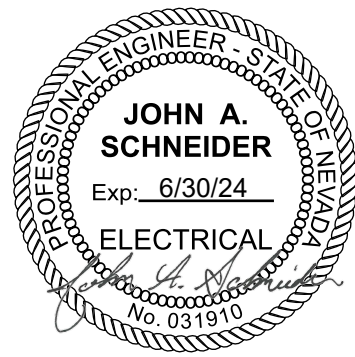


SECTION 26 12 19
DISTRIBUTION TRANSFORMERS



PART 1 - GENERAL

1.1 DEFINITION OF TERMS

- A. "Bidder", "Seller", or "Contractor" shall be considered synonymous terms and shall mean the person, firm or corporation with whom Owner may enter into contract for execution of work specified.
- B. "Owner" shall mean:
Southern Nevada Water Authority
100 City Parkway, Suite 700
Las Vegas, NV 89106
(702) 862-3786

Colorado River Commission of Nevada
Attn: Bob Reese
555 E Washington Avenue
Las Vegas, NV 89101
(702) 486-2670
breese@crc.nv.gov
- C. "Engineer" shall mean:
HDR Engineering, Inc.
Attn: John Schneider
Project Manager
3231 Greensboro Drive, Suite 200
Bismarck, ND 58503
Phone: (701) 557-9711
john.schneider@hdrinc.com
- D. "Work" shall mean work to be done in the course of construction and furnishing materials and equipment under the Equipment Contract, unless some other meaning is indicated by the context.

1.2 COMPONENTS OF SPECIFICATIONS

- A. Detailed Specifications
1. Part 1 - General
2. Part 2 - Products
- B. Numbered addenda if appended to the foregoing.

1.3 INTENT OF SPECIFICATIONS

- A. To set forth requirements of performance, type of equipment desired, standards of materials and construction, tests to be made, and guarantees to be met.

- B. To require Seller to furnish all materials and equipment and perform all work and services described in the contract documents, unless otherwise specifically indicated.
- C. To require Seller to provide complete and operable equipment in spite of omission of specific reference to any minor component part.
- D. To require Seller to provide new materials and equipment.

1.4 INTERPRETATION OF SPECIFICATIONS

- A. Report any errors or omissions in specifications to the Engineer as soon as detected. The Engineer will answer questions and interpret intended meaning of specification. His interpretation shall be accepted as final.

1.5 METHOD OF BIDDING

- A. Equivalent products:
 - 1. Whenever specifications or plans call for item of material or equipment by manufacturer's name and type, "or equal", it is intended that products of equal quality and performance by other manufacturers may be substituted, subject to the approval of the Engineer.
 - 2. Furnish drawings or other data as required to indicate all modifications resulting from use of such substitute items. Furnish general arrangement drawings, full descriptive data, and other information required to demonstrate to Engineer that material or equipment proposed is, in fact, equal to that specified. Burden of proof of equality shall in all cases remain with Seller. Final approval of the substitution shall be made by the Engineer.
 - 3. Abide by Engineer's decisions when proposed substitutions of material or equipment are deemed to be unacceptable.
 - 4. Owner may consider such factors as over-all project arrangement, over-all project cost, and similar factors in determining acceptability of proposed substitutions.
 - 5. Approval of substitutions shall not relieve Seller of responsibility for providing workmanship, material, and equipment equal to that specified.
- B. Form of bid price submittal:
 - 1. Lump sum for all items to be furnished and delivered under this contract.
 - 2. Bid price shall cover complete work described in specifications, including costs incidental thereto, unless specifically indicated otherwise.
 - 3. List separately the price of services of Service Technician, as defined in the Summary of Proposal.

1.6 DATA TO ACCOMPANY BIDS

- A. A complete Equipment Contract and Summary of Proposal, as bound in the front of this specification, shall be properly completed and submitted to the Engineer, along with all other material listed below. All items submitted shall be sent to the Engineer no later than the time and date specified.
 - 1. Any exceptions taken by the Seller to the Specifications, Equipment Contract and/or Summary of Proposal at time of bid shall be clearly and simply stated or summarized, formatted, in a specially prepared letter of transmittal attached to and made a part of the Summary of Proposal.

Note: Manufacturer's "standard conditions of sale" catalog pages

are not acceptable for purposes of stating exceptions to the specifications.

2. Seller shall complete one copy of the "Summary of Proposal" for each alternative bid or proposal submitted. Additional copies may be prepared by photocopying the blank "Summary of Proposal" pages. Seller shall clearly identify each summary by alternate number.
- B. Seller's proposal shall also contain, as a minimum, one copy of the following:
1. Manufacturer's specifications, guarantees, and descriptive data on equipment proposed.
 2. Itemized list of special tools and spare parts which Seller proposes to furnish.
 3. Outline drawings showing general arrangement, approximate dimensions, space requirements and clearance, and approximate weights of proposed equipment.
 4. Standard and specified accessories and instruments to be furnished separately shall be listed in detail. List shall clearly define those items to be shipped separately. It is understood that all items not so listed shall be shipped, mounted and connected. Use Summary of Proposal for listing.
 5. Complete copy of the warranty the Seller will offer including option for extended guarantee through five years' total guarantee period.

1.7 EQUIPMENT GUARANTEE

- A. Without limiting any other provision of this specification regarding guarantees, guarantee the equipment as follows:
1. Seller shall guarantee to the Owner that the complete distribution transformer, together with all parts included in the original purchase, is free of defect in workmanship and materials and is capable of continuous and satisfactory performance when operated in accordance with the instructions provided by the Seller at the specified rating and capacity.
 2. Guarantee shall extend for a minimum of one year from the date of commercial operation. It shall cover all defects and malfunctions of the transformer and accessories. Guarantee shall cover all out-in freight by common carrier in full and the costs of removal from the site and reinstallation after repair. Seller shall not be liable for special, indirect or consequential damages, nor costs of moving structures or associated equipment.

1.8 DELIVERY AND SHIPMENT

- A. Bid shall include delivery F.O.B. jobsite, freight prepaid, with final destination delivery date as specified by the Seller in the Summary of Proposal.
- Project Location: Las Vegas, NV (36.308883°,-114.989844°)
- B. The Seller shall notify the Owner and Engineer when equipment is ready for shipment. Seller shall not release transformer for shipment until release is authorized by the Engineer.
1. All equipment in this contract with a common delivery destination shall be made in a common shipment. The Seller shall be responsible for all incidental costs incurred by the Owner due to separate shipments of such equipment.

2. Immediately after shipment, Seller shall notify the Owner and Engineer of transportation carrier and all transfers and references to permit follow-up on status of shipment and delivery.
 3. The Seller shall investigate all limitations in regard to shipping the equipment F.O.B. destination. Transformer shall be shipped as completely assembled as transportation limits allow.
 4. A three-axis impact recorder shall be attached to the transformer to continuously record the date, time, place, and magnitude of impacts during loading, shipping, and unloading. The recorder shall be placed in operation before loading and shall remain in operation until the unit is placed in its final position on its foundation. Equipment shall not be accepted until the Engineer has examined the recorder record for impacts. GPS equipped recorders are preferred.
 5. Equipment damaged in shipment will be refused on delivery and it will be the Seller's responsibility to arrange for prompt repair or replacement to the standards of new equipment. The Seller will not be relieved of the responsibility of delivering undamaged equipment even if the damage is internal or otherwise goes undetected and the nature of the damage remains unknown until the equipment is energized and tested.
- C. In the case rail transport is used for any part of delivery:
1. Equipment shall be shipped by cushioned underframe or end-of-car cushioned rail cars on which the cushioning devices have been recently inspected and determined to be 100 percent operable, or other means agreed to by the Owner's Engineer.
 2. Impact recorders furnished by the Seller shall be properly packaged, oriented, and attached to the rail cars as near the equipment bases as possible. The recorders shall be three-way, measuring X, Y, and Z impacts separately. The charts shall be stamped adequately to determine the date, time, and place of severe impacts. Impact recorders shall be placed in operation before the equipment begins shipment and shall remain attached and in operation until the equipment has been sided at the proper rail siding. Equipment will not be accepted by the Owner until after the Engineer has examined the recorders for impacts and any visible damage to equipment.
- D. Prior to shipment, all gauge and indicator glass shall be thoroughly cleaned and covered with non-adhesive shipping protectors.
- E. The transformer shall be shipped with the vacuum/pressure gauges installed and connected. Prior to shipment, the Seller shall affix signed and dated weatherproof tags to the vacuum/pressure gauges listing the gauge readings, the ambient temperature, and the barometric pressure at the time of reading. Sealed tank constructed transformers shall be shipped with a dry-air oil blanket to assure positive pressure. Transformer with dry nitrogen oil preservation systems shall be shipped with preservation system in operation to assure positive pressure. Transformer shipped dry shall be shipped with positive pressure.
- F. When transformer draw-lead type bushings are removed for shipment, the bushing leads shall be securely attached to the underside of the blind flanges covering the bushing hole so that the leads are readily accessible for connection from outside the transformer tank.
- G. Insulating oil shipped separately shall be delivered F.O.B. destination, freight prepaid. For transformer shipped dry, oil shall be delivered by tank truck. For

transformer shipped oil filled, any make-up oil of quantities less than 1,000 gallons shall be provided in 55-gallon non-returnable drums. Oil to be shipped by tank truck shall not be released for shipment until release is received from the Engineer. A tentative date for delivery of oil will be furnished by the Engineer subsequent to establishing transformer delivery and assembly schedule. Seller shall inform Engineer of standard demurrage-free time allowed for unloading of oil shipped by tank truck. Demurrage-free unloading time allowed by the seller shall not be less than four (4) hours.

- H. Oil shall be accompanied by a certified test report showing characteristic of oil as described in Section 1.12 of this specification. Oil shall not be shipped unless it meets minimum requirements as specified.
- I. Delivery shall not be made prior to earliest acceptable delivery specified in Summary of Proposal. Should delivery be made prior to earliest acceptable delivery date, the Owner reserves the right to withhold initial payment without any additional cost until 30 days after the earliest acceptable delivery date. In addition, the supplier shall be responsible for all incidental costs incurred by the Owner due to early delivery.

1.9 DRAWINGS AND INSTRUCTIONAL MATERIAL

- A. Manufacturing Progress Reports
 - 1. Within thirty (30) days of order, the Seller shall furnish the Engineer with a manufacturing schedule for transformer to be furnished under this specification. Seller's schedule shall include projected time allotment for engineering, major materials delivery, all major divisions of fabrication and assembly, testing, and shipment. This schedule shall allow for work completed on each item to be shown in conjunction with projected schedule in a manner which allows updating for furnishing progress reports.
 - 2. Progress reports shall be furnished to the Engineer monthly, with each report showing progress from the previous month. However, the Engineer may request progress reports on a more frequent basis should the Seller's progress seriously fall behind his projected schedule.
- B. Shop Drawings for Approval
 - 1. "Shop Drawings" refers to all the detailed installation drawings prepared by the Seller and/or his suppliers required to construct the material as defined in the specifications, and shall include all fabrication drawings, working drawings, design calculations, foundation loadings, material schedules, detailed layouts, and assembly information.
 - 2. The Seller agrees that submittals and shop drawings processed by the Engineer are not change orders; that the purpose of submittals and shop drawings by the Seller is to demonstrate to the Engineer that the Seller understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install, and by detailing the fabrication and installation methods he intends to use. The Seller alone accepts all responsibility for assuring that all materials furnished under these specifications meet in full all requirements of the contract documents. The Engineer's review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Seller from compliance with the project plans and specifications, nor departures therefrom. The Seller remains responsible for details and accuracy for

confirming and correlating all quantities and dimensions, for selecting fabrication processes and for techniques of assembly.

3. Submit the following shop drawings to the Engineer in the manner specified hereinafter. Make initial submittal of information requested on or before the date specified in the Summary of Proposal:
 - a. Certified outline assembly and installation drawings as appropriate for each item.
 - b. Complete nameplate data for each item.
 - c. Schematic diagrams of all control and alarm circuits.
 - d. Complete connection diagram of items, including current transformers and linear couplers.
 - e. Bushing current transformer data, including excitation and ratio correction factor curves.
 - f. Such other similar information as the Owner may request.

C. Engineer's Action

1. Engineer will review shop drawings and indicate action taken according to the following classifications:
 - a. No Exceptions Taken: Indicates that the shop drawing has been reviewed and appears to be in general agreement with the requirements. Seller may make further distribution of shop drawings and proceed with fabrication and/or installation of the work detailed on the drawing.
 - b. Make Corrections Noted: Design revisions, deletions, additions, and comments shown on these drawings shall be incorporated into the design before proceeding with fabrication or drawing distribution.
 - c. Amend and Resubmit: Indicates that the shop drawing, or part thereof, does not appear to be in general agreement with the requirements. Engineer's comments are noted on the shop drawing and/or separate letter. Seller shall recheck and make any necessary revisions and resubmit for Engineer's review.
 - d. Rejected: Indicates that the shop drawings do not conform to requirements. Reasons for rejection are noted on the shop drawing and/or separate letter.

D. Shop Drawing Submittal and Distribution

1. Initial Submittal (REVIEW): Submit one (1) electronic copy in PDF and AutoCAD format of each shop drawing to the Engineer; direct mailing to the Engineer's email address given in Section 1.1, C. One (1) copy of the shop drawings indicating the Engineer's action will be returned to the Seller with one (1) week from the date of receipt.
2. Resubmittal: If drawing is returned to the Seller with Engineer's comments and action noted "RESUBMIT", the drawing should be rechecked and revised as necessary and resubmitted in manner described in "1 - Initial Submittal".
3. Final Distribution (CERTIFIED): Within the time schedule listed in the Summary of Proposal, Seller shall submit to the Engineer one (1) electronic copy in PDF and AutoCAD format of all final drawings covered in Section 1.9, B above. AutoCAD drawings shall be emailed along with all related dependent files such as x-refs, font files, and plot styles. Transmit to the Engineer's email address given in Section 1.1, C.

E. Instruction Manuals, Test Reports, and Parts Lists

1. Seller shall furnish complete instruction manuals covering installation, operation and maintenance for all equipment. Manuals, bound in vinyl and properly labeled to indicate the facilities covered, shall include:
 - a. All shop drawings listed in Section 1.9, B. (Reduce as required to fit in manuals.)
 - b. Specific equipment instruction books.
 - c. Renewable parts lists for all replaceable parts and assemblies.
 - d. Test report for all shop tests required under Section 1.11.
 2. Submit one (1) electronic PDF copy to Engineer for distribution and one (1) printed paper copy with distribution transformer delivery (located inside control cabinet). Paper copy shall be bound in vinyl and properly labeled to indicate the facilities covered. Engineer's address is given in Section 1.1, C.
- F. Shop Drawing and Instructional Material Transmittal Form
1. Seller may use his own form of transmittal letter for distribution of shop drawings, clearly marked "For Approval" or "Certified" as applicable.
 2. Submit one (1) electronic PDF copy of transmittal form with each set of drawings or instructional materials.
- G. Seller's Responsibility
1. Prior to submittal, check shop drawings for errors, correctness of details, and conformance with the specifications.
 2. Notify Engineer of any inconsistencies or questions regarding approval revisions or comments on the drawings.
 3. Review of shop drawings by Engineer does not relieve the Seller of responsibility for errors, correctness of details, or conformance with the specifications.
 4. Fabrication and shipment of materials or equipment prior to Owner's release of drawings, data, and information mentioned hereinbefore, shall be at Seller's risk.

1.10 CODES AND STANDARDS

- A. Perform work in accordance with best present-day installation and manufacturing practices.
- B. Unless specifically noted to contrary, conform with and test in accordance with applicable sections of latest revisions of following codes and standards:
 1. American National Standards Institute (ANSI).
 2. American Standards Association (ASA).
 3. National Electrical Manufacturer's Association (NEMA).
 4. American Society for Testing Materials (ASTM).
 5. International Electrotechnical Commission (IEC) Standards.
 6. Institute of Electrical and Electronic Engineers (IEEE).
 7. National Electric Safety Code (NESC)
- C. Conflicts between referenced codes and standards: Code or standard establishing more stringent requirements shall be followed.
- D. If the transformer fails any test, the Engineer shall be notified immediately. The Engineer shall be consulted about the failure, and based on the test results, the Engineer may require that all tests be repeated.

1.11 SHOP TESTS

- A. Perform required tests on all transformers in accordance with the latest version of ANSI C57.12.00, Section 8. Tests shall include:
 - 1. Resistance measurements of all windings.
 - 2. Ratio tests for all no-load tap positions.
 - 3. Polarity and phase relation tests at rated voltage.
 - 4. No load loss at rated voltage and frequency.
 - 5. Impedance voltage and load loss.
 - 6. Excitation current at rated voltage and frequency.
 - 7. Temperature test (manufacturer may supply results of such standard test if made of previous unit of same rating and design.)
 - 8. Low frequency dielectric test.
 - 9. Impulse tests, with the exception of front-of-wave test, shall be performed on all terminals per ANSI C57.12.90.
 - 10. Induced potential and corona test (per IEEE P262 B.)
 - 11. Audible sound tests per ANSI C57.12.00 and NEMA TR-1.
- B. Provide Engineer with one (1) certified electronic PDF copy of all transformer test data, including oscillograms when performed. Copies shall be in the form that they can be bound into instruction books by others.
- C. Owner and/or Engineer may visit factory as required to witness tests and assure compliance with specification. Seller shall notify the Engineer two (2) weeks in advance of the proposed date of testing. Visits will be made at no cost to Seller.

1.12 INSTALLATION

- A. The Seller or a third party approved by the Seller and supervised by the Seller's representative shall receive, offload transformer onto pad, assemble, and fill the transformer.
- B. The transformer shall be field filled with the same type of oil that was used for the factory testing. The transformer oil in each tanker delivered to the installation site shall be tested before filling the transformer to assure that no contamination occurred during transport. The oil shall be tested for PCBs, moisture content, dissolved gases, and adequate dielectric strength. The oil shall also be tested for corrosive sulfur per the following:
 - 1. Doble Test D1275B – Corrosive Sulfur in Oil
 - 2. Doble CCD Test – Aids in determining if the copper sulfide deposition in the paper is likely to occur
 - 3. Doble Test for sulfur compound
- C. Prior to oil filling, Seller shall supply certified oil tests showing insulation oil meets the following minimum requirements per ASTM:
 - 1. Dielectric strength - 34 kV
 - 2. Acid number (NN) - 0.05 mg/KOH/g
 - 3. Interfacial tension (IFT) - 36 d/cm.
 - 4. Color (number) - clear.
 - 5. PCB content (PPM) less than one (1) PPM.
- D. Seller shall provide certification by test that the oil is PCB-free per EPA definition 7-1-96, and contains less than one PPM PCB's. If Seller is unable to provide certification of less than one PPM, seller must include as part of proposal the PCB content seller will certify.

1.13 FIELD SERVICE TECHNICIAN

- A. Provide a competent Field Service Technician who shall as a minimum:
 - 1. Inspect transformer on pad before assembly crew begins assembly of transformer.
 - 2. Supervise assembly of transformer by assembly crew.
 - 3. Perform mechanical and electrical tests as required to ensure integrity of service.
 - 4. Inspect assembly to assure that devices are correctly assembled and connected.
 - 5. Supervise any oil filling of transformer including pulling vacuum.
 - 6. Inspect completed assembly for oil leaks.
 - 7. Fully instruct operating personnel in construction, assembly, operation, and maintenance of equipment.
- B. Field Service Technician shall submit report to the Engineer, listing all test results and mechanical clearances. All required test equipment shall be furnished by Field Service Technician.
- C. Service Technician shall make no less than one (1) trip to the jobsite to supervise assembly.
- D. If any of the Service Technician's time spent at jobsite, or if any of his trips to jobsite are required to make corrections to equipment supplied under this specification resulting from defective material or workmanship used in the manufacture of equipment, such time and trips will be at the Seller's expense.

1.14 FIELD TESTS

- A. The Seller or a third party approved by the Seller and supervised by the Seller's representative shall perform acceptance testing on the transformer after field assembly is complete. The tests shall include as a minimum:
 - 1. Insulation Power Factor Test (Overall winding, Bushings, Excitation, Oil, and Arresters)
 - 2. Insulation Resistance (Windings and Core Ground)
 - 3. Turns Ratio (TTR)
 - 4. Bushing Current Transformers (Ratio, Polarity, Excitation, and Insulation Resistance)
 - 5. Functionals (Alarms, Gauges, and Controls Verifications)
 - 6. Baseline Oil Analysis (DGA and Oil Screen)
- B. If equipment fails to function properly because of defects, Seller will make necessary corrections and, upon completion thereof, demonstrate to Owner that these defects have been corrected.

1.15 DEFECTIVE EQUIPMENT

- A. Should equipment fail to conform to specifications or to operate satisfactorily, Owner will have right to operate equipment until defects are corrected and guarantees met.
- B. Owner will have right to operate rejected equipment until it is replaced without cost for depreciation, use, or wear.

- C. Equipment may be removed from operation for examination, adjustment, alteration, or change, only at time approved by the Owner.

1.16 TRANSFORMER BID EVALUATION

- A. In estimating the lowest cost to the Owner as one of the factors in deciding the award of the contract, the Owner will consider, in addition to the prices quoted in the Summary of Proposal, the following:
1. Any exceptions taken and noted in the Summary of Proposal.
 2. If escalation is proposed by the Bidder, the maximum escalated price will be used in comparison of bids. Escalation will be computed based on past 12 months of BLS statistics.
 3. An amount in dollars equal to the following formula will be added to the proposal price for evaluation of transformer efficiency:
 - a. 12.47-4.16/2.4 kV, 10MVA Distribution Transformer
$$\text{Evaluated transformer loss} = (\text{NL} \times \$4,000\text{kW}) + (\text{LL} \times \$2,000\text{kW}), \text{ where}$$
$$\text{NL} = \text{No Load loss guarantee in KW at rated voltage.}$$
$$\text{LL} = \text{Load Loss in KW at ONAN rating and nominal voltage.}$$
 4. Most favorable time for delivery. The owner explicitly reserves the right to otherwise evaluate or reject any bid which has a guaranteed final delivery date which may result in failing to meet the project completion deadline.
 5. Assembly costs will be considered as follows when evaluating bids:
 - a. Oil handling for filling tank and radiator.
$$\begin{aligned} &\$2,000 \text{ (small quantities of make-up oil)} \\ &\$12,000.00 \text{ (if core \& coil exposed)} \end{aligned}$$
 - b. Other items based on Engineers' hourly estimates for time of assembly.
$$\$200.00/\text{crew hour}$$
 6. Freight charges for oil to be shipped separately, where such freight is not included as prepaid in bid price, will be estimated at \$3.00 per gallon.
 7. Estimated LTC maintenance costs for comparing types of LTCs proposed, if an LTC is specified.
 8. Field service technician as estimated by bidder in the Summary of Proposal. Note: Bidder shall provide all field service items specified in Section 1.13 in the estimated time.

1.17 FAILURE TO MEET GUARANTEED DELIVERY DATE

- A. Since delivery of transformer specified herein is critical to the scheduling of the Owner's project, the Seller shall make every reasonable effort to meet the guaranteed delivery date specified in the Summary of Proposal.
- B. The Owner agrees to indemnify the Seller for circumstances resulting in late delivery of transformer where such circumstances are beyond the control of the Seller. Circumstances beyond the control of the Seller are defined as: acts of God, acts of government, transportation to final destination, failure of equipment under test, material shortages due to failure of others to make timely delivery, and any other circumstances reasonably beyond the control of the Seller.

- C. Upon any actual or projected departure from the manufacturing schedule which, in the opinion of the Seller, may result in delay in shipment, the Seller shall immediately notify the Engineer of the following:
 - 1. Explanation of delay or potential delay.
 - 2. Means by which delay could be minimized.
 - 3. Projected new shipment date.
 - 4. Additional details as requested by the Engineer.
- D. Should the Seller fail to make a reasonable effort to meet the guaranteed delivery date where this failure is evidenced by: failure to inform the Engineer of changes in the manufacturing schedule, failure to allow sufficient time for delivery of materials and equipment necessary for manufacturing, or lack of cooperation in effective measures by which delays could be minimized, the Owner may charge the Seller an amount not in excess of \$1,000.00 per day for each day that the factory shipping date falls beyond the guaranteed delivery date specified in the Summary of Proposal.
- E. The Engineer reserves the right to inspect the progress of work at the Seller's facilities at any time subsequent to notice of such intent.

1.18 PENALTIES FOR FAILING TO MEET PERFORMANCE GUARANTEE

- A. In the event that the Seller's factory test or the Owner's field tests show that the transformer does not meet the loss guarantees quoted in the Summary of Proposal, the Seller will be penalized an amount equal to the "actual loss" evaluation in excess of "guaranteed loss" evaluation, as determined by:
 - 1. 12.47 - 4.16/2.4 kV, 10MVA Distribution Transformer
$$(NLA-NLG) \times \$4,000/kW + (LLA-LLG) \times \$2,000/kW, \text{ where:}$$

NLA = Actual no load loss in kW
 NLG = Guaranteed no load loss in kW
 LLA = Actual total loss minus actual no load loss in kW
 LLG = Guaranteed total loss minus guaranteed no load loss in kW

There shall be no additional payment to the Seller if the test results indicate that losses are less than Seller's guaranteed limits.

Losses will be computed in kW at ONAN rating and nominal voltage.

1.19 SHORT CIRCUIT PERFORMANCE

- A. In addition to test requirements as specified in Section 1.11, the following requirements shall be met:
 - 1. Short-circuit strength:
 - a. Without limiting in any way obligation of the Seller under this agreement, the Seller shall demonstrate, to the satisfaction of the Owner, that the transformer proposed to be furnished under this specification shall have sufficient mechanical strength to withstand, without failure, all through-fault currents. The Seller shall state that the transformer meets this requirement by one of the following methods:
 - 1) Certified test data showing that a transformer, with a core and coil identical in design and construction and identical or similar with respect to kVA capacity, kV ratings, BIL,

- impedance and voltage taps, has been tested without failure for short-circuit strength. Seller shall indicate if test reports for these units show allowable variation of impedance in conformance with ANSI specifications C57.12.90. A description of the test code, under which the transformer was tested for short-circuit strength, shall be provided by Seller to the Owner.
- 2) A history of successful experience with transformers of identical or similar ratings, design, and construction. The Seller shall provide a list of transformers in service, with core and coils which are essentially identical in design, construction and manufacture to the transformer on the date of installation and failures, if any. Where such transformers have not been built, or the cumulative service record is less than 20 transformer years, a list of transformers in service which represents the closest approximation to the transformer covered by this specification shall be submitted. The information submitted shall be representative of the total experience of the manufacturer with the design of the transformer it proposed to furnish and include the dates of installation or shipping, the ratings of the transformers, and the failures and causes of failure, if any have been experienced.

1.20 FINAL ACCEPTANCE AND PAYMENT

- A. Owner will not accept equipment as final until installation is complete and equipment is ascertained to be in conformance with specifications and guarantees.
- B. Payment will be made thirty (30) days after receipt of all equipment, drawings, instruction books and test reports as required by these specifications and in accordance with the contract. However, the Owner reserves the right to withhold payment up to thirty (30) days beyond the earliest acceptable delivery date specified in the "Summary of Proposal" for equipment received prior to this specified date. In addition, Seller shall be responsible for all incidental costs incurred by the Owner due to early delivery.

PART 2 - PRODUCTS

2.1 12.47-4.16/2.4 KV, 10 MVA DISTRIBUTION TRANSFORMER - GENERAL

- A. Quantity to be furnished:
1. Two (2) Distribution Transformer to be used for step-down purposes. All transformers with the same ratios provided under this specification shall be of identical construction, including all ratings, components, wiring, physical size, etc.
- B. Service Conditions:
1. Outdoor, continuous duty.
 2. Altitude: Transformers shall be suitable for operating at an altitude of less than 3,300 feet above sea level. For altitudes above 3,300 feet, apply Altitude Correction Factors in accordance with ANSI C57.12.00, Paragraph 4.3.

3. Ambient Conditions: Ambient temperature of cooling air shall not exceed 50°C; average temperature shall not exceed 40°C for any 24 hour period. Expected minimum temperature is 0°C. The top liquid temperature of the operating transformer shall not be lower than -20°C.
4. Auxiliary AC power available: 120/240 Volt, single-phase.
5. Auxiliary DC power available: 125 Volt DC.
6. Seismic Loading: In accordance ASCE values
 - a. SDS: 0.522 g
 - b. SD1: 0.284 g
 - c. FPGA: 1.34
7. Use: Step-down from distribution voltage to service voltage.
8. Special: Transformer shall be designed and tested in accordance with ANSI C57.12.34.

C. The following specifications apply to base bid transformers and any alternate transformers unless specifically stated otherwise.

2.2 ELECTRICAL CHARACTERISTICS

- A. The transformer shall be rated:
1. Number of Phases..... Three (3)
 2. Coolant..... Oil
 3. Class of Cooling ONAN
Liquid Immersed, Self-Cooled
 4. Distribution Transformer Rating.....10 MVA, 55°C rise
All MVA ratings for the transformer shall be continuous.
 5. Frequency 60 Hz
 6. Impedance H-X ANSI Standard
 7. Polarity ANSI Standard
 8. Angular Displacement ANSI Standard
 9. High voltage winding shall be Delta-connected, rated 12,470 Volts, 95 kV BIL. Provide de-energized tap changer with 2.5% full capacity de-energized taps, two above and two below the nominal voltage rating. Full MVA rating shall be available at all tap positions.
 10. Low voltage winding shall be grounded wye-connected, rated for voltage operation with full rated capacity at 4,160Y/2400 Volts, 60 kV BIL.
 11. Neutral winding connection shall be rated for 60 kV BIL. The system will be a solidly grounded wye.
 12. Voltage ratings of individual windings and taps shall be no-load voltages, based on turns ratio.
 13. Winding Temperature: The average winding temperature rise above ambient shall not exceed 55° C; hottest-spot temperature rise shall not exceed 70° C.
 14. Audible Sound Level: The audible sound level shall not exceed the value given in NEMA Standard TR-1 1.05 when measured in accordance with the IEEE C57-12.90.

2.3 CONSTRUCTION FEATURES AND REQUIRED ACCESSORIES

- A. The transformer shall have sealed tank construction with welded cover and with bolted and gasketed handhole type inspection port. The tank shall be of sufficient strength to withstand a pressure of 25% greater than the maximum operating pressure without permanent distortion. The transformer shall be suitable for operation over a top oil temperature range of -5°C to +105°C provided the liquid level has been properly adjusted to the indicated 25° C level.

When required, corrugated cooling panels or radiators shall be provided on the sides of the tank. The tank base must be designed to allow skidding or rolling in any direction.

1. Tamper Resistant Construction: The transformer and associated terminal compartments shall be designed and constructed as to be tamper resistant as set forth in ANSI C57.12.28 including, but not limited to, the pry test, pull test, and wire probe test. There shall be no screws, bolts or other fastening devices which are externally removable.
2. Terminal Compartments: Full-height, air-filled incoming and outgoing terminal compartments with individual hinged doors shall be located on each end for top or bottom cable entry of high and low voltage cables. To facilitate making connections and permit cable pulling, the doors and compartment hood shall be removable. The doors shall have a 3-point latching mechanism with cabinet handle having provisions for a single padlock. In addition to the regular locking provision, all access doors shall be secured by a recessed, captive, pentahead bolt that meets the dimensions set forth in ANSI C57.12.28. The doors shall be equipped with lift-off type stainless steel hinges and door stops to hold the doors open when working in the compartments. Removable door sill on compartments shall be provided to permit rolling or skidding of unit into place over conduit studs in foundation. ANSI tank grounding provisions shall be furnished in each compartment.
3. Incoming Line Section: The incoming line compartment shall enclose the high voltage terminations and equipment and provide for incoming cable from below. Design shall be dead front and conform to ANSI C57.12.10 requirements and RUS dead front equivalent design standards.

The incoming line equipment shall be arranged for radial feed, one cable circuit to the transformer.

Equipment enclosed in the incoming compartment shall include:

- a. Bushing Style:
 - 1) Three (3) - HV sidewall porcelain bushings with NEMA 4-hole spade terminator. Porcelain color shall be ANSI No. 70.
 - 2) One (1) - Neutral sidewall bushing with externally removable link for testing.
- b. Bushing Supports:
 - 1) Bushing supports shall be provided for all bushings and shall be attached to the cabinet sidewalls or roof; tank-mounted support mountings are not acceptable.
 - 2) The high voltage compartment shall have a removable, insulated barrier across the front which must be removed before access to the high voltage compartment can be obtained subsequent to opening of the door.
4. Outgoing Line Section: The outgoing line compartment shall enclose the low voltage bushings and provide for outgoing cables from above or below. Design shall be in accordance with ANSI C57.12.10 requirements and RUS dead-front equivalent design standards.

Equipment enclosed in the outgoing compartment shall include:

- a. Bushing Style:
 - 1) The transformer shall be provided with tin-plated spade-type bushings. The spacing of the connection holes shall

- be 1 3/4" on center, per ANSI C57.12.26 Figure 9. The quantity of connection holes shall be 10 holes.
- b. Bushing Supports:
 - 1) Bushing supports shall be provided for all bushings regardless of connection holes. Bushing supports shall be attached to the cabinet sidewalls or roof; tank-mounted support mountings are not acceptable.
 - c. Bushing Configuration:
 - 1) The transformer shall be provided with bushings in a in-line arrangement in accordance with Figure 8b of ANSI C57.12.26. The bushing heights shall be in accordance with Figure 7 of ANSI C57.12.26.
5. Tap Changing Mechanism: A tap changing mechanism shall be provided for accurate voltage adjustment without opening transformer tank. The tap changing mechanism shall be externally operated and shall be for de-energized operation only. The tap changer mechanism shall have an operating handle brought outside of the tank in accordance with ANSI C57.12.10. Provisions for padlocking tap change in place shall be provided.
 6. Radiators: The transformer shall be equipped with removable radiators composed of galvanized steel tubes. Radiator assemblies shall be provided with butterfly type shut-off valves between the header and the main tank and shall be provided with means for draining the radiator assembly. The radiators shall be grouped so that cleaning and painting of the radiators and transformer bank in the field can be accomplished without removing the radiator.
 7. Other Accessories:
 - a. Dial-type top oil thermometer with over-temperature alarm contacts. Provide Qualitrol Series 104.
 - b. Magnetic liquid level gauge with low level alarm and trip contacts. Sensor shall be located on the tank wall at a location as required to protect insulated parts due to an excessively low oil level. Mounting location shall be below normal oil level a sufficient distance to assure security from false operation. Provide Qualitrol Series 032.
 - c. Pressure vacuum gauge, with adjustable high and low pressure alarm contacts. Provide Qualitrol Series 70.
 - d. Dial type gauges, valves and control cabinet should be grouped together on the LV side of the transformer for easy accessibility and maintenance. All gauges over 96" from the floor shall have their faces tilted down at a angle of 30° from the vertical. Wells for oil thermometer bulbs and liquid level gauge floats shall be outside the main tank so as not to require untanking for their removal. All gaskets shall be of reusable rubber with means provided for controlled compression.
 - e. A cover-mounted pressure relief device (PRD) for the transformer tank shall be provided in accordance with ANSI C57.12.39. PRD shall feature an alarm contact, automatic resealing-resetting operation, and mechanical signal for indication of device operation. Provide Qualitrol Series
 - f. Manually activated pressure relieve valve (PRV) with pull ring for use with a standard hookstick. The PRV shall be designed and located to minimize liquid egress.

- g. Provide one (1) rapid pressure rise relay, Qualitrol 900-009-03 (flange connected in oil space) with seal-in relay, style 909-200-01. Seal-in relay shall be rated for operating at 48 VDC and 125 VDC and shall provide separate alarm and trip contacts. Qualitrol rapid pressure rise relay shall be mounted on the side of the transformer tank with a gate type shutoff valve, located in the lower half of the tank to permit testing. Seal-in relay chassis shall be mounted in control cabinet, Item "K" below.
 - h. All alarm and trip contacts shall be Form C and per ANSI C57.12.10, Paragraph 9.7.1, suitable for operation at 48 VDC and 125 VDC. All alarms and trips available from gauges, indicating devices and relays shall be prewired to terminal blocks for remote wiring interface.
 - i. Two-hole NEMA type tank grounding pads per ANSI C57.12.10, one in each compartment (1/2 - 13 tap) with stainless steel bolts and split lock washers. Provide two (2) bronze ground terminal connectors, Anderson Catalog No. SWH-025-B, or approved equal.
 - j. Diagrammatic nameplate to include all ratings and impedances shall be located per ANSI C57.12.10 in Segment 1 or 4 near the centerline and near eye level.
 - k. Lifting eyes/hooks on main tank for lifting complete transformer with high and low voltage bushings installed.
 - l. Facilitates for lifting core and coil assembly from tank and for lifting transformer cover.
 - m. Jacking facilities with pulling eyes at four corners of the base.
 - n. Globe type combination drain and lower filter valve (2 inch screw end) with sampling device (3/8 inch) for the transformer tank. The drain valve shall be located so as to allow draining or sampling from the bottom of the tank.
 - o. Globe type upper filter valve, 2 inch screw end for the transformer tank.
 - p. Four (4) NEMA standard grounding pads shall be provided near the base of the transformer at each corner of the tank wall (exterior of terminal compartments). Grounding lugs shall be furnished and installed on each pad for a 4/0 7-stranded cable. (Anderson Catalog No. SWH-025-B, or approved equal.)
 - q. Provide phase barriers between the high and low voltage bushings.
8. Control Cabinet: Provide one (1) waterproof, dust tight control cabinet with hinged front door. The control cabinet shall be mounted on the main tank for termination of all auxiliary and accessory equipment wiring. This cabinet shall provide terminal blocks for terminating control and alarm wiring, as well as individual short-circuiting type terminal blocks for all current transformers. Accessories for this cabinet shall include:
- a. An LED maintenance light with guard
 - b. GFCI convenience outlet
 - c. Thermostat controlled heater(2), sized to mitigate condensation and maintain a 0°C minimum cabinet temperature over the specified environmental operating conditions, and compatible with available auxiliary AC power.

Cabinet height shall be convenient for access from floor level. Control wiring shall be brought into control cabinet through suitable rigid conduit, sized according to N.E.C. and painted as specified for the transformer

tank. Cabinet shall be arranged and designed to permit outgoing conduits to exit from the side and bottom as may be required. Ten percent spare terminals shall be provided for terminating spare control cable wiring. Include a copper ground bus tapped for grounding all CT's, spare control wires, and cable shields.

9. Surge Arresters: Surge arresters of intermediate class shall be mounted beneath the high voltage bushings and connected to the spade connector. Location of surge arresters shall not interfere with connection of incoming line conductors. Provide Ohio Brass, Type PVR, 7.65 MCOV surge arrester with tank mounted brackets.

2.4 PAINT AND FINISH

- A. Preparation for and application of paint to exterior of tanks and accessories shall meet or exceed requirements of ANSI C57.12.28. The transformer exterior shall be coated to minimum thickness of 3 mils. Color shall be ANSI #70 light grey (Munsell 5BG 7/0.4). Provide two quarts of touch-up paint for each transformer along with a coating system repair procedure.
- B. All masking materials shall be removed from the transformers prior to shipment. Protective shipping covers for gauges, etc., shall be provided in accordance with previous sections.

2.5 STANDARDS

- A. The transformer shall be designed, constructed, and tested in accordance with the latest revision of the applicable IEEE, ANSI, and NEMA standards, except where specific requirements of these specifications conflict with these standards. In such cases, these specifications shall take precedence.
- B. It is assumed that the equipment provided by the manufacturer will be in strict compliance with these specifications unless specific exception is taken and an explanation provided.

APPENDIX
SUMMARY OF PROPOSAL – ITEM NO. 1
12.47 - 4.16/2.4 kV, 10 MVA DISTRIBUTION TRANSFORMER
(Requires Completion by Bidder)
*Denotes guaranteed value

A. Price and Delivery

1. Base Bid:

Total price to furnish and deliver F.O.B. to jobsite, one (1) 12.47-4.16/2.4 kV, 10 MVA Distribution Transformer and accessories as described in Part 2 of these specifications.

\$ _____

2. Can Seller meet delivery date based upon award of contract within ten (10) working days after bid opening?

_____ *

(yes, no)

If not, Seller shall enter the earliest guaranteed delivery date of equipment to its final destination.

_____ *

mm/dd/yyyy

3. Are the prices quoted in A.1 above firm?

_____ *

If not:

For delivery as specified in A.2 above, what is the maximum percentage increase that will be applied to the price quoted in A.1?

_____ %*

If price is to be adjusted other than above, Seller shall supply price policy in detail with bid, complete with base data necessary for evaluation.

4. Does price quoted in A.1 above include all freight prepaid and allowed to jobsite for any oil to be shipped separately as specified?

_____ *

(yes, no)

5. Transformer Loss Evaluation:
(Section 1.16, A.3)

\$ _____ *

B. Warranty Options

1. Five (5) year extended warranty with first year IN/OUT

\$ _____ *

C. Drawings

Will Seller meet delivery times as listed below for drawings based upon award of contract within ten (10) working days after bid opening?

1. Approval Drawings
 - a. Outline Drawing (6 weeks ARO) _____ *
 - (yes, no) _____
 - b. All Approval Drawings (8 weeks ARO) _____ *
 - (yes, no) _____
2. Final drawings (8 weeks ARA)
based on return of approval drawings
by Engineer within ten (10) working days _____ *
- (yes, no) _____
3. If Seller cannot meet drawing delivery
dates listed above, show the delivery dates
below which can be met:
 - a. Outline Drawings (weeks ARO) _____ *
 - b. All Approval Drawings (weeks ARO) _____ *
 - c. Final Drawings (weeks ARA) _____ *

D. Data

1. Manufacturer _____
2. Location of factory _____
3. Type of transformer design. (Core
or Shell; if core form, state number
of legs). _____
4. Concise description of winding design(s).
 - a. High voltage (12.47 kV) _____
 - b. Low voltage (4.16/2.4 kV) _____
5. Winding material _____ Copper only
6. Shipping weight of largest piece _____ lb*
7. Weight of transformer complete _____ lb
8. Weight of core and coil assembly _____ lb
9. Weight of oil _____ lb

10.	Quantity of oil	_____ gal
11.	Weight of case	_____ lb
12.	Type of oil	_____
13.	Type of oil preservation system	_____
14.	Will any oil be shipped separately?	_____
		(yes, no)
	If yes list approximate quantity and means of shipment (tank truck, drum, or other)	_____ gal
	Is the cost of oil shipment included in the bid price?	_____
		(yes, no)
15.	Height over cover	_____ in
16.	Height over top-mounted HV bushings	_____ in
17.	Height over top-mounted LV bushings	_____ in
18.	Width, including radiators, and width of base	_____ in
19.	Depth, including radiators (LV to HV side), and depth of base	_____ in
20.	Shipping height	_____ in
21.	Current rating of high voltage bushings	_____ A
22.	Manufacturer and catalog number of high voltage bushings	_____
23.	Current rating of low voltage and neutral bushings	_____ A
24.	Manufacturer and catalog number of low voltage and neutral bushings	_____
25.	Do all bushings meet specified kV BIL rating after applying all applicable derating factors?	_____
		(yes, no)
26.	Impedance (guaranteed) Sec. 2.2.A.6 H-X (10 MVA base) \pm 7.5% Tolerance	_____ %
27.	Maximum Regulation (H-Winding to X-Winding) on 10 MVA rating at rated voltage:	
a.	Unity power factor	_____ %*
b.	.95 power factor lag	_____ %*
c.	.90 power factor lag	_____ %*
d.	.80 power factor lag	_____ %*

28. Maximum no-load loss at rated voltage (corrected to 20°C) _____ kW*
29. Maximum no-load loss at 110% rated voltage (corrected to 20°C) _____ kW*
30. Maximum total loss including no-load loss and load loss at 55°C rise and ratings listed below (loss corrected to 85°C)
- a. For 10 MVA, rated voltage (Class ONAN) _____ kW*
32. Audible sound level:
- a. Audible sound level limit for this transformer design and rating per NEMA TR-1 _____ dB
- b. Guaranteed maximum audible sound level for Manufacturer design as proposed in Item A.1. _____ dB*
33. Items which will be shipped separately and require field assembly (list):*
- a. _____
- b. _____
- c. _____

Seller Company: _____

Address: _____

By: Name: _____

Title: _____

Date: _____

END OF SECTION