
Progressive Engineering Consultants, Inc.

**CONTRACT DOCUMENTS
FOR THE PURCHASE OF
THREE-PHASE POWER TRANSFORMERS
WITH
ON-LOAD TAP-CHANGERS
FOR
DELIVERY #7 – ALEX COOPER PARK
1500 FIFTH ST., STATESVILLE, NC 28677**

**CITY OF STATESVILLE
STATESVILLE, NORTH CAROLINA**

RESPECTFULLY SUBMITTED BY



September 8, 2026

A handwritten signature in black ink, appearing to read "Robert F. Thomas, Jr.", written over the printed name and seal area.

P.O. Box 690638 Charlotte, North Carolina 28227-7011

Telephone (704) 545 - 7327

progress@pecinc.net

TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>NO. OF PAGES</u>
AP	Advertisement for Proposals	1
NIB	Notice and Instructions for Bidders	3
BP	Bidders Proposal	1
C	Contract	2
B	Bond	2
S	Specifications	20

ADVERTISEMENT FOR PROPOSALS

SECTION AP



ADVERTISEMENT FOR PROPOSAL

**The City of Statesville
P.O. Box 1111
Statesville, North Carolina 28677**

Sealed proposals for furnishing **Two (2) – Three-Phase 20/27/33 MVA Power Transformers with OLTC, One (1) Spare OLTC Controller, and One (1) Spare Transformer Monitor** as specified, shall be received by the City of Statesville, 915 Winston Ave., Statesville, North Carolina 28677 on or before **2:30 p.m. local time Tuesday, October 13, 2026**, at which time and place the sealed proposals shall be publicly opened and read.

Proposals should be addressed to the City of Statesville at the above address to the attention of Mr. Cody Leis. Copies of the bidding documents, notifications, and/or instructions may be obtained by contacting Cody Leis at the above address, calling (704) 832-3831, or by visiting our website at:

<https://www.statesvillenc.net/bid-postings>

Contract documents may be examined at the following locations:

City of Statesville

Progressive Engineering Consultants, Inc.

Statesville, North Carolina

Charlotte, North Carolina

A certified check or cashiers' check payable to the City of Statesville or a satisfactory Bid Bond executed by a corporate surety licensed under the laws of North Carolina to execute such bonds in the amount equal to five (5%) percent of the total bid, shall be submitted with each bid in a separate sealed envelope. Bid proposals may not be withdrawn for ninety (90) days after the date of receipt.

The successful bidder shall be required to furnish a separate one hundred percent (100%) Performance Bond on the forms included as a part of the Contract Documents. The Performance Bond shall be in full force and effect for one (1) year from the date of final acceptance of the equipment by the City of Statesville, North Carolina. Contract and Performance Bond are not to be completed at the time of this proposal and are included in order to advise the Bidder as to form.

The bid deposit shall be retained by the City of Statesville if the successful bidder fails to execute the contract or fails to provide the required bonds as stated above, within ten (10) days after award of the contract.

Pursuant to General Statute 143-48 and Executive Order #150, the City of Statesville invites and encourages participation in this procurement process by businesses owned by minorities, women, disabled, disabled business enterprises and non-profit work centers for the blind and severely disabled.

The City of Statesville reserves the right to reject any or all bid proposals and to accept any proposal which is deemed to be in the best interest of the City of Statesville, North Carolina.

**CITY OF STATESVILLE
STATESVILLE, NORTH CAROLINA**

By

Title

NOTICE AND INSTRUCTIONS TO BIDDERS

SECTION NIB

NOTICE AND INSTRUCTIONS TO BIDDERS

The City of Statesville, North Carolina (hereinafter called the "Purchaser") will receive sealed proposals for furnishing **Two (2) – Three-Phase 20/27/33 MVA Power Transformers with OLTC, One (1) Spare OLTC Controller, and One (1) Spare Transformer Monitor** as specified. Proposals will be received, publicly opened and read at the time and location as follows:

Location: City of Statesville
915 Winston Avenue
Statesville, NC 28677
Attn: Mr. Cody Leis

Time: 2:30 p.m., local time

Date: Tuesday, October 13, 2026

Proposals received after the date and time specified for the opening will be returned unopened.

INSTRUCTIONS

1. Proposals and supporting documentation shall be submitted in a sealed envelope addressed to the City of Statesville, North Carolina no later than 2:30 p.m. local time on Tuesday, October 13, 2026, at which time and place they shall be publicly opened and read.

Mailing Address (USPS)

City of Statesville
PO Box 1111
Statesville, NC 28677
Attn: Mr. Cody Leis

Physical Address (FedEx, UPS)

City of Statesville
915 Winston Avenue
Statesville, NC 28677
Attn: Mr. Cody Leis

2. The name and address of the Bidder as well as the date and time of the opening of the Proposals must appear on the outside of the envelope in which the Proposal is submitted. Proposals shall also be marked "**SEALED PROPOSAL FOR THE PURCHASE OF THREE-PHASE POWER TRANSFORMER(S) WITH OLTC.**"
3. Bidders will be required to comply with all applicable statutes, regulations, etc., as set forth by the State of North Carolina and those attached to and made a part of these bid documents.
4. Each proposal must be accompanied by a certified check on a bank that is a member of the FDIC, payable to the order of the Purchaser, or a Bidder's Bond acceptable to the Purchaser and running in favor of the Purchaser, in an amount equal to (5%) of the maximum bid price. If a proposal is accepted, the Bidder agrees that by filing its proposal together with such check or Bidder's Bond in consideration of the Purchaser's receiving and considering such proposal, said proposal shall be firm and binding upon each such Bidder and such check or Bidder's Bond shall be held by the Purchaser for a period not to exceed ninety (90) days from the date set for the opening of the proposals.
5. The successful Bidder will be required to enter into a contract with the Purchaser and to furnish a one hundred percent (100%) Performance Bond, on the forms included as a part of these documents, in a penal sum equal to the contract price and with Surety satisfactory to the

Purchaser's Attorney. Contract and Performance Bonds are not to be completed at the time of this proposal and are included in order to advise the Bidder as to form. The Performance Bond shall be in full force and effect for one (1) year after the date of final acceptance of the equipment by the Purchaser.

6. Any conditions, requirements or restrictions included as part of the Bidder's Proposal as set forth in these Notice and Instructions to Bidders may result in the Proposal being deemed non-responsive.
7. The Proposal shall include transportation charges for all equipment to the substation site located in the City of Statesville, North Carolina.
8. North Carolina sales tax is applicable to the purchase of this equipment. Each Bidder shall show, as a separate item, the amounts which will be payable by the successful Bidder as a result of taxes imposed by any taxing authority for the sale, purchase or use of these materials, supplies and equipment included in the taxable items furnished.
9. The Purchaser reserves the right to make a contract for the lump sum price to one Bidder or to award contracts to multiple Bidders by section. The Purchaser also reserves the right to award contracts to multiple vendors based on pricing and experience.
10. The Purchaser reserves the right to waive minor irregularities or minor errors in the proposal which appear to have been made through inadvertence, provided such irregularities or errors so waived are corrected on the Proposal prior to its acceptance by the Purchaser. The Purchaser also reserves the right to reject any and all Proposals or to accept a bid other than the lowest submitted if such action is deemed to be in the best interest of the Purchaser.
11. The quantities shipped shall be the same as the quantities bid. Any items received in excess of the bid quantities shall not increase the bid price.
12. The proposal form shall be completed exactly as presented with all prices, terms and signatures as required. Any proposal which is not properly completed shall be deemed non-responsive and shall not be considered for contract award.
13. The City prefers to receive a firm, non-escalated bid for the substation transformer. In the event a bid is quoted as "non-firm," the Engineer will adjust the quoted price by considering the proposed delivery date and any monetary impacts affecting the bidder's proposal. The adjusted evaluated bid price shall be used for bid comparison purposes. The methods utilized by the City or its agents in the evaluation of bids shall be solely at the discretion of the City.
14. Payment terms shall be Net 30 days following the successful completion of all specified tasks by the Bidder.
15. It is the policy of the Purchaser to provide minorities and women equal opportunity for participating in all aspects of the City's contracting and procurement programs, including but not limited to employment, construction projects, and lease agreements consistent with the laws of the State of North Carolina.

16. It is further the policy of the Purchaser to prohibit discrimination against any person or business in pursuit of these opportunities on the basis of race, color, national origin, religion, sex, age, handicap, or veteran status. It is the policy of the Purchaser to conduct its contracting and procurement programs so as to prevent such discrimination and to resolve any and all claims of such discrimination.
17. Questions regarding the specifications and/or requirements of the Request for Proposal or requests for documentation shall be directed to Progressive Engineering Consultants, Inc., PO Box 690638, Charlotte, NC 28227; by calling (704) 545-7327 or via email to progress@pecinc.net.

**CITY OF STATESVILLE
STATESVILLE, NORTH CAROLINA
(Purchaser)**

PROGRESSIVE ENGINEERING CONSULTANTS, INC.
(Engineer)

Date: September 8, 2026

BIDDERS PROPOSAL

SECTION BP

BIDDERS PROPOSAL

To: City of Statesville
Statesville, North Carolina

Gentlemen:

The undersigned has carefully examined the attached Notice and Instructions, Contract, Bond, and Specifications and hereby declares that he will furnish the material, equipment, and services as specified for the following price:

<u>Section 1</u>	<u>Price Each</u>	<u>Extended Price</u>
Two (2) – Three-Phase 20/27/33 MVA Power Transformers with OLTC, as specified	\$_____	\$_____
One (1) – Spare OLTC Microprocessor Based Voltage Regulating Control, as specified		\$_____
One (1) - Spare Transformer Monitor		\$_____
	TOTAL	\$_____

Losses

No Load (Watts) _____ Load (Watts) _____

Manufacturer**Delivery****Price Terms****Exceptions**

_____	_____
Bidder	By
_____	_____
Address	Print Name
_____	_____
City State Zip	Title
_____	_____
Telephone	Email

Date	

COMPLIANCE STATEMENT

The Bidder shall attach a Statement of Compliance including a list of any and all exceptions referenced by paragraph to the Specifications. If no exception is taken to a paragraph, it shall be deemed that the Bidder meets or exceeds the requirements as stated therein.

CONTRACT

SECTION C

**CONTRACT FOR THE PURCHASE OF
THREE-PHASE POWER TRANSFORMER(S)**

THIS AGREEMENT, made and contracted this _____ day of _____, 2026 between the City of Statesville, North Carolina (hereinafter called the Purchaser), party of the first part, and _____ hereinafter called the Materialman, party of the second part.

ITEM 1. WITNESSETH: That for and in consideration of the payments and agreements to be made and performed by the Purchaser, under penalty expressed in the bond bearing even date with these presents, and hereunto annexed, the Materialman at its own proper cost and expense, with skill and diligence, will furnish **Two (2) – Three-Phase 20/27/33 MVA Power Transformers with OLTC, One (1) Spare OLTC Controller, and One (1) Spare Transformer Monitor** for the total sum of _____ US Dollars (\$_____), *plus any applicable State and Local Sales Tax*, and furnish same in accordance with the Notice and Instructions to Bidders, Bidder's Proposal, Contract, Bond, and Specifications attached in full compliance with the agreement.

ITEM 2. And the said Materialman agrees to accept the price stated under Item 1 above in full compensation for the performance of this contract.

ITEM 3. This contract together with the aforementioned documents constitutes the entire agreement between the Purchaser and the Materialman.

ITEM 4. On completion of this contract by the Materialman and acceptance by the Purchaser as being in accordance with all portions of this contract, the Purchaser shall pay the above-named contract price as follows: _____

ITEM 5. The Materialman shall be responsible for all fees or claims for any patented invention used by him and shall defend any suit or proceeding for infringement of any patent or patents covering materials purchased hereunder which may be brought against the Purchaser and shall hold said Purchaser harmless for use or infringement of any patented thing or method used in connection with any article, equipment, device, or thing furnished or constructed hereunder.

IN WITNESS, WHEREOF, the parties hereto have caused this contract to be signed and sealed, all as of the date and year first written:

Executed in three (3) counterparts.

ATTEST:

Signature

Print Name

Title

(Materialman)

Signature

Print Name

Title

**AFFIX
SEAL**

**CITY OF STATESVILLE
STATESVILLE, NORTH CAROLINA**

(Owner)

ATTEST:

Signature

Print Name

Title

Signature

Print Name

Title

**AFFIX
SEAL**

BOND

SECTION B

BOND

KNOW ALL MEN that we, _____ of _____,
County of _____, State of _____,
hereinafter called the Principal, and _____,
_____ hereinafter called the Surety
or Sureties, are held and firmly bound to the City of Statesville, North Carolina, hereinafter called
the Purchaser, in the sum of _____
_____ Dollars (\$_____),
plus any applicable State and Local Sales Tax, for payment whereof the Principal and the Surety
or Sureties bind themselves, their heirs, executors, administrators, successors, and assigns, jointly
and severally, firmly by these presents.

WHEREAS, the Principal has, by means of a written Agreement, dated the _____ day
of _____, 2026 entered into a contract or agreement with the Purchaser to
furnish **Two (2) – Three-Phase 20/27/33 MVA Power Transformers with OLTC, One (1) Spare OLTC
Controller, and One (1) Spare Transformer Monitor** a copy of which Agreement is hereto attached
and made a part hereof:

NOW THEREFORE, the condition of this obligation is such, that if the Principal shall
faithfully perform the said Contract on his, its, or their part and satisfy all claims and demands
incurred for the same, shall fully indemnify and save harmless the Purchaser from all cost and
damage which the Purchaser may suffer by reason of failure to do so, and shall fully reimburse
and repay the Purchaser all outlay and expense which the Purchaser may incur in making good
any such default, and shall pay all persons who have contracts with the Principal, or any sub-
contractor of the said Principal for labor or material, or both, then this obligation shall be null and
void, otherwise, it shall remain in full force and effect.

And said Surety, for value received, hereby stipulates and agrees that no change, extension
of time, alteration or addition to the terms of the contract or to the work to be performed thereunder
or the specifications accompanying the same shall in any wise affect its obligations on this bond,
and it does hereby waive notice of any such change, extension of time, alteration or addition to the
terms of the contract of to the work or to the specifications.

IN TESTIMONY WHEREOF witness the hands and seals of the parties hereto on this _____ day of _____, 2026.

Executed in three counterparts.

ATTEST:

Signature

Print Name

Title

(Materialman)

Signature

Print Name

Title

**AFFIX
SEAL**

ATTEST:

(Witness as to Surety)

(Surety Company)

Signature

Countersigned:

(Licensed Resident Agent)

Print Name

Title

**AFFIX
SEAL**

INSTRUCTIONS

Bonds must be executed by a Surety Company authorized to conduct business in the State of incorporation of the Owner, acknowledged before a Notary Public, and accompanied by Power of Attorney or other authority satisfactory to the Owner.

SPECIFICATIONS

SECTION S

**SPECIFICATIONS FOR
20/27/33 MVA POWER TRANSFORMERS WITH OLTC**

A. GENERAL

These specifications cover two (2) – three-phase, sealed tank construction, oil insulated, copper or aluminum wound, substation type power transformers for connection to a three-phase 108,000-volt three wire primary and a 24,940/14,400Y volt four-wire secondary. The transformer shall conform to the latest revision of all applicable ANSI and IEEE standards for Class II transformers, except where these standards conflict with the specific requirements contained in the specifications.

The transformer shall be connected delta-wye and shall conform to ANSI standard 30-degree displacement.

Any exceptions, clarifications, or deviations to the specifications contained herein shall be clearly stated and so noted in the Proposal. If no exceptions are taken, it shall be deemed that the Bidder complies with all of the requirements of these specifications.

All equipment shall be new and unused. The major components of the power transformer shall be manufactured and assembled in the United States of America.

The manufacturer shall certify the insulating liquid to be free of PCB contamination. The term "free" shall mean less than two (2) parts per million by volume.

The transformer shall be designed to withstand a minimum force of 5g in the shipping direction, 3g lateral, and 2g vertical. Additional permanent internal bracing shall be added as required to meet these minimum design force requirements.

B. RATINGS

The transformer shall be rated 108,000-24,940Y/14,400 volts, 60 Hz, with seven (7) full capacity high voltage taps at 108,000, 105,750, 103,500, 101,250, 99,000, 96,750 and 94,500 volts. Transformer basic impulse levels shall be 550 kV for the 108 kV primary and 150 kV for the 24.94 kV secondary. The transformer shall be furnished with the following continuous ratings:

- 20 MVA OA with an average winding temperature rise not exceeding 55 degrees C
- 26.667 MVA OA/FA with an average winding temperature rise not exceeding 55 degrees C
- 33.333 MVA OA/FA/FA with an average winding temperature rise not exceeding 55 degrees C

An additional 12% load bonus shall be available at each rating by operating the transformer at 65 degrees C rise. Maximum rating shall be 37.333 MVA OA/FA/FA at 65 degrees C rise.

C. BUSHINGS AND CONNECTIONS

The transformer shall have three (3) fully insulated high voltage and four (4) fully insulated low voltage cover mounted porcelain bushings. All bushings shall be ANSI-70 Grey porcelain and shall have a minimum current carrying capacity equal to the maximum transformer rating. Oil-filled bushings shall be furnished with a visible liquid level indication.

High side bushings shall be 800 amperes minimum, static shielded, and shall be furnished with NEMA spade type four-hole terminals. Secondary bushings shall be furnished with NEMA spade type terminals (four-hole minimum) suitable for a minimum of 1200 amperes continuous capacity.

Bushings shall be capacitance graded, oil impregnated, condenser type. The high side bushings shall be single-piece porcelain construction and shall be draw lead type. The low side bushings shall be single-piece porcelain construction and shall be bottom connected.

Trench bushings shall not be accepted.

The transformer shall be furnished with potential taps on the bushings for power factor measurements. Power factor tests shall be conducted and recorded, with copies provided for the Purchaser's records.

The transformers neutral bushing shall be connected to a tank grounding bar running the height of the transformers to a tank grounding pad with a 1/4" x 3" (minimum) copper strap. This grounding pad shall also have provision for connection of 4/0 copper ground grid. The transformers shall also be provided with two additional clamp type tank grounding terminals suitable for 4/0 stranded copper conductor.

D. CURRENT TRANSFORMERS

The transformer shall be provided with: (a) eight 600:5 amperes, multi-ratio, bushing type current transformers; and (b) six 1200:5 amperes, multi-ratio, bushing type current transformers.

Six (6) of the 600:5 ampere phase bushing current transformers shall be mounted on the high-voltage side of the power transformer (H1, H2, H3) and shall be wired to shorting type terminal blocks in the control housing.

The 1200:5 ampere phase bushing current transformers shall be mounted on the low-voltage side of the power transformer (X1, X2, X3) and shall be wired to shorting type terminal blocks in the control housing.

The remaining 600:5 ampere neutral (X0) bushing current transformers shall be mounted on the low-voltage side of the power transformer neutral and shall be wired to shorting type terminal blocks in the control housing.

All bushing current transformers shall be C800 accuracy class. See terminal connection requirements below.

E. ON-LOAD TAP-CHANGER

The on-load tap-changer shall as a minimum be a Reinhausen Vacuum Reactive Type RMV-II or approved equal.

The on-load tap-changer (OLTC) shall be designed to provide regulation of the 24.94 kV winding. The OLTC shall be able to deliver full capacity kVA at all tap positions above rated voltage and rated current at all tap positions below rated voltage.

The OLTC shall be designed with a phase end BIL of 200 kV and a neutral end BIL of 110 kV.

The OLTC shall be designed to operate on a preventive autotransformer (reactor) switching principle using vacuum interrupters to accomplish the tap-change operations in order to eliminate oil contamination. The manufacturer shall provide valves, connecting pipes and fittings to equalize the pressure between the OLTC compartment and the transformer main tank during vacuum processing and filling.

The OLTC shall be equipped with a single-phase 240 VAC electronic motor drive unit. The electronic motor drive shall be supplied by the OLTC manufacturer and completely wired and tested at their facility. Automatic voltage regulation control shall be wired and mounted in the motor drive or transformer control cabinet by the OLTC manufacturer.

The motor drive unit shall be **ETOS-MDIV unit or approved equal**.

- **ETOS® General**

- All required functions shall be combined in one central control and monitoring system (ETOS).
- Integration of the OLTC motor drive function, AVR function and common monitoring functions such as OLTC monitoring, cooling monitoring, bushing monitoring (BM), DGA, and vibro-acoustic monitoring (VAM) shall be integrated in a single cabinet.
- Additional secondary technology shall be integrated in the control and monitoring system cabinet.
- The control and monitoring system shall be compatible with sensors from any manufacturer.
- Visualization via 7" Touch Screen display.

- **ETOS® Mechanical / Electrical**

- Control cabinet shall be made of aluminum with a protection class rating of IP65 and supports passive cooling.
- The control and monitoring system shall be installed directly to the transformer.
- The model 1500 control cabinet shall have thermostatically controlled anti-condensation heating.
- A UV-resistant inspection window is required so that relevant information is visible when the door is closed.
- Suitable for ambient temperatures: standard: -25°C...+50°C.
- The housing shall be an integrated socket and service interface (RJ45) that can be reached without the use of tools.
- Additional space in the transformer monitoring cabinet shall be available for later function upgrades.

- **ETOS®MDIV – Motor Drive Functions**

- The control system's operation of the on-load tap-changer must consist of an oil-free belt drive.
- A cover made of corrosion-resistant aluminum shall be used for protection of the drive shaft arrangement between the transformer monitoring system with OLTC - drive function and on-load tap-changer.

- The Reinhausen MDIV motor drive for the on-load tap-changer shall be designed as a drive function of a modular system. The internal detection of the on-load tap-changer position is carried out via an electronic angle-of-rotation encoder.
 - The drive function of the on-load tap-changer shall be digital ready where digital inputs/outputs are integrated as a standard.
 - The ETOS transformer monitoring system must be integrated into the MDIV motor drive unit of the on-load tap-changer. The hardware of the system must be modular and allow user-friendly hardware and software changes and extensions at any time.
 - A spare processor module shall be provided with ETOS system.
 - All operating signals and fuse status of the motor drive function shall be connected to an integrated device (Intelligent Electronic Device), and the status shall be available for SCADA communication.
- **MDIV – Motor Drive Functions**
 - The tap changer shall be driven via a flexible, pre-connected and pluggable cable with the MDIV motor drive function of the control and monitoring system.
 - Electronic drive control shall include automatic recognition of the end positions via torque measurement.

- **ETOS® Controller Functions**

The voltage regulation controller shall be a Reinhausen ETOS Controller (preferred) or Beckwith Electric Company Type M-2001D Digital LTC Voltage Regulator Control (alternate) or approved equal and shall be capable of taking a position signal from the OLTC electronic motor drive for local display and provide an active remote position analog output for customer's use utilizing an ethernet multi-mode fiber optic connection with DNP 3.0 protocol.

A Beckwith Electric M-2025D Current Loop Interface Module or Reinhausen/Messko equal may be quoted in addition to the preferred mentioned above. Additionally, the LTC system shall include a Beckwith Electric M-2948 Tap Position Sensor, designed to interface directly with the M-2025D Current Loop Interface Module and RMVII LTC to provide tap position to the M-2001D controller. An accurate indication of tap position is required for both local monitoring and SCADA integration.

Additional Controller Functions

- Basic control functions on the transformer such as OLTC tap-changer, AVR and DGA shall be combined in one control system.
- The control and monitoring system shall be modular and shall be individually assembled which combines monitoring, control and actuators for tap changers and cooling in one system. Individual functions shall have the ability to be retrofitted at any time.
- The monitoring system shall be able to evaluate the condition of the transformer, provide comprehensive overviews and reports on operational risks, and make concrete recommendations on corrective measures.

- The system shall simultaneously evaluate the probability & criticality of a possible fault as well as possible consequences for the transformer and shall have options for rectifying the fault.
 - The monitoring system shall have a dynamic, optimized operation of the transformer by checking the expected load, calculating the specific temperature limit, and ageing.
 - Individual programming of functions shall be by means of function blocks via web visualization without software installation on a PC is possible
 - AVR Parallel Pro function for OLTC operating control is required with three desired autoregulation voltage settings.
 - The AVR function shall have a voltage setpoint adjustment via digital or analog inputs.
 - Compensation function to compensate for the load-dependent voltage drop between the transformer and the consumer load, at least the two compensation-methods RX and Z compensation shall be available for compensation.
 - An MSense DGA5 or approved equal gas monitoring system shall be required and wired to ETOS control.
 - Simultaneous graphic visualization measured values of different types (e.g., temperature, voltage, gas-in-oil content) are required.
 - Easy import of stored settings from PC are required
 - Easy export of data to CSV file to MS EXCEL directly on PC are required.
 - On site control commissioning provided by the manufacturer of OLTC control system are required.
- **Communication Requirements**
 - DNP 3.0 communications protocol with ethernet ports
 - Intelligent sensors can be connected to the control and monitoring system via a bus system.
 - **Security Requirements**
 - The control and monitoring system has role-based access control (RBAC) and an integrated firewall, thus preventing external access by third parties.
 - The modification of the parameterization settings of the monitoring system must be protected by user authorization (password) and role-based user management (log-in levels) in accordance with the requirements of NERC / BDEW / FIPS to ensure a high level of security.

Transformer & OLTC Monitoring Accessories

The following accessories shall be required and installed:

- **Dehydrating breather**

Breather shall be Messko DB100 or approved equal. This device shall be designed to include a UV coated laminated safety glass, built-in breather. Replacement shall not require lowering the oil in the respective oil compartment. Where required, an analog output will be available at the indicator for remote indication purposes.

Lighted indication for device status shall be provided as well as a space heater in the control box to prevent condensation of moisture. Breather shall feature control software designed to allow regeneration only when the transformer is breathing out. In addition, error and status relays shall be provided for remote indications. The breather shall be installed with a 1/4" isolation valve and on an installation pad welded on the OLTC and transformer wall. If necessary, an output filter heater shall be installed to prevent formation of ice on the unit.

The desiccant container shall be located at operator level for ease of maintenance.

Additional features

- The dehydrating breather shall be maintenance-free mounted on the OLTC oil compartment. The self-monitoring mechanism is equipped with alarming contact for remote signaling and a test button to perform quick self-evaluation. The external cover of the breather shall be made of tempered glass with UV protection filter.
- Three (3) exterior LED indicators for the status of the breather.
- The humidity and temperature sensor, the silica gel and the PCB shall be replaceable in the field.
- No moving parts to restrict or redirect the air flow from the desiccant chamber. The use of fans to expel condensed water out of the desiccant chamber is not permitted.
- Control for breather shall have Modbus communication wired to ETOS control.

- **Gauges**

The winding and temperature gauges shall be weatherproof, shock-proof dial capillary type indicator (bourdon spring system). The view glass must be laminated safety glass with a UV-filter. The temperature indicator shall be maintenance-free, and no calibration shall be necessary during the entire lifetime of the device. The winding temperature gauge shall have four adjustable contacts with colored indicators for temperature alarm, trip and control of the cooling groups if needed. A Modbus output will be built in the gauge for connection to ETOS control. The gauge would have an inbuilt mechanism to simulate winding temperatures without the need of a heated well, external heater coil or an external resistor. These gauges shall be a Messko MT-ST or approved equal.

A magnetic type oil level gauge with contacts shall be installed on the side wall of the main tank and also on the tap changer compartment. The view glass must be UV-stabilized safety glass. Gauge shall be provided with ANSI connector and provide low level alarm contacts. The gauge shall be easily readable by an observer at ground level. The oil level Indicator should have an analog output of 4-20mA with its mechanism built inside the gauge. The float material of the oil level Indicator should be Rohacell and resistant to temperatures of up to 160C. Oil level indicator shall be a Messko MTO or approved equal.

- **Pressure relief device**

The OLTC shall be furnished with a pressure relief device. The device shall be Reinhausen-Messko, MPreC series or approved equal. The pressure relief device mechanism including micro switches must be fully protected by a cover featuring lateral openings for the OLTC tank. The trip contacts must be directly activated by a self-locking red signal pin. Device release time must be within 2ms. All material must be rated for salt water and corrosive environment operation.

The pressure relief device (PRD) for the transformer tank and OLTC shall consist of double synthetic coated and cathode corrosion protected springs made of spring steel to make sure that the springs transmit the pressure equally to the entire opening plate and neither lose their tension nor corrode. The spring should be colored for easy identification of the operating pressure of the PRD. The PRD device cover shall allow for directional flow of oil. PRD shall be provided with ANSI connector and provide alarm contacts with microswitches mounted inside the PRD cover for protection. The contacts shall have the protection class IP65 and be directly activated by a self-locking pin. The pressure relief device should have a yellow metal semaphore for visible tripped indication.

- **Liquid level Indicator**

The OLTC shall be furnished with a Messko liquid level indicator.

- **Additional features of the OLTC**

The OLTC shall have a range of ten (10) percent above and ten (10) percent below normal voltage in thirty-two (32) equal 5/8 percent steps. The Load Tap Changer shall meet the requirements of IEEE Std. C57.131-1995 IEEE Standard Requirements for Load Tap Changers.

The OLTC mechanism shall be mounted in a separate oil filled compartment, capable of withstanding full vacuum in the main tank, without the use of bypass piping and equipped with:

- Messko or approved equal liquid level gauge with alarm contacts.
- Pressure control switch with trip contacts.
- Cover mounted mechanical Messko MPREC or approved equal mechanical pressure relief device.
- Drain valve with sampling device.
- The load tap changing equipment shall provide automatic plus and minus 10% adjustment of the low voltage in 32 equal steps with the OLTC designed for full capacity on tap positions above rated voltage and reduced capacity of tap positions below rated voltage.
- Filling plug located at the top of the compartment.
- Operating mechanism with a 240 VAC electronic motor drive. The MD-IV electronic drive motor shall be easily accessible and not immersed in oil.
- Local position indicator.
- Operation counter.
- The cover on the oil filled compartment, regardless of weight of the cover, shall be hinged to support itself when open.
- OLTC tank bottom shall be sloped to drain oil away from the door.
- OLTC compartment shall include a lip to prevent oil spills after draining compartment and opening the door.

The LTC electronic motor drive cabinet shall be mounted such that the center of the cabinet is at an approximate height of six feet above grade.

The manufacturer shall include (in the main transformer tank) a Beckwith Electric Company M-0169A, 5A : 0.2A or Messko/Reinhausen equivalent current transformer for input to the line drop compensator. The manufacturer shall also provide a potential source for operating the voltage regulating control, which will consist of one line to ground potential transformer primary rated at 14.4 kV and a secondary voltage (X0-X1) of 120 volts.

The following equipment shall be supplied and mounted in a cabinet attached to the transformer tank. The cabinet shall incorporate motor drive functionality along with advanced monitoring, regulation, and control features in a single modular enclosure. It shall support transformer condition monitoring, sensor integration, and digital communication interfaces for real-time diagnostics and predictive maintenance. It shall have multiple 100BASE-FX Ethernet ports with LC connectors and support DNP3 protocol. The cabinet shall be mounted at a height that ensures safe and convenient access for operation and maintenance from ground level.

The following standard features shall be supplied:

1. Vacuum tap changer mechanism with 33 operating positions.
2. Operating mechanism with motor drive.
3. Local position indicator.
4. Operation counter.
5. Raise and lower switches for manual operation.
6. Provision for remote manual operation.
7. Motor and controls protected by circuit breakers.
8. Terminal board in control compartment for termination of control and signal wiring.
9. Automatic-Off-Manual toggle switch with status feedback to controller.
10. Voltage testing terminals.
11. Line drop compensator with resistance and reactance settings plus or minus 72V.
12. Three current transformers for line drop compensation.
13. Control compartment heater with switch.
14. Output voltage limit control as specified below.
15. Tap-position indication via HMI screen with electronic sensing for each tap position.
16. Control compartment light and convenience outlet with appropriate switch.
17. Control compartment heater (if recommended) with switch and thermostat.
18. Terminal board in control compartment for termination of control and wiring.
19. Drill plate in bottom of cabinet for attachment of purchaser's conduit.
20. Motor and controls protected by circuit breakers.
21. The manufacturer shall furnish a complete description of the OLTC equipment.

22. Manufacturer shall wire controls such that purchaser can operate both auto-off-manual circuit as well as raise-lower circuit by supervisory control.

The electronic drive mechanism shall be designed such that the load tap changer can be manually operated, while energized under full load.

If the electronic drive mechanism can be stalled in the "off-tap" position, it shall be designed to include an alarm with remote contacts and be capable of maintaining full load indefinitely.

OLTC performance shall be based on entire range of operations (+/-16) and maximum nameplate rating of the transformer.

F. ACCESSORIES

The transformers shall be furnished with ANSI standard accessories including thermostatically controlled cabinet heaters, liquid level gauge, top oil temperature gauge, loss of 240V AC and 48V DC control power indication, tank lifting facilities, core and coil lifting facilities, tank cover lifting facilities, welded cover with handholes, jacking facilities, winding temperature gauge, pressure vacuum bleeder, stainless steel nameplate, diagonally located ground pads, control cabinet light and GFI convenience outlet, base capable of tank movement in all horizontal directions, drain and lower filter valve, upper filter valve, pressure vacuum gauge, sudden pressure relief device, and gas sampling valve. All gauges shall be grouped and tilted to provide convenient viewing access from ground level. The winding temperature, top oil temperature, liquid level, pressure vacuum gauges, loss of AC and DC control power functions, and positive pressure nitrogen system shall all be equipped with alarm contacts and wired to terminal blocks in the control housing for Purchaser's use. All terminal and shorting blocks shall be furnished with Phillips-head or combination slotted/Phillips-head screws.

Manufacturer shall provide a can of touch up paint. (ANSI 70 Sky Grey)

One (1) full set of spare gaskets for transformers and accessories.

Where wiring requires connectors, these shall be crimp type lugs. All control wiring terminal strips shall be of the molded type with recessed clamp terminals and shall be sized to suit incoming cabling.

The terminals shall be grouped according to the circuit voltages with dividers or spaces between each group. Where wires are required to be terminated in the one terminal, lip blade lugs (UTILUX or equivalent) shall be used back-to-back. However, the preferred method is to use bridged terminals with each terminal having one wire. Provision shall be made to short and earth the winding temperature, line-drop compensator, and metering CTs in the control cubicle by bridging terminals. Sliding link terminals for CT connections are not to be used. The Supplier shall include full details of any alternative terminals offered. For stud type terminals e.g., at CT terminal box, complete circular eye type connectors shall be used complete with flat and spring washers. All exposed 110 Vdc (or higher) and 415/240 Vac electronic terminals where access may be gained while the equipment is live shall be fitted with shrouds. This includes fuse holders and relay terminals and any terminals exposed by opening hinged panels on other access doors (no equipment other than wiring and terminals shall be mounted behind hinged access panels). Shrouding of terminals is to be shown on all appropriate drawings.

Control cabinets shall be provided with UV protected safety glass windows over transformer alarms/controls. The control cabinets shall also contain a transformer monitor, manufactured by Schweitzer Engineering Laboratories, model 2414, or approved equal to monitor the following alarm functions: (a) sudden pressure seal in relay, (b) top oil temperature indicator, (c) winding temperature indicator, (d) liquid level indicator, (e) pressure relief device indicator, (f) loss of AC power, (g) low nitrogen cylinder pressure, (h) excessive tank pressure, (i) excessive tank vacuum, and (j) pressure relief operation. The transformer manufacturer shall provide and wire the ambient and top oil resistance temperature devices (RTDs) Type PT100 to the SEL-2414 transformer monitor. The manufacturer will also need to wire at least one phase CT (primary and secondary sides) to the 2414 to enable the transformer monitor to accurately calculate winding hot spot temperature. The transformer monitor shall be furnished with at least two communication ports. The first port shall have one uniquely addressable serial fiber optic port capable of communication with DNP 3.0 protocol. This communication shall be accomplished with one multimode fiber optic cable with ST type connectors from the transformer monitor back to the customer's fiber optic star. The second communication port shall have dual Ethernet fiber optic ports (A and B) capable of communications with DNP 3.0 protocol. This communication shall be accomplished with one multimode fiber optic cable with LC type connectors from the monitor back to the customer's Ethernet switch. These ports shall be a direct output from the transformer monitor. Copper to Fiber converters shall not be allowed. The transformer monitor shall be equipped with a minimum of three (3) spare digital inputs and three (3) spare digital outputs for future use.

Control power circuit breakers shall be furnished for all AC and DC input connections.

Each transformer shall be provided with a rapid pressure rise relay and 48V DC seal in auxiliary relay with reset switch and two (2) sets of 240V, 10-amp contacts for Purchaser's use.

All alarm functions shall be supplied from the Purchaser's 48V DC source.

A dedicated 10A fuse or circuit breaker shall be installed to power the DG monitor.

The case ground shall be connected to a suitable grounding point on the transformer tank.

Five output contacts and two analog outputs shall be wired to terminal blocks inside the control cabinet for remote gas monitoring.

G. Online DGA MSENSE-DGA5 Multi Gas Analysis Sensor or Approved Equal

- One dissolved gas and moisture-in-oil (DG) monitor (Device 95FG), Reinhausen MSense DGA 5 or approved equal shall be provided.

The following components shall be included:

- Maintenance-free online dissolved gas-in-oil diagnosis sensor with more than 5 years of field experience.
- Supply of online trend Dissolved Gas Analysis (DGA) monitoring system to acquire early fault detection based only on Hydrogen (H₂), Carbon Monoxide (CO), Ethylene (C₂H₄), Acetylene (C₂H₂), and Moisture (H₂O). In addition, the oil temperature at the location of the DGA measurement shall be taken.
- Rate of change of gas formation programmable to per day/week/month

- Warning and alarm limits for gas concentrations and rates of change.
- Parametrization software shall be included in the standard scope of delivery.
- Gas extraction from the oil shall be of the headspace type with vacuum support and the gas concentration measurement principle shall be based on near infrared spectroscopy (NIR).
- The light source and the IR detectors shall be integrated into one compact measurement chamber.
- For the detection of hydrogen, a metal oxide sensor shall be used.
- For the detection of moisture in oil a thin film capacitive sensor shall be used.
- At the beginning of a measurement cycle the system must perform an automated leakage test.
- The elemental sensor signal is the ratio of irradiated light intensity and transmitted light intensity that is detected. This optical signal is transferred into an electrical signal.
- The online DGA sensor system shall be compact (one single device), lightweight (less than 15 kg) and therefore easy to handle for a single service technician to allow quick installation on the transformer.
- The installation of the sensor shall be possible directly on a designated DGA sensor oil port on the transformer.
- The sensor does not require any consumables (such as carrier or calibration gases).
- Default limit values and the overall accuracy shall be in accordance with recognized standards, for example the IEEE C57.104, the IEC 60567, and/or the IEC 60599 as well as CIGRE procedures and recommendations.
- For warning and alarming purposes for each of the gases as well as for the humidity limit monitoring shall be available and configurable for both the absolute concentration value of each gas and the humidity as well as for the daily rate of gas and humidity concentration change. The trend for each value has to be visualized on the system related software in a graphical and tabular form.
- Each warning and alarm shall be signalized via at least four relay contacts. The measurement value for each gas and the humidity are communicated via a 4 :20 mA output per gas/humidity.
- The sensor shall be equipped with a display and keypad for easy and convenient use and configuration without the need for a service computer, if necessary.
- The use and configuration of the online DGA sensor shall be allowed using a system related PC software for Microsoft Windows operating system. The software has to be supplied together with the sensor.
- The measured data shall be able to be integrated into an ETOS modular system in the MDIV motor drive 1500 cabinet via MODBUS RTU. This system should give data evaluation and recommendation for action.
- The system shall be equipped with DNP 3.0 communication protocol for transmission to the SCADA system.
- IP class should be IP55.

- The DG monitor shall be mounted on a 1½ inch full bore gate valve on the main tank wall where there is a good forced or convective oil flow. The valve shall be brass and has a plug on the sensor side of the valve. The valve shall be mounted at a height of 48" above the concrete transformer pad or as recommended by the manufacturer.
- The DG monitor shall be the Multi-Protocol version with two analog output cards pre-installed. The unit shall be specified for 120 VAC operation or as recommended by the manufacturer.

H. POSITIVE PRESSURE NITROGEN SYSTEM

Each transformer shall be furnished with a positive pressure nitrogen system with weatherproof enclosure to include the nitrogen cylinder, three stage pressure regulators, pressure relief, manual shutoff valves, high- and low-pressure gauges, high pressure, and low-pressure alarm contacts. Provision shall be included to allow the replacement of the nitrogen cylinder without requiring the transformer to be removed from service.

I. DE-ENERGIZED -TAP CHANGER

The transformers shall be furnished with a stored energy, positive action, de-energized high side tap changer mechanism. Tap positions shall be provided at 108,000, 105,750, 103,500, 101,250, 99,000, 96,750 and 94,500 volts. The tap changer shall be furnished with a nameplate providing visual indication of the tap position and provisions for padlocking in all tap positions.

J. LIGHTNING ARRESTERS

The transformers shall be furnished with three (3) high side and three (3) low side lightning arresters, which are station type, gapless, metal oxide varistor, with grey polymer housing, with a duty cycle rating of 110 kV and 21.0 kV, respectively, and maximum continuous operating voltage suitable for use on a 108 kV three wire system and on a 24.94 kV four wire system, respectively, on which the terminal voltage may vary $\pm$ ten percent. The arresters shall be Ohio Brass MOV or approved equal.

Arresters must comply with ANSI/IEEE Standard C62.11 - 1993 or latest revision thereof.

K. THERMAL RELAYS AND FANS

The transformers shall be furnished with hot-spot winding temperature indicator and relays on the high side and low side, along with dial indicators to display the winding hot spot temperature. Each temperature indicator shall have three relay contacts which shall be adjusted to close at 80, 90, and 115 degrees centigrade winding hot-spot temperature. The 80-degree centigrade relay contacts shall be connected for stage 1 fan control. The 90-degree centigrade relay contacts shall be connected for stage 2 fan control. The 80, 90 and 115-degree centigrade relay contacts shall be furnished with separate dry contacts to provide for remote customer indication and shall be wired to a terminal board and appropriately labeled. Additionally, the 115-degrees contact shall be furnished with two (2) additional sets of contacts for customer use.

The transformer shall be furnished with automatically controlled fans to provide a maximum continuous forced-air, 65-degree C rating of 37.333 MVA. The stage 1 and stage 2 fans shall be controlled from the 80 and 90 degree winding hot-spot relays, respectively. The fan control relay shall be furnished with a separate dry contact wired to the SEL-2414 transformer monitor, closed

to indicate that each stage of the fan(s) are running. A hand-off-auto (HOA) control switch shall be furnished and labeled to by-pass the relay contacts for manual operation. The SEL-2414 transformer monitor shall also be wired to turn on each stage of fans independently.

One additional fan control switch shall be furnished and shall be marked "STAGE 1" "STAGE 2" and "BOTH" for sequencing control of fans. Closing of the 80-degree C winding temperature contracts shall cause operation of either stage of cooling fans or both depending on position of this switch.

Fans shall be weatherproof and shall be totally enclosed in an OSHA approved safety screen. The fans shall be attached to the radiators with suitable brackets which will allow for rigid mounting, maximum air flow, and minimum noise. The fans shall be rated 240 volts, single phase, 60 Hertz with automatic reset thermal protectors and permanently lubricated sealed ball bearings. All leads and fittings between the fans and control cabinet shall be of weatherproof construction. All fan control and customer power connections shall be terminated in a weatherproof control cabinet on terminal blocks and shall be labeled. Fans shall be Kernz or approved equal.

All fan motors shall be suitable for direct starting and continuous running from the 240 V supply voltage. All motors shall be of the totally enclosed weather-proof type. Bearings of all motors shall be of the ball or roller bearing type. Each motor shall be equipped with a terminal box arranged to accommodate the incoming cable provided by the manufacturer. If necessary, a suitable cable box shall be provided to terminate the cable. Motors shall be provided with starters, overload protection (three-phase where applicable) and, in the case of three-phase motors, single-phasing protection. All motors shall be labelled indicating kW and A ratings.

Fan blades and fan ducting shall be of aluminum alloy, stainless steel, galvanized steel, or other corrosion- resistant material and shall be designed to keep noise and vibration to a minimum. All fans shall be provided with galvanized wire-mesh guards. The rotation and air flow directions shall be clearly and indelibly indicated by appropriate arrows. Fans shall be mounted on anti-vibration dampers. Mesh guards shall be provided on all fans to prevent accidental contact with moving parts.

L. STANDARDS

The transformer and accessories shall, at a minimum, conform to the latest revision of the following ANSI and IEEE standards.

- ANSI/IEEE 21-1976
- ANSI/IEEE 24-1984
- ANSI/IEEE C37.90-1989 - Relays Associated with Electric Power Apparatus
- ANSI/ IEEE C57.12.00-1987 - General Requirements for Transformers.
- ANSI C57.12.10-1988 - Requirements for Transformers
- ANSI C57.12.28-1988 - Switchgear and Transformers Enclosure Integrity
- ANSI C57.12.70-1978 - Terminal Markings and Connections for Transformers
- ANSI/ IEEE C57.12.80-1978 - Standard Terminology for Transformers

- ANSI/ IEEE C57.12.90-1993 - Test Code for Transformers
- ANSI/IEEE C57.92-1981 - Guide for Loading Oil-Immersed Transformers
- ANSI/IEEE C57.19.00 - 1996 - General Requirements and Test Procedures for Outdoor Power Apparatus Bushings
- ANSI/IEEE C57.19.01 - 1997 - Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
- ANSI/IEEE C57.19.100 - 1995 - Application of Power Apparatus Bushings

M. PROTECTIVE COATING SYSTEM

The transformer protective coating shall meet or exceed the requirements as described in ANSI C57.12.28-2005, Pad - Mounted Equipment Enclosure Integrity, Sections 5.1 through 5.4.7.

The transformer shall be painted ANSI 70, sky grey.

Transformer base to be undercoated.

Surface Preparation and Painting

- All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks, or other defects.
- All primers shall be well marked into the surface, particularly in areas where painting is evident, and the first priming coat shall be applied as soon as possible after cleaning.
- However, wherever airless spray is not possible, conventional spray be used with prior approval of the purchaser.

Cleaning and Surface Preparation

- After all machining, forming, and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.
- Steel surfaces shall be prepared by shot blast cleaning (IS9954) to grade Sq. 2.5 of ISO 8501-1 or chemical cleaning including phosphating of the appropriate quality (IS 3618).
- Chipping, scraping, and steel wire brushing using manual or power-driven tools cannot remove firmly adherent mill-scale. These methods shall only be used where blast cleaning is impractical. Manufacturer to clearly explain such areas in his technical offer.

Protective Coating

- As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

Paint Material

- Following are the types of paint which may be suitably used for the items to be painted at shop and supply of matching paint to site: Heat resistant paint (Hot oil proof) for inside surface.
- For external surfaces one coat of thermo setting powder paint or one coat of epoxy primer

followed by two coats of synthetic enamel/polyurethane base paint. These paints can be either air drying or stoving.

- For highly polluted areas, chemical atmosphere or for places very near to the seacoast, paint as above with one coat of high build micaceous iron oxide (MIO) as an intermediate coat may be used.

Painting Procedure

- All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.
- Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking, or general softness) the supplier shall remove the unsatisfactory paint coating and apply another coating. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%.

Damaged Paintwork

- Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that was originally applied.
- Any damage paintwork shall be made good as follows:
 - The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.
 - A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.
 - The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

Dry Film Thickness

- To the maximum extent practicable, the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags, and drips should be avoided. The different coats may or may not be of the same color.
- Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.
- Particular attention must be paid to full film thickness at the edges.
- The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below.

<u>SI No.</u>	<u>Paint Type</u>	<u>Area to be Painted</u>	<u>No. of Coats</u>	<u>Total Dry Film Thickness (min.) (microns)</u>
1.	Thermo setting powder paint	Inside	01	30
		Outside	01	60
2.	<u>Liquid Paint</u>			
	a. Epoxy (primer)	Outside	01	30
	b. P.U. Paint (Finish Coat)	Outside	02	25 each
	c. Hot oil paint	Inside	01	35/10

Tests for Painted Surface

- The painted surface shall be tested for paint thickness.
- The painted surface shall pass the crosshatch adhesion test and impact test as acceptance tests and Salt spray test and Hardness test as type test as per the relevant ASTM standards. *Note: Supplier shall guarantee the painting performance requirement for a period of not less than 5 years.*

N. TEST AND PERFORMANCE DATA

The following standard tests shall as a minimum, be made in accordance with the latest revision of NEMA TR-1 and ANSI General Requirements C57.12.00-1993 and ANSI Test Code C57.12.90-1999 for all units:

1. Resistance measurements of all windings on the rated voltage connection of the unit.
2. Ratio tests on all tap positions.
3. Polarity and phase relation test on the rated voltage connection.
4. Excitation loss at rated voltage on the rated voltage connection.
5. Excitation current at rated voltage on the rated voltage tap.
6. Impedance voltage and load loss at rated current and rated frequency on the rated voltage connection of the unit.
7. Temperature rise test shall be conducted on the unit.
8. Applied potential test.
9. Induced potential test.
10. Tank pressure test.
11. Sound Level Test

Guaranteed performance data must be attached to this proposal, and the Bidder's price shall include furnishing certified test data on the transformer supplied using standard tests in accordance with the latest revision of ANSI Standard C57.12.90-1999 for Class II transformers.

Transformer losses will be evaluated as follows:

TNLL	= Transformer No-load losses in Watts
TLL	= Transformer Load losses in Watts (Total Full Load losses-TNLL above)
PP	= Purchase Price
Evaluated Cost	= PP + \$5.15 (TNLL) + \$2.05 (TLL)

In the event that the certified losses exceed the guaranteed losses quoted, liquidated damages shall apply and shall be the difference in dollars between the guaranteed losses and the certified losses in accordance with this evaluation formula. The difference shall be deducted from the amount due from the Purchaser and shall result in a corresponding decrease in the contract amount.

O. WITNESSING OF TEST

The City of Statesville (COS) reserves the right to witness any of the tests specified. The Supplier shall ascertain the sequence of tests required in each particular case and whether witnessing of tests is required, and, after completion of all works preliminary tests, shall then give the purchaser not less than 14-days' notice of the firm date when the transformers and associated apparatus will be ready for the witnessing of testing. For suppliers not located in the United States, the minimum required notification time period is eight weeks. Inspection and test plans (ITPs) shall be provided at the time notice is given. As many tests as required shall be arranged to take place on the same day. ITPs shall comply with the requirements of the Quality Assurance Inspection Plan.

Any costs incurred by the Supplier as a result of abortive or protracted visits by COS representatives, due to poor organization on the part of the Supplier or test failures, shall be the Supplier's responsibility. COS shall be notified as soon as possible of all test failures and corrective measures. This shall take the form of abbreviated reports that shall, upon request, be supported by more detailed reports. COS shall be notified of all test failures to allow for inspection if desired.

P. PLACING IN SERVICE

The Bidder's proposal shall include provisions for a qualified service engineering team to be on site and complete the installation of all bushings, radiators, fans, oil, and all additional auxiliary equipment, and to supply any special tools or equipment (excluding lifting equipment) that may be required for these installations.

The service engineer shall be responsible for initially placing the transformer in service, checking for correct functional operation of all equipment, and initiating the manufacturer's warranty. The service engineer shall perform all tests as recommended by the manufacturer prior to energizing the transformer. The cost of any tests or test equipment shall be included and shall be deemed to have been included in the proposal price.

Q. SHIPMENT

The successful Bidder shall furnish all equipment F.O.B. unloaded on existing concrete pad to the City's substation, located in Statesville, North Carolina. Shipment shall be by truck, and the successful Bidder shall notify the City four weeks prior to arrival, then seventy-two hours prior to arrival. Shipment shall only be accepted Monday through Thursday for arrival and unloading between the hours of 9:00 AM and 2:00 PM local time. Unloading and placing in service is included as a part of this contract.

During shipment, each transformer shall be equipped with two (2) electronic three axis impact recorders placed on diagonally opposite sides of the tank. The impact recorders shall continuously monitor the lateral, longitudinal, and vertical forces during the entire shipment to ensure that the unit is not subjected to shock stresses in excess of the manufacturer's design limits. The recorders shall incorporate GPS tracking for date, time, and position indication and shall be programmed to supply scheduled status updates during shipment as well as updates for any event that exceeds the preset limits. The electronic impact recorders shall be capable of capturing waveform data. For any alarm recorded during shipment, the transformer manufacturer shall provide analysis of the event in both time and frequency domain in order to determine the transformer's suitability for service. The data shall also be furnished to the purchaser in digital format for third party analysis if requested.

The transformer shall be "wrapped" for transit to prevent animal/rock damage during shipping. In the event that the impact recorders indicate excessive shock stress during shipment, the Bidder shall undertake appropriate internal diagnostic tests of the unit and furnish the Purchaser with a written report of the results of the tests and any corrective actions which are required. The Purchaser shall then reserve the right to either accept or reject the repaired transformer. Should the Purchaser elect to accept the repaired transformer, the Bidder shall extend the warranty from five (5) to ten (10) years at no additional cost to the Purchaser.

Sweep frequency response before and after shipment tests shall be compared to determine the unit acceptability for service.

All cabinets shall be locked shut and all valves shall be covered with locked valve covers during shipment.

It shall be the Supplier's responsibility to make all arrangements for transport to the site with the appropriate authorities. COS will only accept delivery of transformer on site. It shall be the Supplier's responsibility to co-ordinate the arrangements for all stages of the transport of the transformer from the manufacturer's works to site, including trans-shipping where necessary. Where off-loading is required, all apparatus, materials and packages shall be addressed to the Supplier, who shall take delivery of the same at site. The dimensions of the transformer shall be such that when packed for transport, it will comply with the requirements of the loading and clearance restrictions for the approved route. All metal blanking plates and covers that are specifically required to transport the transformers shall be considered part of the transformer and be handed over to the purchaser after completion of erection. A listing of all these items and relevant drawings shall be included in the manuals, to enable the purchaser to have duplicates of the plates manufactured if required. The dimensions and quantity of each item required for transport shall be on the drawings. Where the supply of oil is included in the contract and where transport weight limitations permit, the transformers shall be transported with sufficient oil to cover the core and windings during all transport and storage conditions. The tank shall be sealed for transport to prevent all breathing. Alternatively, where the above method is not applicable, the transformer shall be maintained continuously under positive pressure of dry air of at least 10 kPa during transport and storage until final installation. The pressure and the temperature at the time of filling shall be documented as part of the quality system. A pressure gauge and non-return valve, fitted directly to the transformer tank and suitably mechanically protected, shall be attached to each transformer to facilitate checking of gas pressure during transit and on site. If another gas, such as nitrogen, is used, appropriate safety labelling shall be provided. The total duration that the unit is filled with dry gas shall be limited to three months where after the transformer shall be

appropriately processed and filled with oil as for service. Dehydrating breathers to be fitted at this stage.

Field service engineers shall accompany the assembly crews and supervise the installation of the transformer through field assembly and certify that the unit is ready for energizing. All costs associated with field assembly shall be included in the proposal.

R. DRAWINGS

Upon acceptance and execution of a contract, the successful Bidder shall, within eight weeks, furnish for approval two (2) sets of drawings and instructions covering the physical size, weight, arrangement, dimensions, electrical characteristics, wiring diagrams and other pertinent data for the transformers. The Bidder shall also supply four (4) prints of the finally approved issue of each drawing for use in the field and for the Purchaser's records. The Bidder shall also furnish all drawings in printed format and in digital format for use in AutoCAD® and for use in Adobe Acrobat (pdf) on a thumb drive. The Bidder shall also supply four (4) sets of printed, written instructions and renewal parts lists suitably illustrated, covering the operation and maintenance of the transformer furnished. All drawings, documentation, information, test reports, operating and maintenance instructions and other correspondence and like items shall be in the English language printed and on a thumb drive.

S. APPROVED MANUFACTURERS

The transformer shall be manufactured by one of the following:

1. ABB/Hitachi
2. Delta Star
3. Virginia Transformer
4. Pennsylvania Transformer
3. General Electric Company
4. Hyundai
5. Siemens
6. Waukesha/SPX
7. WEG
8. Niagara Power Transformers

T. WARRANTY

Transformers shall be furnished with a manufacturer's full warranty of not less than seven (7) years from the date the transformers are placed in service. The warranty shall provide for on-site repair or replacement of defective parts or workmanship during this period at no cost to the Purchaser. Should the defect be such that either or both units are required to be returned to the factory, the manufacturer shall pay all costs associated with the diagnosis, removal, transportation, repair, and re-installation of the transformers.

The warranty shall include complete parts, labor, and transportation warranty. Warranty shall extend seventy-four (74) months from the date the transformer is placed in service, or eighty (80) months from shipment, whichever occurs first. Warranty shall extend to all parts included at the time of installation and shall warrant same to be free of defects in workmanship and materials for the entire warranty period.

<u>QTY</u>	<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>MANUFACTURER</u>	<u>UNIT PRICE</u>	<u>EXTEND PRICE</u>
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
TOTAL, ALL TRANSFORMERS					\$ _____

LOSS OF DATA TO BE COMPLETED BY BIDDER**LOSS DATA INFORMATION**

<u>MANUF.</u>	<u>KVA</u>	<u>QTY</u>	<u>PP</u>	<u>TNLL IN WATTS</u>	<u>TLL IN WATTS</u>	<u>EVAL. COST</u>
_____	_____	_____	\$ _____ + \$ _____ x _____	_____	+ \$ _____ x _____	= \$ _____
_____	_____	_____	\$ _____ + \$ _____ x _____	_____	+ \$ _____ x _____	= \$ _____
TOTAL PURCHASE PRICE			\$ _____	TOTAL OWNERSHIP COST \$ _____		

ADDITIONAL COMMENTS, EXPLANATIONS, OR EXCEPTIONS

<u>MANUF</u>	<u>KVA</u>	<u>%1X</u>	<u>%Z @ 85 C</u>	<u>TOTAL LOSSES @ 85 C</u>	<u>WEIGHT</u>
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____