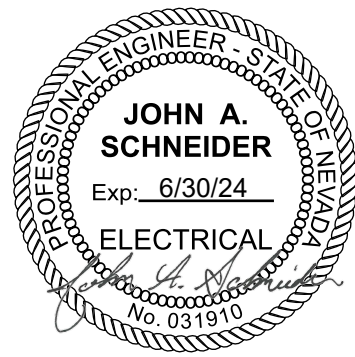


SECTION 33 73 13
POWER TRANSFORMERS



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 power 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. transformer pad, 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 power 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. National Electrical Manufacturer's Association (NEMA).
 - 3. American Society for Testing Materials (ASTM).
 - 4. International Electrotechnical Commission (IEC) Standards.
 - 5. Institute of Electrical and Electronic Engineers (IEEE).
 - 6. 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 and C57.12.90 for Class II power transformers. Tests shall be conducted at the factory, unless otherwise specified.

- 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. 230-12.47/7.2 kV, 10 MVA Power Transformer

Evaluated transformer loss = (NL X \$4,000/kW) + (LL X \$2,000/kW), where

NL = No Load loss guarantee in KW at rated voltage.

LL = 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.
\$2,000 (small quantities of make-up oil)
\$12,000.00 (if core & coil exposed)
 - b. Other items based on Engineers' hourly estimates for time of assembly.
\$200.00/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. 230-12.47/7.2 kV, 10 MVA Power Transformer

$(NLA-NLG) \times \$4,000/kW + (LLA-LLG) \times \$2,000/kW$, 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

2.1 230-12.47/7.2 KV, 10 MVA POWER TRANSFORMER - GENERAL

- A. Quantity to be furnished: Two (2) Power Transformers 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.
 - 4. Auxiliary AC power available: 120/240 Volt, single-phase.
 - 5. Auxiliary DC power available: 125 Volt DC.
 - 6. Seismic Loading: In accordance with the ASCE values.
 - a. SDS – 0.522 g
 - b. SD1 – 0.284 g
 - c. FPGA – 1.34
 - 7. Use: For interconnection between electric utility transmission system and distribution system.
- 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
4. Power Transformer Rating10 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 230,000 Volts, 825 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 at 12,470GrdY/7,200 Volts, 110 kV BIL.
11. Neutral winding connection shall be rated for 110 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 following accessories are to be supplied for all units under these specifications and listed in the attached equipment contract(s) unless specifically stated otherwise. All accessories shall be located in accordance with ANSI Standards.
- B. Winding Design:
 1. The winding design shall be of a circular disk or circular helical design and utilize copper winding material; layer winding designs will not be accepted.
 2. The transformer, including all core and coil assemblies, shall be power class, round core/circular coil design and construction. High voltage and low voltage windings for the main core/coil assembly shall be either disk or helical construction; layer/barrel windings are not acceptable. All windings shall be copper conductor and either rectangular magnet wire or continuous transposed cable.
 3. The purchaser reserves the right to inspect the completed core and coil assembly prior to tanking. The manufacturer shall notify the purchaser not less than five days prior to the date of tanking to allow the customer to witness tanking, if so desired.
 4. The regulating winding shall be fully distributed and be electrically independent from or placed on a separate winding tube from the high and low voltage windings.
 5. Internal surge arresters or non-linear resistors shall not be included as part of the internal insulation system unless written authorization is first obtained from the engineer.

6. SHORT CIRCUIT WITHSTAND: Transformer design and construction shall ensure that a short circuit test of the transformer will not result in an impedance change exceeding 2% of the impedance value measured prior to short circuit testing.
- C. Bushings: The Seller shall furnish ABB, PCORE, or Trench bushings only.
1. All bushings shall meet requirements of IEEE Std C57.19.00 and C57.19.01. All bushings 15 kV and below shall be solid porcelain construction. Bushings above 15 kV shall be standard for interchanging between power circuit breakers and outdoor transformers. All liquid-filled bushings shall be supplied with liquid level indication and provision for power factor test.
 2. All bushings shall be located on the transformer cover in accordance with ANSI/IEEE standards, unless specified otherwise.
 3. All bushings shall be ANSI No. 70 light grey.
 4. All bushings shall have draw-lead type connections where possible. If required, bottom connected bushings shall be installed prior to shipment.
 5. All bushings shall meet the BIL specified after applying any altitude correction factors per Section 2.1, B.2.
 6. The upper bushing terminal shall be a bronze stud with 12 threads per inch.
 7. Three (3) ANSI/NEMA standard bushings shall be provided on the high voltage (H1,H2,H3) terminals rated 230 kV, 900 kV BIL, draw lead, continuous ampacity sized as required for transformer MVA rating.
 8. Four (4) ANSI/NEMA standard bushings shall be provided on the low voltage (X0,X1,X2,X3) terminals rated 15 kV, 110 kV BIL, draw lead, continuous ampacity sized as required for transformer MVA rating. The neutral bushing shall be identical to the phase bushings.
- D. Tank:
1. The tank shall be of welded steel plate construction, complete with welded connections for radiators, valves and devices as required and a cover with all necessary bushing outlets and manhole.
 2. Provide gaskets at all flanged joints set in grooves or held in position by stops to prevent over-compression of the gaskets.
 3. The tank shall be designed and constructed as to be capable of withstanding, without leakage or distortion, an internal gas pressure of 12½ pounds per square inch minimum and a full vacuum, in accordance with ANSI Standard C57.12.10.
 4. The design, tank shape, proportions, weight of material and construction shall be to best facilitate oil circulation and to ensure against transmission or magnification of noise, or vibration which may be injurious or objectionable.
 5. A manhole of not less than 24 inches minimum dimension with a bolted manhole cover shall be provided.
 6. Mechanical design shall incorporate the following features per ANSI Standards, as well as special requirements where noted.
 - a. Facilities for lifting core and coil assembly from tank and for lifting transformer cover.
 - b. Lifting eyes on main tank for lifting complete transformer with high and low voltage bushings installed.
 - c. Handhole covers for bushing current transformer replacement and tank entrance for inspection and maintenance.

- d. Base design for support of transformer shall be of welded plate, of I-beam or channel construction. Base shall be designed for rolling with provision for pulling in directions of centerlines of segments.
 - e. Jacking facilities with pulling eyes at four corners of the base.
 - f. 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.
 - g. Globe-type upper filter valve, 2-inch screw-end for the transformer tank.
 - h. Diagrammatic nameplate to include all ratings and impedances per ANSI C57.12.00.
- E. Externally Operated Fixed Taps:
 - 1. An eternally operated manual tap changer shall be furnished to allow for the high voltage winding tap changes ($\pm 5\%$) as discussed in Section 2.2, A to be operated only when the transformer is de-energized.
 - 2. The tap changer switch shall be designed for convenient operation by a person standing on the same level as the transformer base. It shall include an operating lever or handwheel, tap position indicator, and a means for locking the switches in any position. The locking device shall be arranged to prevent locking the switched in an off-tap position.
- F. Grounding Pads and Terminal Connectors: Standard NEMA 2-hole grounding pads shall be provided near the base of the neutral bushing, each corner of the tank cover, and the base of the transformer at each corner of the tank. Grounding conductor will be #4/0 AWG stranded copper and provided by the Owner. Furnish ground lugs as follows: Five (5) Sefcor Type FNCT2-12-2B-SND, or equal, and four (4) Sefcor GLT-12, or equal. In addition, transformer tank shall be furnished with ground wire supports and clamps up each corner to support grounds to arresters. Supports shall be spaced not further than four feet apart.
- G. Tank-mounted Arrester Brackets:
 - 1. Three (3) removable brackets for mounting station class arresters near each primary bushing. Brackets shall have 10-inch diameter three-hole bolt circle drilling.
 - 2. Three (3) removable brackets for mounting station class arresters near each secondary bushing. Brackets shall have 10-inch diameter three-hole bolt circle drilling. Note: Brackets are not required for throat-connected transformers.
 - 3. Arrester brackets shall be mounted on the transformer tank so that the base of the arresters shall be at least 8.5 feet above the transformer base except as otherwise required to meet ANSI/NESC minimum clearance.
- H. Radiators: The transformer shall be equipped with removable radiators. Radiator assemblies shall be provided with valves between the header and the main tank and shall be provided with means for draining the radiator assembly. The radiators shall be hot dipped galvanized, and constructed to withstand tank operating pressure and full vacuum.
- I. Cooling Equipment and Controls:
 - 1. Transformer shall be designed for self-cooled/forced cooled operation. Controls for forced air cooling shall be supplied with this order. Forced cooling shall be automatically controlled from its own contact of winding

temperature thermometer or manually controlled from its own selector switch. Fan motors shall be totally enclosed type and compatible with available auxiliary power. Electrical fan and pump connections shall utilize liquid tight flexible conduit.

2. Cooling oil shall be inhibited type oil.

- J. Oil Preservation System: Oil preservation shall be designed for sealed tank operation with dry air or gas blanket above oil. (Preferred Design)

As an alternative to sealed tank design, the oil preservation system shall be a pressurized dry nitrogen gas system. System shall include two fully charged 300 ft³ (Praxair Cylinder Size T) nitrogen cylinders (one active and one spare) and all equipment for proper regulation of gas pressure, including gauges necessary to monitor remaining volume of gas in active tank. In addition, system shall include as a minimum:

1. Three-stage nitrogen regulator with built-in alarm contact to monitor nitrogen cylinder pressure. Provide Smith 237-350858A, or equal.
2. A rain proof cabinet to house all gauges, valves, and bottle regulators of the oil preservation system. Cover of the cabinet shall have a window suitably placed and large enough for viewing all gauges without opening the cabinet. Cover of cabinet hinged with hand operated latch and provisions for padlocking closed.
3. Cylinder pressure gauges with high/low pressure alarm contacts.

- K. Gauges, Indicating Devices, and Relays for the Main Tank:

1. Qualitrol Series 032 – Magnetic liquid level sensor 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.
2. Top oil thermometer shall be a dial-type Qualitrol Series 104 remotely mounted gauge. Gauge is to have 4 sets of contacts with a 0°C – 160°C temperature range for auxiliary cooling, over-temperature alarm, and tripping contacts. All four sets of contacts shall be wired to terminal blocks in the control cabinet.
3. Winding hot-spot temperature sensor located in the secondary winding and furnished with a dial-type Qualitrol Series 104 remotely mounted gauge. Gauge is to have 4 sets of contacts with a temperature range of 0°C – 160°C for one stage of auxiliary cooling; separate over-temperature alarm and trip contacts; and sensing current transformer. All contacts shall be wired to terminal blocks in the control cabinet.
4. Qualitrol Series 208 – Cover-mounted mechanical pressure relief devices with alarm contact, automatic resealing-resetting operation, and mechanical signal for indication of device operation. The pressure relief device shall be connected to piping which, in the case of operation, directs expelled oil to a point near ground level.
5. Provide one (1) rapid pressure rise relay, Qualitrol 900-009-03 (flange connected in oil space) with seal-in relay, style 909-300-01. 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.

6. Main tank pressure/vacuum gauge with bleeder and adjustable high and low pressure alarm contacts. Provide Qualitrol 70 series.
 7. Dial-type gauges, valves and control cabinet should be grouped together on the low voltage side of the transformer for easy accessibility and maintenance. All gauges over 96 inches from the floor shall have their faces tilted down at an angle of 30° from the vertical. Wells for oil temperature bulbs and liquid-level gauge floats shall be outside the main tank so as not to require un-tanking for their removal. All gaskets shall be of reusable rubber with means provided for controlled compression.
 8. All alarm and trip contacts shall be 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.
- L. Control Cabinet: Provide one (1) waterproof, dust tight control cabinet in accordance with IEEE Std C57.148. 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:
1. An LED maintenance light with guard
 2. GFCI convenience outlet
 3. Thermostat controlled heater(s), 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.
- M. Current Transformers: Current transformers shall be provided as follows:
1. High voltage (230 kV) bushing CT's: Two (2) multi-ratio bushing current transformer on each high voltage bushing (total of six (6) units per transformer). CTs shall be rated 600:5 Amp maximum ratio, C800.
 2. Low voltage (12.47 kV) bushing CT's: Two (2) multi-ratio bushing current transformers on each low voltage bushing (total of six (6) units per transformer). CT's shall be rated 600:5 Amp maximum ratio, C800.
 3. Neutral bushing CT: One (1) multi-ratio bushing current transformer rated 600:5 Amp maximum ratio, C800.
 4. Winding hot spot detecting current transformer.
 5. Load drop compensating (LDC) current transformer.
 6. All secondary leads shall be terminated at short-circuiting type terminal blocks.
 7. All bushing current transformers shall have a minimum thermal rating factor of 1.5.
- N. Load Tap Changer: Three-phase load tap changer in the low voltage winding designed and assembled in accordance with ANSI Standard C57.12.10 and C57.131. Physical location of the changer shall be in ANSI Segment 4. Load tap changer shall provide approximately ± 10 percent regulation in 32 steps (16 above and 16 below rated voltage). **Provide Reinhausen VACUTAP RMV-II.**

Load tap changer shall be capable of transformer full rated MVA at rated low voltage, and at all taps above rated low voltage. For voltages below low rated position, tap changer shall be capable of a current equal to the current at rated MVA and rated voltage.

1. Load tap changer mechanical requirements:
 - a. Load tap changer mechanism shall be contained in an enclosure separated from the main tank. The barrier separating the tanks shall be oil-tight for all normal operating pressures and under vacuum in either tank. Tap changer enclosure cover shall be bolted to the tank by such means as to give an air-tight seal between cover and tank. Tap changer compartment air space shall be freely vented to the atmosphere by means of a maintenance-free, silica-gel breather or other approved means to prevent entry of moisture.
 - b. Load tap changer mechanism shall include mechanically-operated electric limit switches to prevent over-travel beyond maximum raise and lower positions.
 - c. All standard construction features, accessories and control features shall be designed in accordance with the latest versions of IEEE Std. C57.12.10 and C57.131. Power supply for motor drive shall be compatible with available auxiliary AC power.
2. Load tap changer automatic controls:
 - a. Automatic voltage regulating equipment, including a voltage regulating relay, line drop compensator with means for setting the resistance and reactance, with direct or reversed, a time-delay relay adjustable up to 120 seconds, plus any required auxiliaries. Furnish Beckwith Electric Company, Inc., M-2001D with vacuum fluorescent display or Reinhausen TAPCON 250. Final part number to be determined at time of order.
 - b. LTC back-up relay to prevent defective LTC control from running to high or low limit. Furnish Beckwith Electric Company, Inc., M-0329B.
 - c. Auxiliary relay for use with M-2001D control relay programmable output contact to prevent LTC from changing taps during abnormal conditions and provide alarm.
 - d. Space for mounting future paralleling controls, relays, and required accessories for parallel option by the circulating-current method.
3. Load tap changer local/remote/SCADA control and indication requirements:
 - a. Synchro transmitter mechanically linked to LTC drive to provide an electrical signal corresponding to its rotary position. Provide Beckwith, Model M-29XX tap position sensor connected to a Beckwith Model M-2025D current loop interface.
 - b. Control shall be designed for remote-local control and indication. Control features shall include:
 - 1) Local/Remote selector switch, Electroschwitch Series 24, with oval handle and maintained contacts. Switch plate shall be labeled "LTC CONTROL" with two switch positions labeled "LOCAL" and "REMOTE".
 - 2) Auto/Manual selector switch, Electroschwitch Series 24, with oval handle and maintained contacts. Switch plate shall be labeled "LTC CONTROL" with two switch positions labeled

- 4.

- j. An operation counter shall be provided in order to register the accumulated number of tap changes performed.
 - k. All circuits shall be protected with an overcurrent automatic trip air circuit breaker with manual reset for control to the potential circuit to the automatic control devices.
 - l. One rapid pressure rise relay, Qualitrol 900-009-03 (flange connected in oil space) with seal-in relay, style 909-300-01 for oil insulated arcing – tap type LTC's. Sudden pressure relay is not required on LTC's with vacuum bottle, arc interrupting design. 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 lower side of the LTC compartment with a gate type shut-off valve to permit testing. Seal-in relay chassis shall be mounted in transformer control cabinet.
- O. Surge Arresters: Polymer housed station class surge arresters shall be mounted next to each high and low-voltage bushing on the transformer tank-mounted brackets for future connection to surge arrester ground pads, which shall be provided on the transformer by the manufacturer. They shall be mounted on the transformer tank with the base at least 8.5 feet above the transformer base except as otherwise required. Minimum distance to live parts shall meet NESC requirements. Arresters shall have a NEMA 4-hole pad line terminal and a standard ground terminal that will accommodate 4/0 AWG stranded copper.

Surge Arresters shall meet all applicable requirements of ANSI C62.11. The metal oxide station-type surge arresters shall provide protective margin equal to or greater than those for each system listed below.

Nominal System kV (L-L)	Arrester MCOV kV
230	140
12.47	7.65

- P. Core Ground: Provide enclosure on transformer tank to bring transformer core ground out of the tank via a porcelain insulator (Auburn #F-630 or equal) to allow meggering of core without opening tank. Provide removable solid copper strap from top of insulator to grounding pad on transformer tank. Transformer shall be shipped with core grounded. Insulator, strap, and ground pad shall be contained in enclosure; provide removable lid with gasket on enclosure.
- Q. Bushing Stud Terminal Connectors:
- 1. Three (3) high-voltage bushing connectors for power transformer (stud to 4-hole NEMA pad) tinned bronze, suitable for either copper or aluminum), Anderson Type HDSF, or approved equal.
 - 2. Four (4) low-voltage bushing connectors for power transformer (stud to 4-hole NEMA pad) as described above.

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.
- C. Top of tank and all other horizontal surfaces subject to foot traffic shall be finished with skid-resistant texture.

2.5 STANDARDS

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.

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

APPENDIX
SUMMARY OF PROPOSAL – ITEM NO. 1
230-12.47/7.2 kV, 10 MVA POWER TRANSFORMER
(Requires Completion by Bidder)
* Denotes guaranteed value

A. Price and Delivery

1. Base Bid:

Total price to furnish and deliver F.O.B. pad,
two (2) 230-12.47/7.2 kV, 10 MVA power
transformers and accessories as described in
Part 2 of these specifications.

\$ _____

2. Can Seller meet the specified 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 (230 kV) _____
 - b. Low voltage (12.47/7.2 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*

31. 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*

32. Items which will be shipped separately and require field assembly (list):*

- a. _____
- b. _____
- c. _____
- d. _____
- _____
- _____

Seller Company: _____

Address: _____

By: Name: _____

Title: _____

Date: _____

END OF SECTION