valve as defined in ANSI C57.12.10. (latest revision).

X.6. TAP CHANGER

Tap changers are only required on the 4kV transformers listed in Section XIII. Tap changers will have two positions above and below nominal voltage of 2-2.5% each for a total range of 10%. External handles shall be furnished with tap changers. Tap changers shall have a positive "Snap Action" or "Cam Action" operation. Manufacturer may supply any of the following approved manufacturer's tap changer switch.

Central Moloney
Cooper Power Systems
ABB

XI. BUSHINGS

- XI.1. The primary bushings and secondary bushings shall be located as in ANSI C57.12.20 (latest revision). Two primary bushings and three secondary bushings shall be provided on ratings 5 through 100 kVA, and two primary bushings and four secondary bushings on 167 through 333 kVA. Two secondary bushings shall be provided for transformers with 277 volt secondaries.
- XI.2. Secondary bushings shall be constructed of epoxy or porcelain (epoxy preferred) and notched to prevent rotation. All terminals shall be plated for bimetallic connectors.
- XI.3. The number of primary and secondary bushings shall be determined by the following chart:

<u>JEA ITEM ID</u>	<u>PRIMARY</u>	<u>SECONDARY</u>
TRA CA 001 - 006	2	3
TRA CA 007 - 009	2	4
TRA CB 001	2	3
TRA CC 001 - 005	2	2
TRA CD 001 - 006	2	3
TRA CD 007 - 008	2	4
TRA CE 001	2	3
TRA CF 001 - 004	2	2
TRA CG 001 - 006	2	3
TRA CG 007 - 008	2	4
TRA CH 001 - 003	2	3
TRA CI 001 - 005	2	2
TRA CO 001 - 006	2	3
TRA SA 001 - 004	2	2 *
TRA SB 001 - 005	2	2 *
TRA SC 001	2	2

* Turn wheel secondary bushings per ANSI (one piece porcelain bushing)

XII. TERMINAL LUGS

All transformers shall have secondary lugs as specified below:

<u>SECONDARY < 600 Volts</u>	<u>BUSS SIZE</u>	<u>NEMA SPADE</u>
15 kVA & below	3/0 Copper (13/16")	Eyebolt Clamp
25 kVA	3/0 Copper (13/16")	Eyebolt Clamp
<u>SECONDARY < 600 Volts</u>	<u>BUSS SIZE</u>	<u>NEMA SPADE</u>
50 kVA	4/0 Copper	Eyebolt Clamp
75 kVA	-----	4 hole
100 kVA (120/240, 208v)	-----	6 hole
100 kVA (240/480, 277v)	-----	4 hole
167 & Larger	-----	6 hole
<u>SECONDARY 2400 VOLTS</u>	<u>BUSS SIZE</u>	<u>NEMA SPADE</u>
50 to 167 kVA	#2 Copper	Eyebolt Clamp
250 & Larger	4/0 Copper	Eyebolt Clamp

These eyebolt clamps should be able to accommodate a 3/4 inch stud.

XIII. RATING

The following table is the "Transformer Ratings" for primary and secondary voltages, BIL, and kVA ratings of those transformers being bid.

<u>ITEM ID</u>	<u>kVA SIZES</u>	<u>PRIMARY VOLTAGE</u>	<u>SECONDARY VOLTAGE</u>	<u>BIL (kV)</u>
TRACA001	10	2400/4160Y	120/240	60 (Tap Changer Req'd)
TRACA002	15	2400/4160Y	120/240	60 (Tap Changer Req'd)
TRACA003	25	2400/4160Y	120/240	60 (Tap Changer Req'd)
TRACA004	50	2400/4160Y	120/240	60 (Tap Changer Req'd)
TRACA005	75	2400/4160Y	120/240	60 (Tap Changer Req'd)
TRACA006	100	2400/4160Y	120/240	60 (Tap Changer Req'd)
TRACA007	167	2400/4160Y	120/240	60 (Tap Changer Req'd)
TRACB001	50	2400/4160Y	240/480	60 (Tap Changer Req'd)
TRACC001	50	2400/4160Y	277/480Y	60 (Tap Changer Req'd)
TRACC002	75	2400/4160Y	277/480Y	60 (Tap Changer Req'd)
TRACC003	100	2400/4160Y	277/480Y	60 (Tap Changer Req'd)
TRACC004	167	2400/4160Y	277/480Y	60 (Tap Changer Req'd)
TRACC005	250	2400/4160Y	277/480Y	60 (Tap Changer Req'd)
TRACD001	10	7620/13200Y	120/240	95
TRACD002	15	7620/13200Y	120/240	95
TRACD003	25	7620/13200Y	120/240	95
TRACD004	50	7620/13200Y	120/240	95
TRACD005	75	7620/13200Y	120/240	95
TRACD006	100	7620/13200Y	120/240	95
TRACD007	167	7620/13200Y	120/240	95
TRACD008	250	7620/13200Y	120/240	95

TRACE001	50	7620/13200Y	240/480	95
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TRANSFORMER RATINGS (CONT)

<u>ITEM ID</u>	<u>kVA SIZES</u>	<u>PRIMARY VOLTAGE</u>	<u>SECONDARY VOLTAGE</u>	<u>BIL (kV)</u>
TRACF001	50	7620/13200Y	277/480Y	95
TRACF002	75	7620/13200Y	277/480Y	95
TRACF003	100	7620/13200Y	277/480Y	95
TRACF004	167	7620/13200Y	277/480Y	95
TRASA001	50	7620/13200Y	2400/4160Y	95/60
TRASA002	75	7620/13200Y	2400/4160Y	95/60
TRASA003	100	7620/13200Y	2400/4160Y	95/60
TRASA004	167	7620/13200Y	2400/4160Y	95/60
TRACG001	10	14760/25565Y	120/240	125
TRACG002	15	14760/25565Y	120/240	125
TRACG003	25	14760/25565Y	120/240	125
TRACG004	50	14760/25565Y	120/240	125
TRACG005	75	14760/25565Y	120/240	125
TRACG006	100	14760/25565Y	120/240	125
TRACG007	167	14760/25565Y	120/240	125
TRACH001	25	14760/25565Y	240/480	125
TRACH002	50	14760/25565Y	240/480	125
TRACH003	75	14760/25565Y	240/480	125
TRACI001	50	14760/25565Y	277/480Y	125
TRACI002	75	14760/25565Y	277/480Y	125
TRACI003	100	14760/25565Y	277/480Y	125
TRACI004	167	14760/25565Y	277/480Y	125
TRACO005 *	10	14760/25565Y	120/240	125
TRACO006 *	15	14760/25565Y	120/240	125
TRACO001 *	25	14760/25565Y	120/240	125
TRACO002 *	50	14760/25565Y	120/240	125
TRACO003 *	75	14760/25565Y	120/240	125
TRACO004 *	100	14760/25565Y	120/240	125
TRASB001	50	14760/25565Y	2400/4160Y	125/60
TRASB002	75	14760/25565Y	2400/4160Y	125/60
TRASB003	100	14760/25565Y	2400/4160Y	125/60
TRASB004	167	14760/25565Y	2400/4160Y	125/60

*Coastal Transformers

XIV. DIMENSIONAL REQUIREMENTS

The maximum distance from the top mounting hole to the top of the bushing shall be 25".

The maximum distance from the bottom mounting hole to the bottom of the transformer shall be 21".

50kVA transformers and below shall have a maximum diameter of 22" and a maximum weight of 650 lbs.

75kVA transformers shall have a maximum diameter of 27" and a maximum weight of 1000 lbs.

100kVA and 167kVA transformers shall have a maximum diameter of 37" and a maximum weight of 1700 lbs.

XV. COASTAL TRANSFORMERS

Transformers identified as JEA Item ID TRA CO 001 - 006 are coastal use units and shall have a primary bushing creep distance of 30". The cover, retaining band or clamp and tank shall be 304 or 304L stainless steel.

XVI. FINAL TESTING AND INSPECTION

XVI.1. QUALITY INSPECTION

- XVI.1.1. Good quality control shall be exercised at all times to ensure completed transformer meets guaranteed losses. Manufacturers shall have in place: engineering product specifications on all parts, assemblies, and finished products; manufacturing product instructions defining how each part is to be made and tested; and documentation of the essential quality characteristics and how each is measured. Such non-proprietary information shall be made available to JEA when requested.
- XVI.1.2. Transformers shall receive a final quality inspection before shipping with special attention to oil leaks at bushings, tightness of the bushings, welds, chips and scratches to finish, decals and add on accessories.

XVI.2. TESTING

- XVI.2.1. Testing shall be as per ANSI standards for distribution transformers C57.12.90 (latest revision).
- XVI.2.2. One hundred percent of transformers leaving production line shall have been tested for the following:
 - A. Polarity
 - B. Ratio - on all taps if supplied with taps.
 - C. Load Losses (or Winding Losses) at 100% loading
 - D. No Load Losses (or Core Losses) at 100% loading
 - E. Dielectric - Induced and Applied Potential. Refer to ANSI Standards for specific units.
 - F. Pressure on tanks - All tanks shall be tested in such a manner to positively indicate leaks.
 - G. Impulse - All transformers shall receive and pass at least one full wave production line impulse test at one hundred percent of rated BIL. The impulse test shall be on 100% of all transformers.
- XVI.2.3. Sample or prototype transformers of each class and each KVA size shall be tested for:
 - A. Short Circuit - Classifications used by JEA shall be able to withstand testing in accordance with ANSI C57.12.90 (latest revision).
 - B. Radio Interference
 - C. Stray Loss (calculated)
 - D. Life Test on Components
 - E. Exciting Current

- F. Impedance
 - G. Power Factor - limited to 1% according to Doble testing procedures.
- XVI.2.4. The results of sample or prototype test shall be made available to JEA in the form of a Certified Test Report when requested.
- XVI.2.5. Transformers shall be supplied with a maximum power factor of 1% according to Doble testing procedures.

XVII. TEST REPORTS SUBMITTALS

Transformer suppliers, manufacturers, and/or representatives must submit a Transformer Test Report and an Asset Management Report on all transformers shipped. Each test report must be submitted within 30 days after each shipment and emailed to the following:

Overhead Standards Engineer: Henry Hoff (hoffht@jea.com)

Electric T&D Standards Manager: Kris Rosenhauer (RoseKK@jea.com)

XVII.1. TRANSFORMER TEST REPORT

The Transformer Test Report must be emailed in a .PDF or .XLS file and include the following data in the exact format as below.

- A. Customer: JEA
- B. JEA Purchase Order Number
- C. Quantity Ordered
- D. JEA Solicitation number
- E. Bid Item Number
- F. Core Loss of each transformer
- G. Average core loss of all transformers on report
- H. Winding Loss of each transformer
- I. Average winding loss of all transformers on report
- J. Impulse Test Statement.
- K. KVA size
- L. Primary Voltage
- M. Secondary Voltage
- N. Impedance
- O. Serial Number

XVII.2. ASSET MANAGEMENT REPORT

The Asset Management Report report must be emailed in a .CSX file and include the following data in the exact format as below.

- A. Manufacturer
- B. Model Number
- C. Manufacturer Part Number
- D. Serial Number
- E. Date Manufactured
- F. Bar Code Number
- G. Purchase Order
- H. Purchase Price
- I. Warranty Start Date
- J. Warranty Duration Months
- K. Tap Position
- L. Percent Impedance
- M. KVA Rating
- N. Primary voltage
- O. Secondary voltage

- P. Type (i.e. POL or PAD)
- Q. Number of Phases

XVIII. TRANSFORMER EFFICIENCY REQUIREMENTS

All transformers manufactured after shall meet the Department of Energy efficiency requirements set forth in the DOE Final Rule, 10 CFR Part 431 (latest edition).

XIX. ANNUAL TRAINING

Each manufacturer that receives an award under this Contract shall be required to provide annually a one day seminar on transformers to JEA personnel at JEA's facility. The seminar shall be at no additional cost to JEA.