



BID SOLICITATION 203.02.102

TECHNICAL SPECIFICATION

FOR

FURNISHING AND DELIVERING

**THREE (3) SINGLE-PHASE GENERATOR STEP-UP TRANSFORMERS
230/ $\sqrt{3}$ kV Wye – 13.8 kV Delta, 4 x 71 MVA, ONAN/ONAF**

FOR

JEFF L. TAYLOR PINE FLAT POWER PLANT

KINGS RIVER CONSERVATION DISTRICT

FRESNO, CALIFORNIA

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Part 3 Seismic Requirements

See Seismic Requirements for specific content.

Attachments

- A Proposal Form
- B Technical Data form
- C Milestone Schedule form
- D KRCD Pine Flat Reference Drawings:
 - LG-11-110-R4 – General Arrangement Plan El. 603.00
 - LG-11-110-S1-R2 – Power Plant Plan El. 603.00 (SH 1) Concrete Details
 - LG-11-320-R3 – Grounding Layout Switchyard and Transformer Deck
 - LG-11-360-R3 – 230KV Switchyard Layout Plan
 - LG-11-417S1-R5 – Embedded Piping Plan El. 603.0 SHT 1
 - LG-17-301-R13 – Main Single Line Diagram
 - 311-2W24075-D – Detail of Iso Phase Duct Main Transformer Connection
 - 311-3W23446-B – Iso Phase Bus Main Transformer Connection Floor Entrance Part
- E Fuji Electric Drawing
 - TRZ38363 – Outline Drawings of Main Power Transformer
- F Main Power Transformers, Bushing Details
- G Existing Main Transformer Nameplate Photos

Part 1 Specific Requirements

1 GENERAL

1.1 Work Included

Transformer Bank Design, Fabrication, Delivery, and Unloading

Under this Specification, the Supplier shall design, fabricate, furnish and deliver three (3) single-phase generator step-up transformers consisting of transformer with oil, cooling equipment, cabinets, 13.8kV iso-phase connections and compartments for auxiliary electric equipment and other appurtenances for installation at the Pine Flat Power Plant Transformer Yard. Supplier shall set the transformers in place on existing foundations. Upon delivery of the transformer and insulating oil to the job site (Pine Flat Power Plant Switchyard), supplier shall be responsible for transferring the insulating oil from the transport vessel to the transformer tank while Supplier's field engineer is onsite. Supplier shall also be responsible for the permitting and road control (traffic control) to meet the State requirements. The field engineer shall ensure that the assembly, processing, filling, and testing are properly performed per manufacturer's instructions as per warranty. The requirements of this Specification are applicable in their entirety. Any and all changes or addenda to this specification, as agreed in writing between KRCD and Supplier, shall become part of this specification.

Spare Transformer Design, Fabrication, Delivery, and Unloading

Supplier shall provide an optional price for design, fabrication, furnishing and delivery of one (1) single phase generator step-up transformer identical to the three transformers specified above. This transformer will be a spare transformer and will be placed on existing foundation where the current spare transformer sits in the plant switchyard.

3-Phase Transformer Design, Fabrication, Delivery, and Unloading

Not required under this specification.

Inspection and Testing of Existing Fuji Spare Transformer

Not required under this specification.

Optional Storage at a location close to the Power Plant

Supplier shall provide an optional price for storage of the transformers at a warehouse close to the Pine Flat Power Plant, Piedra, CA to accommodate change in the outage start date. Price shall be provided on a monthly basis.

Optional Removal and Scrapping of Existing Fuji Transformers

Supplier shall provide an optional price for removal and disposal of the three (3) existing single-phase transformers. KRCD will be responsible for drainage and disposal of existing oil. Supplier shall relocate existing transformer to a disposal company designated by KRCD for scrap.

Optional Removal and Scrapping of Existing Spare Fuji Transformer

Not required under this specification.

Optional Installation, Assembly, and Testing of new GSU Transformers

Supplier shall provide an optional price for the installation, assembly, and test (collectively Dress and Test) for the equipment furnished hereunder including any specific requirements for on-site installation, assembly, fill, and test of transformer for service to be performed as per warranty.

1.1.1 KRCD deems all of the requirements and specifications set forth in the "Specific Requirements" and the "General Requirements" (all hereinafter referred to as

Technical Requirements) contained in this Specification No. 22541001-ES206-001 to be critical to its operation. Therefore, Supplier agrees that if any of the Technical Requirements are not met, in KRCD's sole discretion, KRCD may exercise its option to terminate the Contract with Supplier pursuant to the General Conditions, paragraph 13, Termination of Contract.

1.2 Work Not Included

- 1.2.1 Transformer foundation and oil containment modifications (if any)
- 1.2.2 Connection of the 230kV line conductors to the GSU 230kV bushings
- 1.2.3 Connection of the external power, CT leads, control and alarm wiring entering the control cabinet originating external to the transformer
- 1.2.4 Transformer Protection Design per KRCD's standards

1.3 Required Delivery

Delivery time is critical to allow KRCD to meet planned operational dates. Supplier guarantees that all equipment shall be delivered to the Project Site by the Guaranteed Delivery Date set forth in the table below. Supplier shall quote his best delivery schedule for all equipment to be furnished under this specification. In addition, Supplier may quote longer or shorter delivery times with appropriate adjustment in price as an alternate proposal. See Part 2 General Requirements for description and submittal schedule of other items to be furnished after award.

Pine Flat Power Plant Transformer Yard	Guaranteed Delivery Date
Pine Flat Main Generator Step-up Transformers	Supplier to provide earliest guaranteed date
Insulating Oil	(Coordinate with KRCD)

1.4 Facility and Shipping Address (Jobsite)

The transformer shall be shipped FOB to jobsite and set on KRCD's transformer foundation. Pine Flat Project Office address is:

**Kings River Conservation District
Pine Flat Powerplant Project Office
27709 Pine Flat Road
Piedra, CA 93649**

Pine Flat Power Plant main entrance is half mile down the road from the Project Office. The plant does not have a physical address. The Powerplant geographic coordinates (decimal degrees) are:

Latitude: 36.832571°
Longitude: -119.327314°

The roads to Pine Flat Power Plant have weight and dimension restrictions. Some restrictions may also result from the sharp turns in the roads to the Pine Flat Power Plant. Supplier shall make every effort to design the transformers such that the maximum shipping dimensions and weights, including the truck used to transport the transformer, meet the limitations outlined in Part 1 Specific Requirements, Section 2.12. The Supplier shall provide in their proposal information the approximate shipping weight and dimensions of the transformer and truck characteristics that they have used to deliver similar transformers. If the shipping weight and/or dimensions are not expected to meet the limitations in Part 1 Specific Requirements, Section 2.12 the Supplier shall clearly document this in their proposal. Supplier is responsible for the permitting, and road control to transport the transformer and the insulating oil to the Pine Flat Power Plant Switchyard.

CALL TWO WEEKS BEFORE DELIVERY TO ARRANGE FOR OFF LOADING

Main Contact

Contact: Pawan Niroula
Email: pniroula@krcd.org

Alternate Contact (Buyer)

Contact: Eduardo Blanco
Email: eblanco@krcd.org

2 SPECIFIC REQUIREMENTS

2.1 Use of Data

The information furnished in accordance with this Section is for manufacturing purposes. The Supplier shall not proceed with production or procure special materials before receiving written verification from the specifying engineer.

2.2 Service Conditions

Installation: Outdoor
Coastal Location: No
Elevation: 603.0 ft (183.8 meters)
Average summer daytime: 95°F (35°C)
Average annual temperature: 64°F (17.8°C)
Minimum / maximum daytime temperature: 31°F / 122°F (-0.6°C / 50°C)
Maximum relative humidity: 100%
Relative humidity for controls design: 95% non-condensing
Average annual rain fall: 15 inches (38.1 cm)
Average annual snow fall: 0 inches (0 cm)
Seismic qualification level: High (as defined by IEEE Std. 693)

2.3 Transformer Characteristics

2.3.1 Summary

Quantity:	3 main and 1 spare optional (identical)
Phases:	1
Type:	Generator Step-Up
Voltage/ Frequency:	HV: 230 kV phase-to-phase / 132.79 kV phase-to-ground Grounded Wye – LV: 13.8 kV phase-to-phase Delta / 60 Hz, The angular displacement between high-voltage (H) and low-voltage (X) terminal voltage for delta-wye or wye-delta transformers shall be 30° with X lagging H. (Attachment G , Existing Main Transformer Nameplate Photos)
Form:	Shell or Core form
MVA Rating:	71 MVA / Phase, 213 MVA 3-Phase Bank Total (ONAN/ONAF)
Impedance	Equal to existing Transformers (Existing Transformer impedance is 12.18% at 70.27 MVA/phase), (Attachment G , Existing Main Transformer Nameplate Photos)
Additional cooling stages:	None or 1 (see Section 2.5)
Warranty	5 years, including all accessory equipment
Color (exterior)	ANSI No. 70 Gray

KRCD does not discourage innovative design improvements that have been fully verified. However, such changes from past procurements or general industry methods should be noted in the proposal. See also Part 2 General Requirements, Section 1.4 Pre-Award Meeting.

2.3.2 Application

The transformers furnished under this specification will be installed as a replacement for the Pine Flat Power Plant Main Generator Step-Up (GSU) Transformers. The General Arrangement

drawings for the existing Pine Flat GSU Transformers are provided in **Attachment D** and the existing Fuji Electric outline drawing TRZ38363 is provided in **Attachment E**. The Supplier shall provide the bus extension for the interconnection of the new transformer to the existing isolated phase bus duct. The bus extension shall be similar in design and characteristics to the existing isolated phase bus duct. The extension bus flange to be interconnected to the existing isolated phase bus shall be designed to ensure that modifications needed to be done on the existing isolated phase bus are minimized. Any required modifications to the existing isolated bus are the Supplier's responsibility.

All transformer equipment, including but not limited to bushings, conservator tank, control panel, monitoring devices, and instrumentation shall be installed on the transformer tank. The location of the equipment shall be designed to maintain standard electrical clearances within the existing GSU oil containment structure, as depicted by drawings in **Attachment D**.

2.3.3 Voltage, BIL and Capacities (ref. IEEE std C57.12.00-2015)

Nominal Voltage	Winding Insulation	Winding Capacity MVA
High Voltage (H): 230,000/ 132,790 (Wye)	900 kV	71 MVA/Phase (213 MVA Cumulative)
Medium Voltage (X): 13,800 (Delta)	150 kV (uniform)	71 MVA/Phase (213 MVA Cumulative)
Neutral (H₀):	150 kV (uniform)	N/A
V, Ø to Ø / Ø to Ground	BIL	55°C Rise

2.3.4 Loading Requirements

The transformer shall be capable of carrying the rated loads on all taps without exceeding the allowable temperature rise.

2.3.5 Load Rejection

Generator step-up transformer will be directly connected to the generator in such a way that it may be subjected to load rejection conditions that result in an abnormally high voltage from the generator. Therefore, the transformer shall be designed to withstand, as a minimum, the resulting stresses with 1.4 times the rated voltage for 5 seconds, applied at the transformer terminals to which the generator is to be connected.

2.3.6 Winding Insulation System

The series (H) winding may have reduced insulation from the H₁ terminal to the H₀ terminal. The X winding shall have uniform insulation over the length of the winding. The transformer shall not use metal oxide elements to protect windings or parts of windings.

2.3.7 Impedance

Supplier shall design the new transformer in consideration of the characteristics of the existing Main GSU transformers at Pine Flat Power Plant. The existing transformers have an impedance of 12.18% at 70.27 MVA. (**Attachment G**, Nameplates for existing transformers)

2.3.8 Short Circuit Withstand

The transformer shall be designed and constructed to withstand, without damage, the mechanical and thermal stresses produced by external faults for the duration and the conditions specified in IEEE Std C57.12.00, Section 7 and IEEE Std C57.116-2022. System impedance shall be considered equal to zero. System prefault voltage shall be equal to the voltage rating of

the maximum tap or 1.05 times the principal tap, whichever is greater.

Generator step-up transformer shall also be designed to withstand the resulting forces caused by a surge in terminal voltage and fault current contribution from the generator while coasting to a standstill. Unless additional information is specified about the time/current/voltage characteristics of the generator under fault conditions, the following criteria shall be considered the minimum acceptable to account for these factors:

Type of Generator	Type of Transformer	Voltage Overshoot (times rated voltage)	Time Duration of Fault (seconds)
Hydro-generator	Generator step-up	1.4	5

Bidder should submit the following data:

- 1) Short Circuit Withstand: capable of withstanding what percentage of infinite bus short circuit level (Infinite bus short circuit current is defined in ANSI C.57.12.00-2015).
- 2) Thermal Withstand: capable of carrying what percentage of infinite bus fault for 3 sec.

2.3.9 Temperature Rise

Maximum average temperature rise for any winding under continuous full load (max MVA rating) shall be 55°C rise above ambient. Hottest spot temperature shall not exceed 70°C rise. These limits are both 10°C below IEEE standard C57.12.00-2015 temperature rise limits to accommodate a maximum ambient temperature of 50°C.

The temperature of non-insulated parts shall not exceed 130°C with an ambient of 50°C.

The shielding on tank walls and frames shall be designed such that gassing does not occur at 130% overload.

Note: The windings and internal leads of the transformer shall limit the loading. The temperature rise in the internal leads shall not be more than 1°C above the maximum winding hot spot rise. All accessories such as bushings and tap changers shall have sufficient rating so they do not limit the loading.

2.3.10 Audible Noise

The audible noise shall be no greater than 91 dB in accordance with NEMA Standards

2.4 Taps / Regulation

2.4.1 De-energized Tap Changer

Transformers connected as a complete 3-phase transformer bank shall be equipped with the following full capacity taps:

HV (H) winding (in kV, line to line): 241.50, 235.75, 230.00, 224.25, 218.50 (2.5% per tap)
LV (X) winding (in kV, line to line): 13.8

2.5 Cooling

The transformer shall be equipped with the necessary cooling system to allow loading of 213 MVA (cumulative) under the stated service conditions. Two stages of cooling (ONAN or ONAF) may be provided. The supplier shall recommend either ONAN or ONAF cooling based on equipment cost and meeting limiting shipping dimensions and weight as described in Part 1 Specific Requirements, Section 2.12. Other options may be quoted and noted in the proposal. Cooling system performance should limit top oil temperature to a maximum of 70°C.

2.6 Bushings and Current Transformers

The following bushings shall be furnished for each single-phase transformer. (Supplier to select from the bushing manufacturers shown.) The H & X bushings are resin impregnated paper/synthetic condenser core type with a composite housing (cast epoxy insulator for the oil-side insulator envelope). The bushing connectors shall be furnished by supplier.

The H1, X1, X2, and H0 bushings shall be configured in the orientation depicted by drawing TRZ38363 in **Attachment E**.

Bushing	Class (kV)	BIL (kV)	Continuous Current Rating (A)	Manufacturer
H ₁	230	900	1600	HSP, ABB, MICA FIL, PCore
H ₀	25	150	1200	ABB, GE, MICA FIL or equivalent
X ₁ , X ₂	25	150	6000	ABB, GE, MICA FIL or equivalent

The continuous thermal current rating factor for the CTs shall not be less than 2.0, unless stated otherwise. The short time thermal and mechanical current ratings shall be as stated in ANSI C57.13. The following multi-ratio current transformers shall be furnished and installed. Note that the supplier is responsible for the design of the installation of the current transformers and shall provide all required hardware, mounting brackets, etc. required for installation.

Bushings Current Transformers per Single-Phase Transformer (for KRCD's use)			
Bushing Designation	Qty.	Current Ratios Amps	Accuracy Class
H ₁	1	100/200/300/400/500/600/800/900/1000/1200/1600:5 (ANSI Std)	C800 or better
H ₀	1	100/200/300/400/500/600/800/900/1000/1200:5 (ANSI Std)	C800 or better
X ₁ , X ₂	2	800/1600/2000/3200/4400/4800/6000:5 (ANSI Std)	C800 or better
X ₂ WT-1 HOT SPOT	1	3300:5 (ANSI Std)	C100 or better

2.7 Surge Arresters

The Supplier shall furnish the following arresters mounted on the H₁ bushing of each single-phase transformer.

The equipment shall be designed and installed to maintain standard electrical clearance with the existing pull-off or isophase structure.

WINDING (kV)	WINDING BIL (kV)	ARRESTER RATING (kV)	ARRESTER PART NUMBER
230	900	180 (144 MCOV)	ABB P180-XM245 or Equivalent

2.8 Accessories

The accessories called out in Part 2 General Requirements shall be furnished. In addition, any specific tools and accessories needed for transformer operation and maintenance shall be provided with the transformer.

2.9 Other Requirements

2.9.1 Transformer is Generator Step-Up type and shall comply with IEEE C57.116, Guide for Transformer Directly Connected to Generator.

2.9.2 Connection of the medium voltage transformer lugs to the existing isolated phase bus. The Supplier shall provide the bus extension for the interconnection of the new transformer to the existing isolated phase bus. The bus extension shall be similar in design and characteristics to the existing isolated phase bus. The extension bus flange to be interconnected to the existing isolated phase bus shall be designed to ensure that modifications needed to be done on the existing isolated phase bus are minimized. Any required modifications to the existing isolated bus are the Supplier's responsibility. Terminal connectors, bus extensions, flex connectors and needed accessories to interconnect the transformer to the existing bus shall be provided by the Supplier. Refer to drawings 311-2W24075-D and 311-3W23446-B in **Attachment D**, and drawing TRZ38363 in **Attachment E** for details of existing medium voltage bus and transformer bushings.

2.9.3 The following power feeds will be made available by KRCD for Supplier connection for the transformer control and cooling equipment. Refer also to Part 2 General Requirements, Section 4.6.

- 120 V AC single phase
- 480 V AC three phase
- 125 V DC

2.9.4 Flexible conduit installations shall not exceed 18 inches in length. Refer also to Part 2 General Requirements, Section 5.6.

2.9.5 Stainless steel ground pads are an acceptable alternative to bronze ground pads. Stainless steel ground pads shall have a minimum thickness of 5/8 inch. Provide a minimum of 4 pads.

2.10 Insulating Oil

2.10.1 Transformers shall be oil immersed and furnished complete with insulating liquid. If transformers are shipped without oil, see Part 2 General Requirements, Section 24.2. Oil shall be inhibited naphthenic oil and shall be in accordance with KRCD Engineering Standards and Part 2 General Requirements Section 24 Insulating Oil Specification, based on the American Society for Testing and Materials (ASTM) Standard D3487.

2.10.2 Supplier shall also provide alternate pricing for supplying natural ester-based less flammable fluid (e.g. FR3) in lieu of the insulating oil specified in Section 2.10.1. The natural ester-based fluid provided shall be in accordance with ASTM D6871. Factory testing with natural ester-based fluid (e.g. FR3) shall be performed in accordance with the requirements of Part 2 General Requirements Section 20, without additional costs to the purchaser.

2.11 Connections

HV power connections (H_1 , H_0) shall be brought out through bushings located on the top of the transformer as shown on drawing TRZ38363 in **Attachment E**.

LV power connections (X_1 , X_2) shall be located on the side with flange to mate to existing isophase bus as shown on drawing TRZ38363 in **Attachment E**.

2.12 Weight and Dimension Limitations

The new transformer shall be designed to maintain standard electrical clearances with the existing HV pull-off, isophase structure, and other existing equipment in the Pine Flat Main GSU transformer yard.

The supplier is responsible for ensuring the design of the transformers allows them to be transported over all roads to their position in the Pine Flat transformer yard. The supplier shall provide in their proposal a draft transportation plan including weight and dimensions of the transformer, truck hauler, and axle locations, as it will be rigged for shipping. The supplier is responsible for verifying the transformer can be shipped to the Pine Flat powerplant. Also, the permitting and road control to transport the transformer and the insulating oil to the Pine Flat powerplant is the supplier's responsibility.

3 REQUEST FOR PROPOSAL

3.1 Proposals

Proposals shall be submitted in accordance with this specification. Proposals shall be valid for a minimum of 120 days. By submitting a valid, signed proposal, the Supplier agrees to furnish, upon written receipt of a purchase order, labor, materials, tools, and equipment and to perform operations and incidentals necessary to design, fabricate, test, furnish and deliver the transformer described by and in accordance with this specification. Supplier may offer alternate proposals, either in whole or in part, only after providing a base proposal in accordance to this Specification. Data requested in this specification shall be provided for any alternate proposal(s).

Supplier warrants that the milestone schedule furnished in **Attachment C** is reasonable and practicable based on Supplier's facilities, resources, and past experience in designing and manufacturing like transformers, and that if awarded a purchase order, fully intends to adhere to this schedule except as may be tangibly impacted by delay or request of change by KRCD, or otherwise negotiated with KRCD.

3.2 Pricing

Supplier shall quote F.O.B. Jobsite (Pine Flat Power Plant), freight prepaid and included for standard delivery including off-loading to transformer foundation. For transformers manufactured outside the United States, Supplier is requested to list separately customs' duties and insurance (point of export to shipping destination) charges for information. Supplier is also requested to submit firm, lump-sum prices in United States dollars.

3.3 Non-Exclusivity

3.3.1 Purchasing Option

KRCD has the option of purchasing transformers solely from one supplier, or from a number of different suppliers, as KRCD, in its sole judgment, determines is appropriate or desirable to meet KRCD's business and system operational needs. KRCD RESERVES THE RIGHT TO REJECT ANY AND ALL PROPOSALS AND TO ACCEPT OTHER THAN THE LOWEST PROPOSAL.

3.3.2 Rights

THE PARTIES AGREE THAT ANY CONTRACT ARISING OUT OF BEING SELECTED FOR AWARD PURSUANT TO THE SUPPLIER'S PROPOSAL DOES NOT ESTABLISH AN EXCLUSIVE AGREEMENT BETWEEN KRCD AND SUPPLIER NOR CONSTITUTE A COMMITMENT BY KRCD, WHETHER EXPRESS OR IMPLIED, TO CONTRACT WITH SUPPLIER TO PERFORM OR SUPPLY ANY WORK; NOR IS THERE ANY GUARANTEE AS TO THE VOLUME OF WORK OR THE DURATION OF THIS CONTRACT. KRCD EXPRESSLY RESERVES ALL ITS RIGHTS, INCLUDING BUT NOT LIMITED TO THE FOLLOWING: THE RIGHT TO UTILIZE OTHERS TO PERFORM OR SUPPLY WORK OF THE TYPE CONTEMPLATED BY THIS CONTRACT; THE RIGHT TO REQUEST PROPOSALS FROM OTHERS WITH OR WITHOUT REQUESTING PROPOSAL(S) FROM SUPPLIER FOR WORK OF THE TYPE CONTEMPLATED BY THIS CONTRACT, AND FINALLY THE UNRESTRICTED RIGHT BY KRCD TO BID OR PERFORM ANY SUCH WORK.

3.4 Proposal Documents

THE FOLLOWING FORMS MUST BE PROVIDED BY SUPPLIER, OR THIS PROPOSAL MAY BE REJECTED.

- A. Attachment A, Proposal Form
- B. Attachment B, Technical Data
- C. Attachment C, Milestone Schedule

D. Supplier Proposal, including:

- i) Specific Quality Assurance measures to meet performance objectives (General requirements 1.2)
- ii) Transformer Losses (General Requirements 2.1). Complete Attachment B.
- iii) Percent impedance of windings at the kVA specified (Specific Requirements 2.3.7). Complete Attachment B.
- iv) Power requirements for operation of forced cooling equipment.
- v) Surge arrester ratings, manufacturer, and part number.
- vi) Weights of core and coils, tank and fittings, insulating liquid, complete transformer including insulating liquid, and total shipping weight in pounds.
- vii) Supplier's standard field procedures for oil processing and transformer filling
- viii) Short Circuit Withstand Documentation (General Requirements 11.1)
- ix) Thermal Withstand Documentation (xx)
- x) Seismic Calculations (Seismic Requirements 3)
- xi) Recommended Spare Parts List, with Prices
- xii) Exceptions to Requirements
- xiii) Exceptions to General Conditions
- xiv) Payment schedule
- xv) Volume of insulating liquid, gallons.
- xvi) Transformer shipping weight, height and truck dimension to transport transformer
- xvii) Detailed description of Supplier's standard production impulse tests if different from ANSI/IEEE testing requirements.
- xviii) Supplier shall describe proposed high-voltage shielding or grading ring or both.
- xix) Draft Transportation Plan (Specific Requirements 2.12)
- xx) Draft work/construction plan for all planned on-site work
 - Offloading and placement of new equipment
 - Installation and testing of new equipment
 - Removal and disposal of existing equipment

3.5. Performance Bond

The successful Bidder shall, at the time of signing the Contract, furnish performance bond executed by a surety admitted to conduct business in California.

The faithful performance bond shall be in an amount equal to one hundred percent (100%) of the Contract Amount and shall be for the faithful performance of the Contract, and for the fulfillment of such other requirements as may be provided by Law. The performance bond shall remain in effect to guarantee the repair and replacement of defective equipment, materials, and workmanship, and payment of damages sustained by the Owner on account of such defects, discovered within two (2) year after final acceptance by the Owner, for the work performed under the Contract, which shall remain in effect for a period of two (2) year, to guarantee the repair and replacement, and payments for damages. In Owner's sole discretion and in lieu of a performance bond executed by a surety, Owner may accept an irrevocable letter of credit on behalf of Contractor which satisfies the foregoing requirements.

4 CORRESPONDENCE

4.1 Correspondence Format

Correspondence shall bear reference to KRCD's Specification number, purchase order number, and substation / plant name.

4.2 Contact Information

Correspondence shall be addressed as follows:

Correspondence Pertaining To			Send To	
	Engineering	Procurement	Construction.	QS
Engineering	Original	Copy	---	Copy
Sourcing	Copy	Original	---	Copy
Shipping (Incl. Weights & Dimensions)	Copy	Copy	Original	Copy

Engineering: Pawan Niroula, Director of Power Resources
4886 E. Jensen Ave. Fresno, CA 93725

Sourcing: Eduardo Blanco, Buyer
4886 E. Jensen Ave. Fresno, CA 93725

Construction: Pawan Niroula, Director of Power Resources
4886 E. Jensen Ave. Fresno, CA 93725

QS: Pawan Niroula, Director of Power Resources
4886 E. Jensen Ave. Fresno, CA 93725

<<<< End of Specific Requirements >>>>

Part 2 General Requirements

1 **GENERAL**

It is the Supplier's responsibility that the equipment and materials furnished and designed be in accordance with all applicable codes, regulation, and standards. If not otherwise specified in these General Requirements, the following codes and standards shall apply.

1.1 Industry Standards

The transformer shall conform to and meet, unless otherwise specified, applicable requirements of:

ANSI/IEEE C57.12.00 (2015)	Standard General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers
ANSI/IEEE C57.12.10 (2010)	IEEE Standard Requirements for Liquid-Immersed Power Transformers
ANSI/IEEE C57.12.11 (1980)	Guide for Installation of Oil-Immersed Transformers (10 MVA and Larger, 69-287 kV Rating)
ANSI/IEEE C57.12.70 (2000)	Terminal Markings and Connections for Distribution and Power Transformers
ANSI/IEEE C57.12.80 (2002)	Standard Terminology for Power and Distribution Transformers
ANSI/IEEE C57.12.90 (2010)	Standard Test Code for Liquid-Immersed Distribution, Power and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
ANSI/IEEE C57.13 (2016)	Standard Requirements for Instrument Transformers
ANSI/IEEE C57.13.3 (2006)	Guide for the Grounding of Instrument Transformer Secondary Circuits and Cases
ANSI/IEEE C57.19.00 (2004)	Standard General Requirements and Test Procedure for Outdoor Power Apparatus Bushings
ANSI/IEEE C57.19.01 (2000)	Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
ANSI/IEEE C57.19.100 (2012)	Guide for Application of Power Apparatus Bushings
ANSI/IEEE C57.91 (2011)	Guide for Loading Mineral-Oil-Immersed Transformers
ANSI/IEEE C57.98 (2011)	Guide for Transformer Impulse Tests
ANSI/IEEE C57.109 (2018)	Guide for Liquid-Immersed Transformer Through-Fault-Current Duration
ANSI/IEEE C57.120 (2017)	Loss Evaluation Guide for Power Transformers and Reactors
ASTM D 3487 (2017)	Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
ASTM D 6871 (2017)	Standard Specification for Natural (Vegetable Oil) Ester Fluids Used in Electrical Apparatus
AWS D1.1 (2020)	Structural Welding Code-Steel
IEEE 693 (2018)	Recommended Practice for Seismic Design of Substations
NEMA TR 1 (2013)	Transformers, Regulators and Reactors
IEEE C62.11 (2020)	Metal Oxide Surge Arresters for AC Power Circuits

1.2 Quality Assurance

The transformer specified in this Specification must neither initiate service failures nor fail under electrical and environmental conditions typical to their application on KRCD's system. This Specification sets forth certain basic requirements, including the Production Tests specified in Section 20, directed toward the realization of these goals. Fulfillment of these objectives is heavily

dependent on the Supplier's methods in design, manufacture, and shipment of the specified transformer. Therefore, Supplier shall submit specific measures to be taken by Supplier to assure the quality of materials, workmanship, sub-supplier components, and the overall transformer. This information shall be included in Supplier's proposal and will be carefully considered in determining the award.

1.3 Site Visit Inspection

Each Bidder is required to visit the site of the Work and otherwise thoroughly inform himself of all condition and factors, especially the interconnection to the existing medium voltage isolated phase bus duct and dimension and weight limitations, which could affect the prosecution and completion of the Work, including, but not limited to, the arrangement and condition of existing or proposed structures affecting or which are affected by the proposed Work; the availability and cost of labor; and facilities for transportation, handling, and storage of materials and equipment.

The walk-down is to be at the KRCD site Pine Flat Power Plant- bidders shall request site visit date and time via email to following individuals by June 25, 2026. Availability will be on weekdays between July 1 and 10, 2026.

Address: Pine Flat Power Plant Project Office- 27709 Pine Flat Rd, Piedra, CA 93649

**Contact: Pawan Niroula Email: pniroula@krcd.org
Guy Loya Email: gloya@krdc.org**

1.4 Pre-Award Meeting

The procurement process will include a pre award meeting with the Supplier at KRCD. The purpose of the meeting is to review the design, general layout of the tank and major accessories, conformance with the specification, and commercial issues. The supplier shall disclose any deviations from designs of previous KRCD procurements or from general industry practice. This applies to design principles rather than quantities. KRCD does not discourage innovative design improvements that have been fully verified by the manufacturer. However, the use of such design changes shall be discussed with KRCD. KRCD may choose to include recognized industry experts as consultants in this process. The design information to be furnished includes the general winding layout, major clearances between windings, approximate core induction, short circuit stress calculation methods, and thermal calculation methods.

1.5 Design Review Meeting

KRCD intends to conduct a thorough design review with the Supplier at a KRCD facility. The review will focus on core and coil design fundamentals, engineering calculations, and general tank and accessory arrangements. KRCD may choose to include recognized industry experts as consultants in this process. Supplier shall submit to KRCD at least one week prior to the meeting a summary of design criteria and parameters, engineering calculations (especially short circuit withstand), and winding schematic and details. A follow up design review meeting may be requested at KRCD's discretion after submittal for acceptance of all design drawings (per Part 2 General Requirements, Section 3.1). This meeting would cover all aspects of design.

The purpose of the design review meeting is two-fold, to review the Supplier's design approach and details, and to ensure clarity in understanding the specification and KRCD's expectations. The objective is to minimize conflicts or changes during manufacturing.

2 **LOAD LOSSES/PURCHASE PRICE ADJUSTMENT**

2.1 Losses Evaluation

Within the bid proposal, the Supplier shall state the transformer losses for the design conditions specified herein. The Supplier shall also specify the method used for load loss measurements.

Total error shall be $\pm 1.0\%$ or less. KRCD will evaluate the Supplier's transformer proposal on the basis of power losses. The dollars per kW used in the evaluation are listed below. Load losses shall be based on the ONAN (Self-cooled) rating.

No-load losses	Load Losses	1 st Stage Cooling	2 nd Stage Cooling
\$1,637/kW	\$2,797/kW	\$1,209/kW	\$1,063/kW

2.2. Loss Guaranty

Supplier warrants and guarantees that upon testing the transformer will have losses lower or equal to the loss values stated in the proposal (hereinafter the Loss Guaranty). If the transformer fails to meet the Loss Guaranty set forth above, the provisions of Part 2 General Requirements, Section 2.4 shall apply and KRCD may exercise its rights thereunder.

2.3 Loss Tests

To determine whether or not the transformer losses are greater than Supplier's guaranteed loss values, tests shall be performed by the Supplier prior to shipment of the transformer at the Supplier's expense, in accordance with ANSI C57.12.00, Paragraph 8. Supplier shall provide the specific test schedule, test instrumentation, data collection, calculation, performance analysis, and a certified report to KRCD. KRCD shall not be charged for these expenses.

2.4 Price Adjustment

If the transformer losses as determined in Part 2 General Requirements, Section 2.3 are greater than Supplier's guaranteed loss values, the purchase price for that transformer shall be reduced by the cost of the additional losses based on the power loss evaluation values specified in 2.1. The adjusted purchase price shall be determined prior to the first payment for the transformer as follow:

For losses greater than guaranteed loss values but less than 105% of guaranteed no load losses or 103% of guaranteed total losses; supplier shall pay one-time penalty for all losses above the 100% guaranteed values.

For losses between 105% and 110% of guaranteed no load losses or 103% and 106% of guaranteed total losses; supplier shall pay double penalty.

For losses greater than 110% of guaranteed no load losses or 106% of guaranteed total losses, supplier shall perform extended investigation tests and root cause analysis. Supplier shall pay double penalty if the investigation result is acceptable to KRCD. KRCD shall have the right, at its discretion, to reject the transformer if the investigation result shows the unit is defective and is not acceptable.

The no-load loss value obtained before the dielectric test is to be used for loss evaluation.

Measurement system tolerance for losses is less than IEEE.
No load and load loss tolerances are less than the default values in IEEE. With good design tools and practices transformers can readily meet these tolerances.

3 INFORMATION TO BE FURNISHED AFTER AWARD

3.1 Design Drawings

Within 8 weeks after receipt of purchase order, Supplier shall furnish five sets (full size) of white prints and digital files for all drawings in .pdf and .dgn (AutoCad) formats to the Responsible Engineer for acceptance. If drawings are standard drawings that show items not part of this order, such drawings shall clearly indicate those items pertinent to the purchase order. All drawing and document text shall be in English. Designs made on a metric basis shall show dual metric/English units on drawings. Each set of white prints shall include the following drawings and information:

- 3.1.1 Outline dimensions and general arrangement of the transformer, including overall height and height without bushings, locations of all components and accessories located externally on the tank, weight of core and coils, tank, oil, and total weight. Minimum height required for untanking, overall height after untanking shall be included, Location of center of gravity for the assembled transformer shall be provided. Manufacturer's name, valve sizes, type, rating, and catalog number for all bushings, arrester ratings, stud diameters with thread information and space arrangements with hole patterns shall be included on the transformer outline drawings. Manufacturer bushing and surge arrester drawings shall accompany the outline drawings.
- 3.1.2 Elementary and connection diagrams of accessories and cooling equipment, including ratings and nameplate data for fans, contactors, circuit breakers, oil and winding temperature devices, oil quantity, flow, and fault gas monitoring devices, and alarm contacts including set points.
- 3.1.3 Diagram of connections for de-energized taps.
- 3.1.4 Arrangement of all windings on the core, number of windings, number of turns in each winding, type of coil winding, size and material of conductor in each winding, winding insulation, winding supports and location of all winding taps and leads.
- 3.1.5 Location or locations of the core ground strap(s) connection to the core and the routing and supports to the core ground bushing. Refer to Part 2 General Requirements, Section 6.2.
- 3.1.6 Specifications of the standard painting system used for coating transformer including the number and type of coats applied to exterior metal surfaces.
- 3.1.7 Shipping Outline Drawing, including the following: (1) Center of gravity; (2) Maximum "G" force, horizontally and vertically, that the transformer can withstand without damage; (3) Details of base, including all dimensions and design locations under base plate; (4) Shipping weights and dimensions including crates and packing, and any other pertinent shipping data; and (5) Jacking pads and pulling eyes, with all dimensions and loading.
- 3.1.8 Nameplate Data sheet showing the layout of the nameplate and all data specific to this purchase order. Data on nameplate shall be in accordance with Section 8 herein.
- 3.1.9 Original manufacturer drawings and/or data sheets of each device supplied with the transformer, including but not limited to, bushings, CTs, surge protection, cooling equipment, instrumentation, on-line monitoring systems, electrical control equipment and valves.
- 3.1.10 Short-time over-excitation capability curve similar to what is shown in IEEE C37.91, Figure 38 so that KRCD can accurately set the over-excitation protection.

3.2 Drawing Acceptance

KRCD's acceptance of drawings is required for Supplier to commence fabrication, unless waived in writing by a KRCD's Responsible Engineer (hereinafter RE). RE will examine each drawing furnished by Supplier and return, in ten (10) working days after receipt in RE's office, one complete set stamped to indicate the required remedies or actions, if any. Drawings will be marked either "Accepted - Submit final document - Manufacturing may proceed", "Accepted except as noted - Make changes and resubmit acceptance document", or "Not accepted - Correct and resubmit".

3.3 Drawing Revisions

For drawings marked as "Accepted except as noted - Make changes and resubmit acceptance document", or "Not accepted - Correct and resubmit", Supplier shall revise and resubmit to RE for acceptance all drawings in .pdf and .dwg (AutoCad) formats within ten (10) working days after receipt of drawings returned to Supplier by KRCD in accordance with Part 2 General Requirements, Section 3.2 above.

3.4 Final Drawings

RE acceptance applies only to the general arrangement and does not relieve the Supplier of the responsibility for correctness of design, details, and dimensions in order to meet the performance requirements of this Specification. Within 30 calendar days after receipt from RE of all drawings marked "Accepted - Submit final document - Manufacturing may proceed", Supplier shall submit to RE one reproducible original of each final drawing marked "Certified for Construction". Additionally, one reproducible original of the following curves and data for each type and size of Current Transformer (hereinafter CT) shall also be included with the final certified drawings:

- 3.4.1 Exciting current curve extending to exciting current values which indicate definite saturation.
- 3.4.2 Typical ratio correction factor curves for the relay burdens specified, for each ratio over the range of 0.25 to 20 times rated primary current.
- 3.4.3 Rated burden, accuracy class, continuous thermal current rating factor, short-time mechanical current rating and short-time thermal current rating.

3.5 Progress Reports

By the first of each month, Supplier shall submit a general progress report to RE for the preceding month including a forecast for the remainder of the schedule. Reports shall address the status of all aspects of the purchase including, but not limited to, materials procurement, design, fabrication of tank, core and windings, and testing. Additionally, reports shall include an updated production schedule indicating approved schedule and current schedule (advances and delays) plus a description of any significant events such as completion of a milestone, delay in materials procurement, design difficulties, resource shortages, test failures, and their cause and impact on the overall schedule. Projected delays in schedule shall be reported immediately and include a written explanation for the delay. Reports shall be submitted to KRCD Purchasing (Contract administrator) with copies to the Responsible Engineer and Supplier Quality Control.

3.6 Instruction Books

Supplier shall furnish three (3) hard copies and one (1) digital (.PDF) copy each of instruction books, maintenance manuals, parts bulletin, performance curves, photos (one photo for each of four sides and top of core and coil assembly just prior to tanking), etc. to the RE thirty (30) calendar days prior to the shipment of transformer. Photos shall be approximately 8 x 10 inches (20 x 25 cm), black and white.) All written material shall be in clear English. The instruction books shall include copies of all drawings and test data furnished under the preceding sections. In order to expedite the furnishing of the instruction books, the "test data" may be furnished later provided the copies are marked "FOR INSERTION IN INSTRUCTION BOOKS". Instruction books shall contain data on accessories and equipment including contact adjustments, handling, maintenance, and installation instructions. Prior to shipment, one complete set of reference materials (same as submitted to RE) shall be placed in the transformer's control cabinet drawing pocket located on the inside of the door. Digital copies of

the complete instruction manual including the test reports and all drawings shall be supplied.

3.7 Certified Test Reports

Three (3) hard copies and one (1) digital (.PDF) copy of the certified test reports showing evidence of compliance with the test requirements set forth in ANSI C57.12.90, and the Production Tests specified in Part 2 General Requirements, Section 20, shall be submitted to the RE within 10 working days of testing completion. One (1) additional copy of the certified test reports shall be faxed or hand delivered to KRCD's Supplier Quality Control (SQC) representative for his/her acceptance. **The transformer shall not be released for shipment until written acceptance of these test results for the specific unit is received from KRCD's SQC representative.**

3.8 Short Circuit Withstand

Three (3) hard copies and one (1) digital (.PDF) copy of the final documentation which substantiates proof of short-circuit withstand shall be submitted to the RE at the same time as the certified test reports specified above. Extent of documentation shall be the same as that required with the proposal per Part 2 General Requirements, Section 11.2, updated and finalized as necessary.

3.9 Identification of Purchase Order

KRCD's Specification number and Purchase Order number and the Name of the Substation shall be shown on every document, including acceptance and record drawings, test reports, instruction books, bills of material, transmittal letters and the actual nameplates.

3.10 Shipping Data

Supplier shall submit to the RE, three (3) months prior to shipment of the transformer, the shipping height, width, length, and weight of transformer. In addition, the shipping dimensions and weight of other items (i.e., radiators, bushings, etc.) shall be also submitted to the RE. The method of shipment, i.e., drop center car, top hat assembly, etc., shall be described in detail in the Supplier's submittal to the RE in order that proper evaluation of KRCD's handling, transportation, and assembly procedures can be made.

4 **CABINETS AND COMPARTMENTS FOR AUXILIARY ELECTRICAL EQUIPMENT**

4.1 Type and Location

Cabinets and compartments that house auxiliary electrical equipment shall be weatherproof (NEMA 3 minimum) and located on segment 3 of the transformer. Top of cabinet(s) shall be a maximum 84 inches above the transformer base and the bottom not less than 24 inches. All gauges and controls shall be located between 36 inches and 60 inches above transformer base. Glass window shall be provided to permit easy reading of gauges, local annunciator lamps, and operation counter by an average height person standing on the ground without opening the door.

The cabinet door handle(s) shall be located approximately 4'-0" above the top of foundation and shall have provision for padlocking with a separate lock (furnished by KRCD).

4.1.1 The control cabinet will either be one unit divided into two sections (compartments) with separate doors or will be two separate cabinets mounted adjacent to each other. One cabinet or compartment will house all circuit breakers, isolating switches, motor contactors, relays, and other power related components. One cabinet or compartment will house all Fan and Load Tap Changer related SCADA and Non-SCADA control switches, tap position monitor-transmitter, and mounting provisions for KRCD furnished RTU. Control switches, tap position monitor-transmitter, and related devices will be mounted on a hinged swing-out panel to allow access to the back of the devices for wiring and maintenance.

4.2 Vents, Heaters, Lights, and Convenience Receptacle

Vents: Cabinets and compartments shall be vented adequately in or near the top and bottom with

suitable means provided for escape of any collected or condensed moisture. Vent openings shall be provided with nonferrous or stainless steel screens. Bottom vents shall be provided with Fiberglass Dust Stop filters installed so as to permit them to be readily changed. Fully gasketed access doors shall be provided. **Heaters:** Cabinets and compartments shall be provided with two circuit breaker controlled cabinet air space heaters with thermostats, rated 240 V AC and connected for 120 V AC operation. Heaters shall have guards to protect operating personnel from accidental burns or electrical shocks. A Waukesha panel heater (self regulating), part number 1030-361/1030-793 is an approved equivalent. **Lights:** All control cabinets shall be equipped with interior light(s) controlled by a door switch. Incandescent lights shall be equipped with guards to prevent accidental contact. **Receptacle:** A weatherproof, duplex, single phase, 3-wire, 15 amp, 120 vac receptacle with ground-fault circuit interruption shall be provided at a convenient location on the exterior of the cabinet.

4.3 Doors

Cabinet and compartment doors shall be equipped with door stops to hold them open during servicing, inspection, and maintenance and, a three-point latching mechanism. Two-point latching mechanism may be furnished subject to acceptance by RE. The control cabinet door(s) shall be furnished with a "drawing pocket" capable of holding all drawings and instruction books issued with the transformer. The drawing pocket shall be provided with a simple hinged cover to prevent rain from getting in during maintenance.

4.4 Ground Bars

A copper ground bar not less than 12 inches in length, 1-inch wide, and 1/4-inch thick shall be mounted near the bottom of each control cabinet. The bar shall have No. 10-32 tapped holes on one inch centers.

4.5 Space for KRCD Equipment

A clear space (approximately 12" H x 24" W or 30 cm H x 60 cm W) shall be provided within the control cabinet for the future addition of SCADA peripheral devices by KRCD.

4.6 Auxiliary Power

Auxiliary power for the operation of accessory equipment will be provided from KRCD station power source. Available AC station service voltage is 120 VAC single phase, and 480 VAC three phase. Available DC station power is 125 VDC.

Supplier shall provide terminals that accept #8 AWG (10mm²) for DC station power cables and #4 AWG (25mm²) for AC station power cables, which will be terminated by KRCD. Auxiliary power circuits shall be protected by circuit breakers at the control cabinet and shall be UL listed for use on 125 VDC with 10kA interrupting rating, 120 VAC with 10kA rms symmetrical interrupting rating, or 480 VAC with 48kA rms symmetrical interrupting rating.

5 **WIRING**

5.1 Wire Type and Size

Power, control, and current transformer wiring shall be 600-volt, stranded copper wire, NEC Type SIS, XLPE or better, or approved equivalent. Insulation shall be flame retardant, moisture, heat, and oil-resistant thermoplastic suitable for dry or oil-immersed service continuously at 90°C or higher temperature, and shall meet all requirements as defined by applicable UL, ICEA-NEMA, and ASTM Standards. Power and control wiring for auxiliaries shall be not less than No. 14 AWG (2.5 mm²). Current transformer wiring shall be not less than the AWG wire size used in the current transformer winding or No. 10 AWG (6.0 mm²) as a minimum. Wiring which is flexed by the opening of cabinet doors or swinging panels shall be Class K stranded copper hinge wire. Wires shall be surface printed with the manufacturer's name, AWG size, voltage class, NEC Type, dry and oil-immersed temperature ratings or verification of temperature ratings by certified test reports furnished by the transformer manufacturer.

5.2 Wire Markers

Each wire shall be tagged with the Suppliers **destination** wire identification at the device(s) and at the terminal block(s) with flame retardant non-shrink sleeves or heat shrinkable tubing with indelible black print on a white background. Heat shrinkable markers shall be shrunk, but not over terminal barrels. Printing shall be legible and read from left to right, or top to bottom. Markers shall be installed with labeling upright and facing forward. Markers are not required at device end where pin connectors are supplied on the device. The following are acceptable marking systems:

- Brady "Permasleeve"
- Critchley HIS System
- Impact Advanced Wiring System
- Raychem "TMS Sleeves"
- Sumitomo Electric "Sumimark"

CT circuit wires shall be tagged with red cable sleeves and VT circuit wires with black sleeves.

5.3 Terminal Blocks

Terminal blocks shall be standard molded, washer-head screw type, with white marking strips.

5.3.1 Power and control wiring shall terminate on standard terminal blocks with white marking strips.

5.3.2 Circuits that interface with KRCD shall be wired to terminal blocks located in the control cabinet located preferably in the bottom part. A minimum of 15 percent spare terminals shall be provided.

5.3.3 Terminal blocks shall be mounted in readily accessible locations, which are not obstructed by pipes, cables, or other components.

5.3.4 Terminal blocks shall be labeled in a manner that will cross-reference them to the associated drawings.

5.3.5 A minimum of 4 inches clearance shall be provided between each edge of terminal block and adjacent block, device, or wall. A minimum of 6 inches shall be provided where KRCD field termination will be performed.

5.3.6 Terminal blocks which are located in a separate compartment adjacent to the main cabinet and not accessible via normal cabinet doors, shall be accessible through a separate swing-type terminal compartment door. Removable access plates or covers are not acceptable.

5.4 Wire Terminals

Terminals shall be un-insulated, tear-drop shape, ring-tongue crimp type with brazed barrel, and installed with an approved ratchet-type crimping tool.

5.4.1 The wire to be terminated shall be stripped free of insulation, without nicking or severing any strands, 1/8-inch longer than the terminal barrel. A 1/16-inch length of bare conductor should be exposed at each end of the terminal barrel when crimped.

5.4.2 Terminations shall provide a permanent, mechanically secure, high conductivity joint, and shall not be covered by wire markers.

5.4.3 For devices that will not accept nor be modified to accept ring-tongue type terminals, the connection shall be made using a connector (ferrule) similar to a butt-splice connector, modified/designed to prevent crushing. Terminations shall not be made by clamping to bare conductor.

5.4.4 If the clearance between un-insulated terminal lugs is less than 3/16", then insulated ring lug terminals shall be used to prevent accidental shorting.

5.5 Auxiliary Power Connections

Supplier shall provide terminals which will accept #8 AWG (10 mm²) for DC station power cables and #4 AWG (25 mm²) for AC station power cables, which will be terminated by KRCD. Neutral wires of power circuits shall be laid down at terminal blocks and not be grounded or interconnected.

5.6 Raceways

Flexible conduit shall be metallic with a protective weatherproof UV resistant sheath. Rigid plastic or corrugated flexible plastic conduit is not acceptable. External wiring shall be run in IMC or rigid steel conduit, or other suitable metal enclosure adequately supported. Vertical conduit runs shall be suitably sealed, or have screened vents, top and bottom.

5.7 Instrument Transformer Wiring

Transition of current transformer secondary wiring through the tank wall or cover shall be accomplished by a method approved by Engineer. Secondary leads of current transformer shall terminate on short-circuiting screw type terminal blocks located in the control cabinet or, if one is not furnished, a weatherproof terminal box located at a convenient height on the low-voltage terminal side of the tank. Use a dedicated block for each CT. Secondary leads shall not be spliced except where connections are made to the current transformer winding or, as necessary to make the transition through the tank cover. Neutral wires of current transformers circuits shall be laid down individually at terminal block. Each neutral shall then be brought to ground (no daisy chaining) to allow KRCD flexibility in lifting individual grounds as necessary.

5.8 Device Nameplates

Devices shall be labeled to identify their function and in a manner which will cross-reference them to the associated drawings. Device numbers shall be in accordance with ANSI C37.2. Labels shall also include information necessary to identify the device on the associated drawing(s). Use of device numbers only will not be permitted. Nameplates/Labels shall be engraved white lettering on a black background (black lettering on a white background will also be considered) on Lamicoid, Formica, Partex, or metallic material; attached with screws and located unobstructed by cabling, wires, switches, etc. All external nameplates shall be located and of sufficient size to be readable when standing on the ground.

5.9 Protection from Energized Parts

Terminals and bare energized parts on devices, terminal boards, knife switches, fuses, etc., with voltages of 208 V and above, shall be guarded to prevent accidental personnel contact. Lighting, convenience outlets, and heaters shall be wired so that no live parts are exposed.

Terminals and bare energized parts on devices, terminal boards, knife switches, fuses, etc., with voltages of 208 V and above, shall be guarded to prevent accidental personnel contact. Lighting, convenience outlets, and heaters shall be wired so that no live parts are exposed.

Provision of guards is a KRCD requirement consistent with its safety policy to minimize and eliminate hazards.
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5.10 Wiring Supports

Wiring shall be adequately supported and protected from severe vibration and mechanical injury.

5.11 Space for Field Wiring

Adequate space shall be provided within the cabinet(s) for the addition of KRCD-installed wiring from terminal blocks to the conduit access plate in the bottom of the cabinet. This space shall not be occupied by any devices or equipment, including nameplates.

5.12 Splices

Conductors shall be continuous from termination to termination. Splices and taps, if necessary, shall be made only at junction and pull boxes (no splices or taps will be permitted within conduit or tray). Splices shall be made only after receiving approval of KRCD. Should splices be authorized, splices and connections shall be insulated properly except for bare ground connectors and where connection is made to an apparatus terminal or terminal board not requiring insulation.

6 **GROUND CONNECTION**

6.1 Tank Ground Pads

Four horizontal bronze (alternate) or Series 304 stainless steel (preferred) ground pads shall be provided, one on each diagonally opposite corner of the transformer tank. Stainless steel pads shall have continuous 5/16 -inch minimum Type ER 309 fillet weld. Pads shall be at least 2 by 3.5 inches and 5/8 - inch thick (5 x 9 x 1.6 cm), and be welded on the base or on the tank wall approximately 12 inches above the base. Each pad shall have two holes horizontally spaced on 1-3/4-inch centers, threaded for 1/2 inch - 13 national-coarse-thread. Silicon bronze bolts and lock washers shall be provided. Each pad shall be furnished complete with a compression-type terminal in conformance with NEMA CC1 for connecting KRCD's 250 (minimum) to 500 (maximum) kcmil bare copper ground cable.

6.2 Core Ground

Core ground from core assembly of main transformer shall be brought out via a tank through bushing for external connection to ground (to facilitate core ground insulation resistance measurement without opening tank). The core ground bushing rated 1 KV minimum (with minimum 5 kV 1 minute AC Test withstand voltage) shall be located on the side of the transformer tank near the top. A nameplate identifying the core ground bushing shall be provided.

6.2.1 In core form transformers. Separate grounds shall be brought out from the core and frames. Separate terminals shall be provided for each ground lead and labels provided.

6.2.2 In shell form transformers. The core shall be insulated from the T-beams and tank. Ground leads shall be brought out from the different sections of the core to terminals. The number of leads required will be determined at the design review.

If core clamp is isolated from the main tank, then a separate ground connection shall be brought out in a similar manner adjacent to the core ground bushing.

All the core ground connections shall be terminated on a copper-faced ground pad adjacent to the bushing and these must be connected to ground for service.

A nameplate identifying the different core ground bushings connections shall be provided.

Tabs on the tank walls shall be provided for support of grounding cables for the arresters.

7 **TANK CONSTRUCTION**

7.1 Construction and Access

The transformer tank and cover shall be of welded construction with bolted manhole cover, and such that the cover may be removed and re-welded without damage to the core and coil assembly. There shall be no weld starts or stops within one inch of any tank corner. The corners shall be formed of plate steel to allow welding in corner areas on flat surfaces (nor welds/joints at the actual corner). Welded vertical seam tank (T-Joint) with welding inside and outside is also acceptable with approval of KRCD RE. Stitch welding of internal seams will not be accepted. There shall be no pinholes in any external weld. Welders and welding procedures shall be qualified in accordance with AWS D1.1 "Structural Welding Code-Steel", or an approved equivalent. The transformer shall be designed when possible so that components can be maintained without personnel entering the enclosed space of the tank. Access portals for essential maintenance and inspection shall be provided as required.

The portals, bushings and other accessories shall not weep or leak.

All gasketed surfaces shall be recessed groove or compression stop design with Buna-N (Nitrile) gasket material M2BG70-1450psi, per ASTM D2000-01. Any deviation in gasketing methods shall be subject to approval by KRCD in writing.

All the manholes shall be raised approximate 1 inch above tank cover and provided with bolted flanges. A minimum of two (2) 22 inch diameter circular manholes shall be provided on the cover.

The jacking pads of size >12 inch shall be located on the tank close to each tank wall corners. These shall be located at approximate 20 inches above the transformer base. The tank walls shall be free from obstructions (valves, cooler pipes, etc.) for the length of the jacking pads plus minimum 6 inches from each end.

The transformer shall have pulling eyes that are unobstructed by accessories (control cabinet, inert air cabinet, etc.) to allow the transformer to be pulled in both directions.

7.2 Pressure Withstand

The tank, conservator, and piping shall withstand full vacuum (full vacuum with external pressure of one atmosphere) in the field. Additionally, the completely assembled transformer tank shall be designed to withstand, without permanent deformation, an internal pressure 25% greater than the maximum operating pressure, or 15 psig (103 kPa) positive pressure (empty), whichever is greater.

7.3 Base

Transformer tank base shall be designed to permit skidding on rollers in both directions and anchoring to a concrete foundation by welding to embedded steel angles or channels. **The transformer shall have a flat base.** Welding of anchor tabs shall be permissible without damage to the transformer or oil after the unit is fully dressed and filled. Supplier shall indicate in the outline drawing locations where field welding to the transformer base is preferred. See also Part 3 on seismic requirements. Centerline marks shall be marked into the tank base plate and highlighted with red or yellow paint on all four sides of the tank for ease of orientation with the foundation centerlines. The location of the centers of gravity shall be permanently marked on all four sides of the transformer tank for the completely assembled oil-filled and for the shipping condition, these shall be identified as "c.g. for complete unit" and "c.g. for shipment".

7.4 Fall Prevention

Provisions shall be made in the transformer's design and fabrication for fall prevention when KRCD personnel are working on the top of the transformer. Provide a "Proman" safety bracket centered as much as possible on the tank cover. For units longer than 12 feet, one bracket is required for each 12 feet, or portion thereof, of length. The bracket is available from SS Supplies and Solutions (510-226-8665), part number 12322. The bracket shall be welded to the tank.

8 **NAMEPLATE**

Supplier shall furnish a stainless steel nameplate. The nameplate shall be affixed to the exterior of the transformer in an accessible location and at a height of 42 to 60 inches (107 to 150 cm). The nameplate data shall be as furnished on the nameplate drawing and in accordance with requirements of ANSI/IEEE C57.12.00. In addition, the nameplate shall include full load current for each voltage and MVA rating, Sound Level, the KRCD purchase order number, and the statement "Tank, conservator, and piping designed to withstand full vacuum."

9 **FINISH**

Supplier shall apply a minimum of three paint coats to all exterior metal surfaces, including one coat of rust-inhibiting primer to achieve a total dry-film thickness of 8 mils (0.2 mm). Galvanized surfaces need not be painted. Non-slip paint or strips shall be added to the surface of the transformer top. Transformer final finish color shall be ANSI 70 gray, non-chalking, non-lead base, polyurethane or equal, to match the existing Power Plant outdoor electrical equipment finish color. Final paint color

inside the transformer tank shall be white and shall be capable of withstanding transformer operating conditions as identified in this specification without degradation such as chipping, cracking, or peeling.

10 CORE ASSEMBLY

10.1 Design Type

The transformer shall be designed and constructed as either a core-form or a shell-form type transformer assembly with circular windings. Step-lapped core construction shall be supplied to reduce noise level, losses, and hot spots at the joints.

10.2 Excitation Current

Exciting current for the core assembly shall not exceed 0.3 % of the rated current at rated voltage and 1% at 110% rated voltage. The exciting current values obtained by test at both 100% and 110% of rated voltage shall be included on the test report.

10.3 Magnetic Core Flux

The maximum core induction shall be 19,000 Gauss (1.9 Tesla) for non step-lap joints and 19,300 Gauss (1.93 Tesla) for step lap core joints at the ANSI/IEEE requirement of 110% rated voltage with no load. The maximum hot spot temperature rise in the core shall not exceed 70°C. This temperature rise limit shall not be exceeded under condition of delivering maximum MVA at power factor of 0.90 and 105% voltage on the loaded winding.

All insulation material in contact with core surface and tie plate shall be Nomex or equivalent insulating material of temperature class ≥ 160 degrees C, to prevent potential heating and gassing due to the impact of Geomagnetic Induced Current (GIC).

The transformer shall be designed to withstand GIC magnitude of 15 Amps/phase for duration of 30 minutes. Supplier shall provide the estimated flux density in the core, temperature rise of core, windings, tie plate, core clamps, and tank wall & cover for this GIC condition, assuming transformer is loaded to maximum MVA. Refer to IEEE C57.163 for additional details.

10.4 Over-Excitation Curve

Bidder should submit Over-Excitation Curve for over voltage capability. Bid data should also include core design is capable of what percentage of continuous over-voltage.

10.5 Volts per Hertz curve

Bidder should submit the Percentage Allowable V/Hz vs rated against Time (in minutes) Curve in the bid document.

11 SHORT CIRCUIT WITHSTAND AND WINDING ASSEMBLY:

11.1 Operation

The transformer high voltage will be operated on a solidly grounded, 60 hertz system. The Medium voltage, 13.8 kV will operate on ungrounded system.

11.2 Short Circuit Withstand

11.2.1 Design proposals shall include documentation which substantiates the short circuit withstand capability. Documentation shall include records from full size transformer tests and model tests. Data from in-service short circuit performance should also be submitted. Design calculations must include the maximum stresses for different fault conditions and tap positions based on fault currents calculated assuming infinite bus (limited by only transformer impedance) and 110% pre- fault voltage. The inner winding buckling stresses

must be determined for both the free (unsupported) and forced (supported) buckling conditions. In addition, the calculations shall include, but not be limited to, all buckling, hoop, radial bending, axial bending, tipping, and radial spacer stresses. The characteristics of the windings along with the withstand capability of winding conductor for each stress must be furnished. The maximum axial forces and the withstand capability of the end support shall also be supplied.

- 11.2.2 The windings, core assembly and internal parts of the transformer shall be mechanically braced to withstand various types of faults. The calculation of axial forces shall be based on a minimum offset between windings of either 0.4% of the winding height or 6 mm height whichever is larger.
- 11.2.3 The core shall be rigidly clamped with clamping structure suitable to withstand short circuit, lifting and clamping forces. For core step supports, high density material shall be used for each step to prevent noise, vibrations and any possible distortions due to short circuit, lifting and shipping forces.
- 11.2.4 The core and coil assembly shall be designed to withstand the shipping acceleration forces of 5/3/3g for shipment by Rail, and 3/2/2g for shipment by Road, without use of temporary shipping braces, and with no damage/displacement to the transformer.
- 11.2.5 Adequate sizing and compression methods shall be used during manufacturing to assure that the windings will be tight when shipped and also will remain tight in service and during short circuit. These manufacturing practices shall be reviewed during Design Review stage.
- 11.2.6 In shell transformers, the bending stresses between spacers shall be calculated. The windings shall be compressed and clamped during core assembly such that the windings are still under compression when the core is completed. Manufacturer shall furnish methods used to support the coil edges during short circuit.

11.3 Winding Assembly

- 11.3.1 Winding conductor shall be copper. Individual conductors of the high and medium-voltage windings shall be circular. Multiple conductors, continuously transposed (CTC), and epoxy bonded are preferred. For CTC construction, each conductor shall have an enamel coating. KRCD prefers that winding leads be brought out of the same side of the winding to avoid half-turn offsets. Uses of compensating turns wound directly on the core (external to the winding) are not permitted. Tap leads shall be rigidly supported with pressboard clamps. Ties with string or tape are not permitted.
- 11.3.2 High density crepe paper, Dennison 22HCC or the KRCD approved equivalent shall be used for all conductors taping. All pressboard parts except formed parts shall be made from pre-compressed material having a minimum density of 1.15 gm/cc. The formed parts shall be made from pressboard having a minimum density of 0.9 gm/cc.

12 **MEDIUM VOLTAGE WINDING**

12.1 Winding Design

- 12.1.1 Medium voltage winding shall be connected in a delta configuration. Connections shall be brought out through bushings on the top of the tank. The medium voltage winding shall be capable of withstanding both thermally and mechanically the resulting current for a period of two seconds resulting from:
 - i) a three-phase fault on the terminals of the medium voltage winding with voltage

maintained on the high winding,

- ii) a single-line-to-ground fault on the X winding with voltage maintained on the high winding, and
- iii) any other condition as determined by the supplier for the design being furnished which may result in equal or greater stresses.

12.1.2 The use of reactors in the transformer, to limit short circuit current through the windings shall be used only after receiving written permission from KRCD's Responsible Engineer. Any reactor used must be designed and made by the Supplier, and which design the Supplier must have employed for at least ten years. Reactor shall be made from insulated copper strap; sheet windings are not acceptable.

12.1.3 In shell form transformer, the medium voltage winding shall be adequately supported to prevent bending or movement during short circuit.

12.2 Capacity

The winding capacities specified for the medium voltage winding in Part 1 Specific Requirements, Section 2, pertains to the connected load and shall be the minimum designed capacity. The actual capacity of the windings may be greater as determined necessary by the short circuit withstand requirements of this paragraph.

13 **TAP CHANGERS**

13.1 Transient Protection

All tap-changers and tap leads shall be designed to withstand transient voltage under impulse conditions without the use of internal metal-oxide varistors (MOVs).

13.2 De-Energized Tap Changer

A de-energized tap-changer (DETC), externally operated, for changing high-voltage taps when the transformer is de-energized shall be supplied with the transformer. The transformer shall deliver the rated MVA at any DETC tap position. The operating shaft shall be brought out through the tank and extend to an operating handle located at a height convenient to operating personnel. The DETC shall have provision for padlocking in any position. The tap changer shall be installed in the high voltage winding as necessary to provide the specified voltage adjustment taps. Designs that require that tap changer be operated periodically to prevent coking will not be accepted. The tap changer will only be moved to wipe the contacts when the tap changer position is changed in service. Instructions for moving the tap changer to wipe the contacts shall be included in the instruction book.

14 **BUSHINGS**

14.1 Design Standards

All bushings shall conform to applicable ANSI/IEEE Standards (pre-approved dimensional variations may be allowed) and shall be capable of carrying, within their normal life expectancy, daily transformer overloads as specified in ANSI C57.91. All bushings shall be rated to carry overload currents as specified in Part 2 General Requirements, Section 20.3.

14.2 Bushings Rated 60 kV and Higher

Bushings rated for 60 kV application and above (Class 69 kV and above) shall be vacuum filled resin impregnated paper (RIP) or synthetic (RIS), condenser core, with a composite insulator housing for the outdoor insulating envelope, and a cast epoxy insulator for the in-board shank insulating envelope.

Weather sheds shall be RTV vulcanized silicon rubber (ANSI 70 gray) without metallic air gaps. High voltage shielding and/or grading rings shall be furnished as necessary. In addition, bushings rated 25 kV and above shall meet the following requirements:

- 14.2.1 Test Report. A certified test report for these bushings for tests in accordance with ANSI C57.19.00 shall be provided with other certified test reports as required in Section 3.7 of these General Requirements. Test report shall include as a minimum partial discharge and power factor test results. Partial discharge shall meet limits given in Table 9 of ANSI C57.19.01.
- 14.2.2 Approved Supplier. HSP, ABB, Micafil, and PCore are the only approved suppliers of these types of bushings to KRCD. Bushings supplied shall be one of those listed in Part 1 Specific Requirements, Section 2.6. Note that these bushings are a hybrid of applicable ANSI and IEC standards.
- 14.3 Bushings Rated Less than 60 kV
 - 14.3.1 Bushings rated less than 60 kV (Class 46 kV and below) shall be paper in oil or impregnated paper, condenser core, with a high-creep porcelain housing, ANSI 70 light gray glaze.
 - 14.3.2 Bushings rated 25 kV or below may be dry, oil filled, or an approved plastic filled type. Oil filled condenser bushings shall be equipped with an oil level indicator. All Bushings shall be furnished without metallic air gaps.
 - 14.3.3 Bushings connected to segregated or isolated phase bus shall be arranged to properly align and connect with existing bus as specified in the Part 1 Specific Requirements, Section 2.6 and 2.9.2.
- 14.4 Through Conductor and Terminals

All bushings with stud terminals shall be furnished without top terminal connectors. Through conductors shall be copper. Supplier shall furnish information necessary for KRCD to order terminals, including dimensions and threading of stud-type connection.
- 14.5 Color

Porcelain color shall be ANSI No. 70 gray.
- 14.6 Current Transformers

All bushings regardless of rating shall be equipped with multi-ratio bushing-type current transformers as specified in the Part 1 Specific Requirements, Section 2.6, and in Part 2 General Requirements, Section 15 below.
- 14.7 Spare Bushings

A quotation for one (1) spare bushing of each specific type and rating shall be provided by the Supplier. Pricing should be based upon shipping the spare and in-service bushings together. Spare RIP/RIS bushing shall include a storage container recommended for long storage period outdoors or indoors to protect against moisture ingress.
- 14.8 Shipping

Oil filled bushings shall be shipped in crates which are constructed to adequately support the bushing in an inclined position to prevent bubble formation in the oil-impregnated insulation. Crates and shipping covers shall be suitable for storage outdoors without deterioration of crate or bushing for a minimum period of 18 months.
- 14.9 Bushing Electrostatic Shield

The 230 kV bushing lower electrostatic shield shall be insulated with epoxy resin or molded pressboard. Sufficient clearances shall be provided from the tank or turret walls to prevent partial discharges during tests.
- 14.10 Bushing Terminals

All bushing shall be furnished with terminal connectors. Terminal connectors shall be stud to flat,

straight, tinned copper, four-hole NEMA spacing, with ampere rating equal to the bushing current rating.

15 CURRENT TRANSFORMERS

15.1 Current Ratio and Accuracy Class

The transformer shall be furnished with multi-ratio bushing current transformers (CT) per Part 1 Specific Requirements, Section 2.6. Each CT shall have a four-section winding with each winding section distributed along the full length of the secondary core to provide the tap ratios and accuracy classification specified. Tap ratios shall be as listed in Part 1 Specific Requirements. All CTs shall be accuracy class C800 or better, unless specified otherwise in Part 1 Specific Requirements.

15.2 Thermal Rating

The continuous thermal current rating factor for the CTs shall not be less than 2.0, unless stated otherwise. The short time thermal and mechanical current ratings shall be as stated in ANSI C57.13.

15.3 Testing

Each CT shall be measured and tested in accordance with Section 20.4.

16 ACCESSORIES

16.1 Mounting Location

Indicators (dials) of temperature indicating and control equipment shall be located not less than 3½ feet nor more than 6 feet (1.1 to 1.8 m) above the base of the transformer, preferably on the low-voltage side of the tank. Indicators shall be constructed and located in such a manner that the temperature sensor portions can be removed from the transformer, while the transformer is energized, by a person keeping all portions of their body below the cover of the transformer.

16.2 Included Accessories

In addition to accessories discussed elsewhere in this Specification, the transformer shall be equipped with the following. The number of contacts specified is for use with the local annunciator described in Part 2 General Requirements, Section 16.2.8 or for tripping and are in addition to any which may be required for Supplier's use. Contacts for KRCD use shall be rated minimum 0.5 Amp inductive at 130 VDC. Alternate supplier must be approved by KRCD's Responsible Engineer in writing.

16.2.1 Magnetic Liquid Level Gauge: Gauge shall be Qualitrol Model 042 Series, or equivalent with electrically separate low liquid level alarm and low liquid level trip contacts. One normally open contact to close when the oil in the transformer drops to the manufacturer's recommended low oil level (SW#1, for alarm), and one normally open contact shall close when the oil in the transformer drops to manufacturer's recommended minimum low-low level (SW#2, for trip). Gauge shall have a terminal box for electrical connections. The set points for the low oil level alarm and the low-low oil level trip will be shown on the control schematic wiring diagram in terms of inches of oil level fall from normal. The gauge shall be 6 inches in diameter with yellow characters/black background and marked "MAX". "25 Deg C", "MIN" and one graduation marker for level alarm just before the "MIN" mark.

16.2.2 Rapid Pressure Rise Relay: Relay shall be a Qualitrol Corporation Rapid Pressure Rise Relay, 900 Series, or equivalent. Provide a bronze wedge-type gate valve between the pressure relay and the transformer tank to permit relay maintenance. The relay shall be located 7 to 8 ft. (2.1 - 2.4 m) above the base to avoid accidental bumping and near, but not less than 1 ft. (.3 m), to tank corner for structural stability. Mounting shall allow servicing by a person keeping all portions of the body below the transformer cover. Wiring between the body of the relay and the control cabinet shall be shielded. The shield shall be connected to a terminal block, but not grounded. All three terminals of the form "C" contact shall be wired to

a Qualitrol 909 seal-in relay. The Qualitrol seal-in relay alarm and trip relay outputs and the power supply inputs shall be wired out to a terminal block for KRCD use. The Qualitrol 909 seal-in relay shall be configured for a 125 VDC power supply.

- 16.2.3 Mechanical Relief Device: Device shall be a Qualitrol XPRD, or equivalent with semaphore and one form "C" contact. Any discharge shall be piped downward to a point two feet from the transformer base and away from the control cabinet and oil sampling valves for safety. Pipe shall be steel (galvanized is acceptable), minimum schedule 10 or aluminum schedule 40. Piping shall be the same nominal size as the device outlet. Install "Pressure Relief Discharge Device" caution sign on or adjacent to pipe. Note: When using schedule 10 pipe with the XPRD, a material is generally required to fill the annulus between the throat and pipe due to the slight difference in diameters.
- 16.2.4 Gas Accumulation/Sudden Pressure Relay: If an atmospheric positive-pressure (sealed conservator) type oil preservation system is used; a Buchholz type relay shall be furnished with two set points. The gas accumulation set point shall have one normally open contact. The excessive oil flow set point shall have one normally open and one normally closed contact. The excessive flow contacts shall be connected to a terminal block for KRCD use. A ball or gate valve, one at each side of Buchholz relay, shall be furnished to provide isolation for relay maintenance.
- 16.2.5 Liquid Temperature (top oil) Indicator shall be bulb, capillary and dial type, with maximum indicating hand, alarm closing contact, and 0-1 mA output (for SCADA), Qualitrol, Series 104-400 or equivalent. Probe shall be serviceable with the transformer energized.
Note: Switch shall be set to engage (alarm) at a calculated top-oil temperature of 90°C.
- 16.2.6 Electronic Temperature Monitor: Monitor shall be a Qualitrol ITM-509. Current sensors shall be installed for each winding (i.e. high voltage, medium voltage, and tertiary windings) and temperature sensors provided for main tank oil temperature and for externally mounted OLTC (RMV type). Probe shall be serviceable with the transformer energized. Current transformers designated in Part 2 General Requirements Section 15 shall not be used for inputs to the temperature monitors. Supplier shall provide additional CTs as required. KRCD will provide the actual Model No. in the EMM. Provide hard copies of Qualitrol ETM configuration (".qcf" file) as set at the factory. Procedure for obtaining this data is described in Qualitrol ITM-509 Software manual, page 36. Include in the test report and CD copy of the instruction manual.
Note: Stage 1 cooling shall engage at a winding hot spot temperature of 70°C. Stage 2 cooling shall engage at a winding hot spot temperature of 85°C. Alarm shall engage at a winding hot spot temperature of 95°C. Trip shall engage at a winding hot spot temperature of 130°C.
- 16.2.7 OLTC Liquid Level Gauge: Not applicable.
- 16.2.8 Optional Local Multi-Drop (10 alarm points) Annunciator: A Schweitzer SEL-2533 with LED, shall be supplied as an option with each single-phase transformer to provide local annunciation. The local annunciator shall be mounted inside the control cabinet and be visible through a viewing window. A failsafe group alarm contact (closes on alarm or loss of power) shall be wired out to a terminal block for KRCD use. The annunciator shall be equipped with the alarm points described below:

POINT	WINDOW DESCRIPTION
1	Pressure Relief Device Operated
2	Hi/Low Nitrogen Pressure – Transformer Tank (Inert Gas System) or Gas Accumulation (Oil Conservator System)
3	Hi/Low Nitrogen Pressure – Nitrogen Cylinder (Inert Gas System) or Gas Accumulation (Oil Conservator System)

4	Low Oil Level (Main)
5	High Top Oil Temperature
6	High Winding Temperature
7	Loss of AC – Controls
8	Loss of AC – Cooling
9	Electronic Temp Monitor Diagnostic
10	Mechanical Pressure Relief (Main tank)

17 **OIL PRESERVATION SYSTEM**

17.1 Type

The oil preservation system shall be either the atmospheric positive-pressure (conservator) type with bladder or the inert-gas pressure (nitrogen cushion) type. KRCD prefers the conservator type.

17.2 Atmospheric Positive-Pressure (Sealed Conservator) Type Oil Preservation System

17.2.1 The atmospheric positive-pressure (sealed conservator) type with bladder shall be designed to prevent the oil from coming in direct contact with the air. The bladder membrane shall prevent saturation of the oil with air for a minimum of 10 years. The transformer manufacturer shall be responsible for furnishing data on the leakage rate of air through the rubber. The system shall provide a positive oil pressure relatively constant for the total operating range. The system shall include the reservoir tank with supports and internal bladder type air-cell, weather-tight maintenance free desiccant type breather connection to air-cell, pressure-vacuum bleeder with a gauge installed between the air cell and breather, drain plug, vent valves, and all other equipment as required.

The oil connection to the main tank shall be provided with two (2) isolation valves, a rate-of-flow check valve (Sergi or approved equivalent) and a buchholz-type relay (see Section 16.2.4).

The equipment and oil expansion capacity shall be suitable for operation with main-tank temperature up to 120°C. The conservator system shall be designed to withstand full vacuum for filling transformer with oil. Suitable connections shall be provided so that the main tank, projections above the main tank, piping to the conservator tank, and the conservator tank can be filled under vacuum.

17.2.2 The conservator tank shall be located in such a manner as to allow connection, with adequate clearance, to the medium voltage bushings using the isolated phase bus. The tank should also not impede cooling airflow.

17.2.3 A preservation system that uses extensive piping to connect each bushing adapter is not acceptable.

17.3 Inert-Gas Pressure (Nitrogen Cushion) Type Oil Preservation System

17.3.1 The inert-gas pressure type preservation system shall be furnished complete with the necessary tanks of nitrogen to purge the gas space and place the transformer in service, reducing valves, and gauges. The transformer tank shall be capable of withstanding, without leaks or deformation, the maximum pressure developed in the tank through a top oil temperature of 110°C.

17.3.2 The nitrogen cylinder and a spare cylinder shall be mounted in a NEMA 4 weatherproof cabinet mounted attached to the transformer at a height of approximate 6 - 10 inches above the base level. Any other means of replenishing nitrogen such as use of nitrogen generator is not permitted. The mounting arrangement of the cylinder shall be such as to facilitate replacement with a minimum of lifting.

- 17.3.3 Provisions shall be included for connection of an external nitrogen cylinder to be located outside of the transformer containment area. The fitting for connection of external nitrogen cylinders shall be accessible without requiring the inert-gas oil preservation cabinet to be opened.
- 17.3.4 Nitrogen regulating equipment shall be fitted with Compressed Gas Association (CGA) Connection No. 555 (valve outlet 0.903-inch 14NGO-LH-Ext).
- 17.3.5 The inert-gas pressure system will be supplied with the following gauges and alarm contacts for each cylinder:
 - 17.3.5.1 One gauge to read directly the pressure in the nitrogen cylinder including low pressure alarm contacts.
 - 17.3.5.2 One gauge to read directly the pressure in the transformer tank including high- and low-pressure alarm contacts.

18 SURGE PROTECTION

18.1 Type and Location

Supplier shall furnish surge arresters as listed in the Part1 Specific Requirements, section 2.7.

18.2 Connections

Supplier shall provide ground cable support clips on the tank wall (see **Attachment D** drawing LG-11-320-R3 for details). KRCD will provide the 250 MCM cable and the connections between the arresters and the station ground grid.

18.3 Spare Surge Arresters

A quotation for one (1) spare surge arrester of each specific type and rating shall be provided by the Supplier. Pricing should be based upon shipping the spare and in-service surge arresters together. Spare surge arresters shall include a storage container recommended for long storage period outdoors or indoors to protect against moisture ingress.

19 COOLING EQUIPMENT

Supplier shall furnish cooling equipment for the transformer that meets the requirements noted below:

19.1 Heat-Exchangers

Steel flat-plate type radiators (heat exchangers) arranged in groups or banks for attachment to the main transformer tank are preferred. The use of aluminum for tubes, fins, or other appurtenances is not permitted. Galvanized radiators are preferred. Alternatively, copper flat sheet or tubular finned type with fin spacing of not more than 10 fins per inch may be supplied.

19.2 Design and Installation

Heat exchangers shall be so designed that there shall be no recesses or surfaces on which water can accumulate and so arranged that surfaces will be readily accessible for cleaning and repainting without removing the heat exchangers from the transformer tank. Heat exchangers shall be rigidly supported to minimize cantilever forces which may result in sagging, fatigue, cracking, and oil leaks in either the connections at the main tank or in the heat exchangers. It is KRCD's preference that all of the heat exchangers should be located on the high-voltage side of the transformer tank.

19.3 Piping

Oil piping and piping accessories shall have welded joints except at disconnect points and connection to valves with NPT threads listed in the following table. Bolted flange connections shall be furnished between the transformer tank, heat-exchanger, and pump (if used). It is KRCD's preference that no pumps are used. The heat exchanger mounting flanges on the main transformer tank, both top and bottom, shall be equipped with a butterfly valve to manually shut-off the oil flow from the main tank to the heat-exchangers.

Drain valves and vent plugs shall be furnished in the cooling system to permit draining oil from the heat-exchanger and pumps (when used). If pumps are furnished, a valve shall be located on both sides of each pump to allow removal. An oil flow indicator shall be provided for each pump with an alarm for low or no oil flow. Oil piping shall be rigidly supported to avoid vibration and stress during transit and when the pump is in operation. Flexible connections shall be furnished with pump and pipe systems to minimize piping strains on coolers and to facilitate maintenance.

The oil fill connection shall be located on top of the transformer (with spray diverted toward tank sides and away from the core coils and active parts) and piped down (inside or outside the tank wall) to a valve near the bottom, 24 inches above the transformer base. The vacuum connection shall be located on the tank cover in a location opposite the fill connection and on the conservator tank. The oil fill piping shall be 2 inch and the vacuum piping shall be 3 inch. The tank drain connection shall be at the lowest possible near the bottom, preferably on the medium voltage side. Install the temporary oil sight valve near the top and directly above the drain valve. Oil piping shall be rigidly supported to avoid vibration and stress during transit and while pumps are in operation.

Any valve otherwise exposed to the atmosphere shall be fitted with a plug, cap or blind flange as appropriate. The following valves types shall be furnished:

Application	Size	Type	Notes
Radiator Isolation	—	Butterfly	With position indicator and lockable in full open and closed position. Packing glands must be serviceable without removing the valves.* Radiator valves must have a provision to be securely bolted in either the open or closed position.
Pump Isolation	—	—	Per Suppliers' standard
Tank Vacuum	3 inch	Gate	Furnish with female national pipe thread (NPT) and bronze pipe plug.
Oil Fill	2 inch	Gate	Furnish with female national pipe thread (NPT) and bronze pipe plug.
Oil Drain	2 inch	Globe	Furnish with female national pipe thread (NPT) and bronze pipe plug, include pick-up pipe inside to ensure full drainage, no sampling device.
Temp Oil Sight	1 inch	Gate	Bronze, near top directly above drain valve

19.3.1 Gaskets shall be flat "Nitrile" rubber (Nitrile ASTM-D-2000-01, 2BG715, per MIL-R-3065) and single piece or approved "Nitrile" O-ring and groove design with stops. The compression in the gasket shall be 70 to 90 percent, and shall be tested per latest revision of ASTM F145 and other applicable standards. Stops located on both I.D. and O.D. of the gaskets shall be provided so that over compression of the gaskets does not occur.

19.3.2 Metal surfaces to which gaskets are applied shall be machined smooth, without any visible voids, pinholes, or deformities, and shall have sufficient rigidity to assure proper compression of the gaskets.

19.3.3 Flange connections shall be leak free and Supplier shall specify in Proposal any alternative field proven designs.

19.4 Controls

The cooling system for ONAF or KDAF rated transformer shall be designed and equipped with a group of forced cooling equipment. The forced-cooling power source shall be monitored by a time delay drop-out (TDDO) type under voltage relay. The TDDO under voltage relay shall have alarm contacts wired to the local annunciator to indicate a loss of voltage condition (less than 70% of nominal voltage). Alternate supplier must be approved by KRCD's Responsible Engineer in writing.

- 19.4.1 Liquid Flow Indicator: When a forced-oil-cooling rating is utilized, a liquid flow indicator with alarm contacts shall be furnished.
- 19.4.2 Power Source: If it's determined that multiple stages of cooling are required (see Part 1, Section 2.5), each forced-cooling stage, whether forced-air-cooled (ONAF or KDAF) or forced-air, forced-oil-cooled (ONAF or KDAF) will be wired for connection to separate external power sources. Stage No.1 power source will normally be designated the primary source and, Stage No.2 power source the alternate source.
- 19.4.3 Time-Delay Drop-Out Undervoltage Relay(s): Each forced-cooling stage power source will be monitored by a TDDO Undervoltage relay. The delay shall be adjustable with a range of approximately 2 to 20 seconds. The TDDO Undervoltage relays will have alarm contacts wired to the local annunciator to indicate a loss of voltage condition.
- 19.4.4 Control Power Transfer Switch: The transfer switch contactor will normally be energized by the primary power source and will transfer the controls to the alternate power source upon failure of the primary source. Upon restoration of primary power, the control source will return to the primary source. The forced-cooling stage connected to the failed external power source will be inoperative, but the controls and the other forced-cooled stage will continue normal operation.
- 19.4.5 Two Automatic-Manual switches relays shall be provided, one for each forced-cooling stage, as applicable. The "Manual" control contact shall be connected in parallel with and not disable the winding temperature control contacts for the associated forced-cooling stage. The switch shall be Electrosch Catalog # 103602LS, marked "AUTO - MAN". The following nameplates shall be provided:

STAGE 1 TRANSFORMER COOLING AUTOMATIC - MANUAL
--

STAGE 2 TRANSFORMER COOLING AUTOMATIC - MANUAL
--

- 19.4.6 Forced-cooling group sequence selector switch shall be furnished only when the two forced-cooling groups are identical (KDAF/ONAF or KDAF/ODAF). The sequence selector switch shall be Electrosch Catalog # 103602LS, marked "NORMAL-ALTERNATE". The following nameplate shall be provided:

COOLING GROUP SEQUENCE SELECTOR SWITCH

- 19.4.7 Remote SCADA Control Switches: Not required.

19.5 Cooling Fans and Pumps

A sufficient number of fans shall be included on the transformer to meet temperature rise ratings and provide uniform air cooling for the radiators. Fans shall be mounted on the radiators in locations which provide optimum forced flow of air. Fan blades shall be stainless steel. Fan cages (guards) shall be

galvanized. Each cooling group shall be adequately protected against overload and short circuit currents. Fan and pump groups shall have direct on-line starters and each shall be furnished with suitably rated motor overload protection in each phase.

19.5.1 Each motor shall be rated for 480 volt, 3-phase operation and be protected by internal thermal elements in each ungrounded conductor. All motors must be furnished in a NEMA frame, hermetically sealed and designed for continuous duty. Motor bearings shall be sealed type and not require field maintenance. Each motor shall be furnished with an electrical disconnecting means (weatherproof insulated receptacle and mated plug) to allow removal from the circuit without affecting other motor(s) in the same cooling group. The fan/motor arrangement shall be bolted to the transformer in such a way that it can be seamlessly removed from the outside (for ease of maintenance/replacement).

19.5.2 Equipment guards shall be furnished in accordance with State of California, Division of Industrial safety, General Industry Safety Orders, Article 37, Section 3944, Guard Clearances, paragraph (a), as follows: "Where guard or enclosure is within 4 inches of moving parts, openings through guard shall be of such size as will preclude the passage of any object greater than one-half inch in diameter".

20 **PRODUCTION TESTS**

20.1 Test Standards and Plan

The transformer manufactured under this Specification shall be subject to routine tests, design tests, and other production tests (collectively "Production Tests") performed by the Supplier prior to shipment, in accordance with Paragraph 8 of ANSI C57.12.00, and ANSI C57.12.90 and NEMA Publication No. TR. 1, including but not limited to the tests specified in Part 2 General Requirements, Sections 21.2 through 21.4 below. A complete written test plan shall be submitted to KRCD's Supplier Quality Control representative at least 6 weeks prior to the performance of any testing. The test plan will be accepted with any amendments or corrections four weeks prior to the start of testing.

20.2 Routine Tests

The completed transformer, including bushings, shall be subjected to loss, sound level, applied potential (hi-pot), induced potential, Radio Influence Voltage (RIV, microvolt and picoCulombs), switching impulse (prior to ANSI impulse), and ANSI/IEEE impulse tests.

20.2.1 The enhanced/ induced potential, RIV, and impulse tests shall conform to the requirements of ANSI C57.12.90, Part I, Section 10, and C57.98 as a minimum and shall not exceed 300 Pico coulombs (PD) and 100 microV (RIV) during the hour, using voltages required for a transformer with the insulation BIL ratings in Part 1 Specific Requirements, Section 2.3.3. If random periodic spikes of discharges of over the specified limit occur during the one hour RIV/PD test, the transformer will be rejected unless Supplier can prove that the source of spikes are external. Use of ground resistors during impulse testing is not allowed unless specifically approved by KRCD. Switching Impulse test is not required on units rated below 60 kV, for duplicate units of the same purchase order or for units of identical design previously tested. Above requirement for impulse testing will apply to all neutral bushings / terminals.

Switching impulse test is required on all new designs, both Class I and Class II units, except as noted, to ensure integrity of design.

20.2.2 The dielectric and heat run tests shall each be done in a continuous manner. Time between the impulse and induced test shall not exceed 16 hours. No oil processing shall be performed between the heat run and impulse tests.

20.2.3 Dissolved gas analysis test shall be performed on the transformer before and after dielectric

tests (see Part 2 General Requirements, Section 21 Acceptance Tests below) to ensure satisfactory winding insulation integrity.

- 20.2.4 Windings which are isolated with no leads brought out via bushings through the tank, i.e., OLTC tap windings, series transformer primary windings, embedded tertiary windings, etc., shall not be exempt from the applied potential (hi-pot) test. (Windings do not have to be tested separately or individually.)

20.3 Temperature Rise

Temperature rise tests must be made on the transformer. These tests shall not be omitted even though records of temperature tests may exist for duplicate or essentially duplicate units. The tests are subject to the acceptance criteria of Part 2 General Requirements, Section 21 Acceptance Tests. The tests shall be in accordance with appropriate ANSI/IEEE standards. All temperature rise tests shall be done at taps with maximum losses with gradient measurement.

For new design unit, all following temperature tests, Section 20.3.1 to 20.3.4 shall be performed:

- 20.3.1 The initial test shall be at 100% of ONAN rating for 55°C temperature rise.
- 20.3.2 100% of maximum MVA rating (top forced-cooling rating) for 55°C temperature rise.
- 20.3.3 At 130% of the top forced-cooling rating for 55°C temperature rise for one hour. Maximum hot-spot temperature for the 130% test shall be less than 120°C at 50°C average ambient. This second test shall demonstrate the 1-hour overload capability following an equivalent pre-load of 90 percent of maximum nameplate rating at 40°C average ambient, in accordance with ANSI C57.91 guidance.
- 20.3.4 When tertiary windings are required, a gradient temperature rise of the tertiary windings shall be performed and documented in the test report.

For duplicated design unit, only section 20.3.2 temperature rise test is required. Winding gradient measurement shall be part of this test.

20.4 Additional Tests

- 20.4.1 Test to determine the impedance, positive sequence resistance, positive sequence reactance and zero sequence reactance between windings for each position of the de-energized tap changer. Include "T" impedance diagrams in the test report.
- 20.4.2 Core ground resistance measurement.
- 20.4.3 Excitation current measurement both before and after the dielectric tests at rated voltage and 110% rated voltage. The exciting current values obtained shall be included on the test report.
- 20.4.4 Audible sound levels shall be tested in accordance with ANSI C57.12.90, and not exceed the levels specified in the Part 1 Specific Requirements, Section 2.3.10. When the sound level specified is less than the value in NEMA TR 1, Table 2 the tested sound level for each cooling stage (1st Stage, 2nd Stage, and both stages operating simultaneously) shall be shown on the test report.
- 20.4.5 Pressure test of tank at a minimum of 8 psi for 12 hours to detect any leaks. All leaks must be repaired to KRCD's satisfaction.
- 20.4.6 Bushing test report including minimum partial discharge and power factor test results. If design test documents are not available, Supplier shall perform the design tests and submit certified test reports. Bushings shall meet partial discharge limits of ANSI C57.19.01.

20.4.7 A CT ratio and polarity test in accordance with ANSI C57.13 shall be performed as part of the final top end control test on each CT designated for KRCD use. CT saturation tests shall also be performed. Data shall be included in the test reports.

20.4.8 Insulation power factor test per ANSI/IEEE method II, C57.12.90, Section 10.10. Winding power factor test values shall be 0.5 percent or less.

20.4.9 Bushing C1 and C2 power factor and capacitance values shall be measured with the bushings installed in their operating positions and values included in the test report.

20.4.10 Swept frequency response analysis (SFRA) test shall be performed on the completely assembled oil filled transformer in accordance with the requirements of IEEE C57.12.149, Guide for the Application and Interpretation of Frequency Response Analysis for Oil-Immersed Transformers. The test shall be done using the Doble SFRA test set and the sweep shall at least cover the frequency range from 20 Hz to 2 MHz. The test shall be performed at the maximum tap position and rated voltage tap position.

20.4.11 As it relates to NERC TPL-007-1 standard, Supplier shall provide:

- Geothermal Induced Currents (GIC) capability curves as a function of loading in percentage
- Provide hottest spot temperature of winding and structural parts in response to a specific GIC curve
- Maximum overloads should be specified

20.5 Certified Test Reports

Immediately after testing, a digital file of the certified test report shall be submitted electronically to KRCD to allow development of system protection settings. Supplier shall furnish KRCD with three (3) properly certified printed copies and one (1) digital pdf copy of all test data and reports in accordance with Part 2 General Requirements, Section 3.7. Each test report shall indicate that all tests have been performed and that the transformer is in accordance with this Specification. The Supplier inspector and the KRCD inspector shall sign each accepted test report.

20.6 Failure to Pass Production Tests

If a transformer does not meet each of the Production Tests specified in the test plan to KRCD's satisfaction, and the Supplier is unable to repair the transformer to meet the Production Tests with a time period that, together with any other extensions of time granted to Supplier pursuant to General Condition, Section 3.2, shall not exceed 120 calendar days, KRCD reserves the right to cancel this and/or reject the transformer without further cost to KRCD. Further, no payment from KRCD will be due with respect to any Work done to date relating to the transformer, and no cancellation charges shall be paid with respect to the transformer. Supplier shall be liable for any additional Supplier costs arising as a result of such cancellation.

21 ACCEPTANCE TESTS

Transformer shall be subject to the following acceptance tests. Acceptance of tests or waiving of tests shall not relieve Supplier from responsibility for furnishing material in accordance with the requirements of this Specification.

21.1 Dissolved Gas

Dissolved gas analysis tests shall be made before and after various production tests and on the insulating oil shipped to the site. Following are the maximum allowed increases of gases in oil during and after each of the listed tests, and the maximum values for oil received on site.

For mineral oil:

Gas (parts per million)	Activity				
	Dielectric Tests	100% OA Temp Rise Test	100% Top Force Cooled Temp Rise Test	130% Top Force Cooled Temp Rise Test	Receipt of oil on site
Methane (CH ₄)	2	2	2	5	2
Ethane (C ₂ H ₆)	2	2	2	5	2
Ethylene (C ₂ H ₄)	1	1	1	5	1
Acetylene	Non detect.	Non detect.	Non detect.	Non detect.	Non detect.
Hydrogen (H ₂)	10	10	10	25	10
Carbon Monoxide (CO)	25	25	25	50	25
Carbon Dioxide (CO ₂)	250	250	250	450	250

For natural ester-based less flammable fluid (e.g. FR3) (alternative):

Gas (parts per million)	Activity				
	Dielectric Tests	100% OA Temp Rise Test	100% Top Force Cooled Temp Rise Test	130% Top Force Cooled Temp Rise Test	Receipt of oil on site
Methane (CH ₄)	20	20	20	20	11
Ethane (C ₂ H ₆)	232	232	232	400	232
Ethylene (C ₂ H ₄)	18	18	18	18	10
Acetylene	Non detect.	Non detect.	Non detect.	Non detect.	Non detect.
Hydrogen (H ₂)	112	112	112	112	50
Carbon Monoxide (CO)	161	161	161	161	80
Carbon Dioxide (CO ₂)	3000	3000	3000	3000	250

Any values measured beyond these maximum values shall be reviewed with KRCD's RE prior to moving transformer from the test department. Any value other than zero for acetylene will not be accepted.

21.2 Dew Point Testing – For Units Shipped Without Oil

The Supplier prior to shipment shall perform dew point testing at the factory. Transformers shipped with dry air will require a dew point measurement of the internal gas at the jobsite by KRCD. This test will be made and equated to the % moisture content of the insulation. The value shall be ≤ 0.5% as performed using the KRCD approved dew point device, which is the Lectrodryer.

Transformers having a dew point of >0.5% at point of delivery, with the above test device, will not be accepted by KRCD and will need to be dried by the Supplier to ≤ 0.5% at the expense of the Supplier.

21.2.1 Supplier shall demonstrate to the KRCD inspector during the core and coil inspection that the coil drying process was performed in accordance with the Supplier's standard procedure and that the assembly was not exposed to ambient conditions for longer than 24 hours after drying.

21.2.2 Supplier shall verify and document that the dry air used to fill the tank is not wet and that the dew point of the dry air is less than -58°F.

21.2.3 After the tank is filled with dry air and prior to shipping, dew point measurements shall be taken

at the following times: 1) 24 hours after, 2) 36 hours after, and 3) 48 hours after. The third dew point measurement shall be witnessed by the KRCD inspector as part of the final inspection. All three readings shall be $\leq 0.5\%$. The last reading shall not be $> 20\%$ from the second reading.

21.3 Certified Test Reports

Supplier shall furnish KRCD with three (3) properly certified printed copies and one (1) digital pdf copy of all acceptance test data and reports relating to acceptance tests performed by Supplier. Each test report shall indicate that all tests have been performed and that the transformer is in accordance with this Specification. Both Supplier inspector and KRCD inspector shall sign each accepted test report.

22 **INSPECTION**

22.1 Inspections To Be Made

KRCD's inspectors will make inspections and witness tests in accordance with KRCD's General Conditions, including but not limited to:

22.1.1 Visual inspection of core and coil assembly before installing pressboard winding barriers on the outside of the coil assemblies and before tanking.

22.1.2 Witnessing of Production Tests performed by the Supplier and the acceptance tests performed in accordance with this Specification. Prior to the performance of these tests, Supplier shall furnish verification to KRCD's inspector of all electrical test instrumentation calibration and certification to ± 1.0 percent accuracy. The equipment's accuracy shall be verified by a calibration system traceable to the National Institute of Standards and Technology (NIST).

22.1.3 Insulating oil is subject to KRCD inspection at the on-loading terminal to ensure the cleanliness of the transport vessel, and to ensure the oil is in compliance with Part 2 General Requirements Section 24. The quality of the oil must not be degraded by handling or transport and is subject to compliance testing at the site prior to filling the transformer.

22.1.4 Final visual inspection prior to shipping.

22.2 Access

KRCD's access to any of the Supplier's facilities, where services are rendered for equipment covered by this Specification, shall be provided in accordance with General Conditions.

22.3 Sub-Supplier Purchase Orders

Upon request at the design review meeting Supplier shall furnish KRCD's inspector two (2) un-priced copies of purchase orders to all sub-suppliers.

22.4 Notification of Tests

Supplier shall notify KRCD Supervising Quality Engineer, as soon as possible, but no later than one week in advance for factories in North America and two weeks in advance for other locations prior to the performance of tests requiring inspection and test witnessing under this Section and Sections 20 and 21 above.

23 **SHIPMENT**

(Refer also to Part 1 Specific Requirements, Section 1.4)

23.1 Release

No transformer shall be shipped until released by the KRCD inspector.

23.2 Blanketing

Supplier shall ship the transformer sealed in dry air (no carbon dioxide will be permitted) with pressure-vacuum gauge connected and operating.

23.3 Shipping Dimensions

The overall shipping dimensions shall be specified by what can be legally shipped from the factory to the site. Accessories and external components shall be removed and boxed to the extent possible prior to shipping to avoid damage or vandalism.

23.4 Bracing and Impact Recorder

The transformer shall be designed and properly prepared for shipment to sustain no damage during transit under repeated impact of Zone 4 (Uniform Building Code, 1997) in both horizontal and vertical direction, with adequate design margin to account for normal rail and/or truck acceleration and/or deceleration. Bolts and nuts shall be secured such that shipping vibration will not cause them to loosen or fall off. Internal structures shall be properly braced and secured, and leads and accessories, such as current transformers, terminal boards, bus work, etc. shall be tied down and secured. No cloth tape shall be allowed.

The transformer shall be equipped with two 3-D electronic impact recorders. Each recorder shall record both horizontal and vertical impacts and have a time duration exceeding the maximum estimated transit time. Supplier shall ensure that the recorders operate properly for the complete duration of transport. If neither recorder operates properly, the supplier shall be responsible for performing, with KRCD participation, a tank internal inspection at the Supplier's expense. The impact recorders shall have security passwords required to remove data or turn the unit off. A photo shall be taken of the unit turned on at the factory and certified by the QC staff that the unit is functioning before it leaves the factory. Failure to comply with run time requirements or security requirements will result in the manufacturer providing a two-year extension on the warranty at no additional charge to KRCD. The supplier shall provide written verification of the dew point, core Megger, and that the impact recorders were turned on prior to shipment.

It is expected that the manufacturer will determine the maximum magnitude of forces on American railroads and design the transformer and shipping conditions in line with these forces. The impact recordings shall be opened in the presence of a utility representative.

23.5 Inspection Upon Receipt

Upon delivery of the transformer to the job site, KRCD will perform an inspection to determine compliance with shipping requirements and to determine the condition of the transformer itself. The impact recorder data shall be reviewed in a timely manner (within 3 days). The impact recorder data is to be reviewed by both KRCD and Supplier. If KRCD determines, either by inspection or review of the impact recorder data that the transformer has sustained damage, SFRA test shall be performed by the supplier and compared with factory results. KRCD reserves the right to reject the goods as non-conforming if there is any visual damage or if SFRA results show any discrepancy as per Doble diagnostics/analysis of comparison oscillograms.

24 INSULATING OIL

24.1 Insulating Oil Specification:

The transformer shall be furnished complete, at the Supplier's expense, with inhibited insulating oil delivered to the shipping address noted in the Specific Requirement. The transformer shall not contain oil during shipment. The Supplier shall provide mineral oil. Oil shall be in accordance with the ASTM D3487. Oil shall be tested in accordance with ASTM standards, including ASTM 1275 Method B for corrosive sulfur which requires testing at 150 degrees C for 48 hours. The certified test report shall be provided at the time of oil delivery. The quality of the oil shall not be degraded by handling or transport. The oil is subject to KRCD inspection, including but not limited to dissolved gas analysis, to ensure cleanliness and compliance with the Requirement.

If selected as an option (see Part 1, Section 2.10.2), the Supplier shall provide natural ester-based fluid

(e.g. FR3) in lieu of the mineral oil. The oil is subject to KRCD inspection, including but not limited to dissolved gas analysis, to ensure cleanliness and compliance with the Requirement. The certified test report shall be provided at the time of oil delivery.

24.2 Oil Delivery

The oil supplied by Supplier shall be delivered to KRCD jobsite where the transformer is being installed. Supplier shall be responsible for transferring the insulating oil from the transport vessel to the transformer tank.

24.2.1 Certification shall be furnished that states the oil meets the EPA requirements or the State requirements (whichever is more stringent), for non-PCB oil when delivered. The oil truck driver (or rider) shall have in his possession and furnish this certification to KRCD upon arrival at the delivery site. Oil shipped in drums is not acceptable.

<<<< End of General Requirements >>>>

Part 3 Seismic Requirements

- 1 General:** All transformers supplied pursuant to this Specification shall be seismically qualified according to the requirements of IEEE-693 (2018) "Recommended Practices for Seismic Design of Substations", except as noted below. Transformers shall meet the requirements of the **High** seismic qualification level. Transformer tanks shall be designed to provide structural integrity as well as house the transformer internals. The transformer anchorage will be designed by Section A.4.2 of IEEE 693 and ASCE Substation Structure Design Guide.
- 2 Qualification/Analysis:** The seismic qualification/analysis shall be performed and certified by an experienced engineer. It is preferable that the engineer be a registered civil or structural engineer. If the engineer is not registered, Supplier shall submit evidence, suitable to KRCD, of the engineer's qualification to perform such analysis.
- 3. Qualification Calculations:** Qualification calculations demonstrating conformance with the requirements of this specification shall be submitted with Bidder's proposal. Qualification calculations shall include verification of the load path from the core, coils, major appendages (such as radiators/coolers and conservator tanks) and base to the anchorage. Sketches shall be provided with the analysis that clearly shows the load path. Section properties, calculated stresses, and allowable for structural parts and members that are part of the load path shall be provided. Anchorage locations shall be clearly identified and reaction loads at those support locations shall be given.
- 4 Qualification Requirements for Bushings:** Bushings shall be seismically qualified according to the requirements of IEEE 693 (2018), Annex D "Transformers and liquid-filled reactors".
- 5 Allowable Stresses:** The 1/3 increase in allowable stresses for seismic loads shall not be used for members and components in the core, coil, base, anchorage load path, and for flange attachment bolts.
- 6 Frequency or Damping Modifying Devices:** Frequency or damping modifying devices such as "Belleville" type washers shall not be used in the construction and testing of transformer. For any other system which changes the frequency or the damping characteristics of the equipment or the equipment support assembly, evidence/proof shall be provided in the qualification report that the damping and the frequency characteristics of the devices/attachments will not change, the devices or attachments will not require maintenance, the devices or attachments do not require pre-load or other installation requirements, and that the system will not adversely affect the operation or maintenance of the equipment over the life of the equipment. The life of the equipment shall be assumed to be 35 years.
- 7 Exceptions:** Exceptions to the stated design and testing requirements may be permitted with prior approval of KRCD.
- 8 Qualification Report:** Supplier shall provide a certified qualification report, which summarizes the results of their seismic analysis. The qualification report shall be submitted in the same manner as other certified test reports as specified in the Part 2 General Requirements, Section 3.7.

<<<< End of Seismic Requirements >>>>

Specification: 22541001-ES206-001

Bidder: _____

Location: PINE FLAT POWER PLANT MAIN GSU

1 BASE QUOTATION

Item	Spec. Ref.	Deliverable	Unit Price	Total Price
			\$	\$
1.1a	SR 1, SR 2	Three (3) 230/132.79 - 13.8 kV, 71 MVA (ONAN/ONAF), single-phase GSU Transformer with conservator type oil preservation system, including all bushings, insulating oil, accessories and 5-year warranty, FOB to jobsite delivery		
1.1b	SR 1, SR 2	Option to provide one (1) spare transformer identical to item 1.1a.		
1.1c	SR 1, SR 2	Option to provide one (1) 3-phase transformer with the identical functions to item 1.1a.	Not required	
1.1d	SR 1.1	Option to test and certify one (1) existing SPARE transformer	Not required	
1.1e	SR 1.1	Adder for temporary storage at leased Warehouse (per month)		
1.1f	SR 1.1	Option to remove and scrap three (3) existing transformers		
1.1g	SR 1.1	Option to remove and scrap one (1) existing SPARE transformer	Not required	
1.1h	SR 2.10	Alternate Pricing for less-flammable fluid (e.g. FR3) filled transformer		
1.1i	SR 1, SR 2	Option to expedite delivery of items 1.1a and 1.1b		
1.2	GR 14	Spare Bushings		
		Furnish one additional H1 terminal bushing		
		Furnish one additional H2 terminal bushing		
		Furnish one additional X terminal bushing		
1.3	GR 15	Additional Current Transformers		
		Install an additional MR CT to any bushing		
1.4	GR 18	Spare Surge Arrester		
		Furnish one additional H terminal surge arrester		
1.7		Field service engineering		
1.7.1	SR 1, GC 27	Field Service Engineering allowance INCLUDED in Item 1.1:		
		Round trip travel expense		
		Per diem lodging and meals		
		Weekday service charge (per day)		
		Number of days		Days
1.7.2	SR 1, GC 27	Additional or extended Field Service Engineering (per person):		
		Round trip travel expense		
		Per diem lodging and meals		
		Weekday service charge (per day)		
		Weekend service charge (per day)		
		Holiday service charge (per day)		
		Overtime service charge (per day)		

1.8	SR 1.1	Optional installation, assembly, and test of new GSU transformers		
1.8.1	SR 1.1	Installation, assembly, and test (collectively Dress and Test) for the equipment furnished in accordance with this specification		
1.9		Freight Allowance included in Item 1.1a		
1.10		Duties and Insurance (Manuf. outside of USA)		
		Customs' duties (included in Item 1.1a)		
		Insurance (point of export to destination) (included in Item 1.1)		
1.11	GC 14	Estimated cancellation charges for engineering and other expenses incurred in period from award to:		
		Submittal of drawings for acceptance		
		Completion of engineering		
		Release for manufacture		
		During manufacture		
1.12	SR 3.1	Recommended Spare Parts (List Below)		

GC = General Conditions GR = General Requirements SR = Specific Requirements

2 WARRANTY

2.1	Increase in price of Item 1.1 for extension to 7 year warranty.		
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3 PROPOSAL EXPIRATION

3.1	Validity period for this Proposal, in calendar days (min 120)		Days
3.2	Date of Expiration for this Proposal:		

4 TERMS OF PAYMENT

		Yes	No
4.1	Terms are in accordance with the General Conditions?		
4.2	Other terms are offered for consideration (attached)?		
4.3	Prices quoted are firm for the delivery offered? (no escalation)		

5 SHIPMENT

5.1	Shipping Point:	
5.2	Method(s) of Shipment:	

6 EXCEPTIONS

- 6.1 Quotation is for the exact conditions set forth in this Specification and attachments thereto. It is understood that, if the proposed equipment differs in any way, the exceptions shall be itemized in the Proposal under a separate heading titled "EXCEPTIONS TO THE REQUIREMENTS OF THE SPECIFICATION". If exceptions are not itemized and listed under this heading, it shall be understood that the Bidder will comply with all the specific and general requirements set forth in this Specification.
- 6.2 If exceptions are taken to the General Conditions of this Specification, it is understood that such exceptions shall be itemized in the Proposal under a separate heading titled "EXCEPTIONS TO THE GENERAL CONDITIONS OF THE SPECIFICATION". If exceptions are not itemized and listed under

this heading, it shall be understood that the Bidder will comply with all the specific and general requirements set forth in this Specification.

6.3

	Yes	No
Are any exceptions taken to the requirements?		
Are there any exceptions to the General Conditions?		

7 CONFIRMATION

The undersigned certifies that this Specification and the attachments herein have been examined, that the contents herein are understood, and that all dollar amounts have been checked. The undersigned understands that KRCD will not be responsible for any errors or omissions on the Bidder's part in preparing this proposal.

The undersigned further agrees that, if awarded a Contract, the Work will be performed diligently and in accordance with the contract documents and that the Work will be fully completed within the time limits stated in each specific Purchase Order.

BIDDER:	PROPOSAL NUMBER:
AGENT:	DATED:
TITLE:	
SIGNED:	PLANT LOCATION:
ADDRESS:	

Specification: **22541001-ES206-001**

Bidder: _____

Location: **PINE FLAT POWER PLANT MAIN GSU**

The requested technical data must be completed in full. Information furnished hereunder is in addition to the complete descriptive information furnished in the Proposal.

1 PHYSICAL DETAILS

		Drawing Numbers
1.1	Dimensioned Outline Drawings:	
1.2	Cross-Section Details Drawings:	
		Dimensions (Inches)
1.3	Shipping (Height x Length x Width)	
1.4	Assembled (Height x Length x Width)	
		Weight (Pounds)
1.5	Shipping Weight of Largest Piece	
1.6	Total Shipping Weight	
1.7	Volume & Weigh of Oil	
1.8	Final Assembled Total Weight	
		Yes/No
1.9	Verify seismic ratings are met per specification	

2 DESIGN/CONSTRUCTION DETAILS

2.1	Submittals (Are they included with proposal?)	Yes	No
	Description of how seismic requirements will be met		
	Short-Circuit capability design calculations		
	Short-Circuit verification by type test		
	Winding Schematic (showing location of tap-changer(s), calculated impedances for all windings and taps, and BIL):		
2.2	Core Configuration:		
2.3	Maximum core induction by design at 110% rated voltage:	Gauss	
2.4	Winding Data:		
		High Voltage	Medium Voltage
	Type Winding		
	Conductor Type		
	Turns		
	Impedance, %		
2.5	Losses (Refer to Section 2 of the General Requirements): Base: 230/ $\sqrt{3}$ k V : 13.8 kV ratio		
	No-Load	Load (ONAN or ONAF rating)	First Stage Cooling Auxiliaries
	kW	kW	kW
2.6	Forced Cooling Equipment Voltage / Current:	V	A
2.7	Calculated temperature rises:		

		High Voltage	Medium Voltage	
	Winding (Average)			
	Hot Spot			
				Temperature (°C)
2.8	Calculated average oil temperature rise:			
2.9	Audible Noise		ONAN:	ONAF MVA:

3 ACCESSORY DETAILS

Device		Manufacturer	Part/Model Number
3.1	230 kV (H) Bushings		
3.2	13.8 kV (X) Bushings		
3.3	H ₀ Bushing		
3.4	High Voltage Surge Arresters		
3.5	DETC		

Specification: 22541001-ES206-001 **Bidder:** _____
Location: PINE FLAT POWER PLANT MAIN GSU

Milestone Schedule

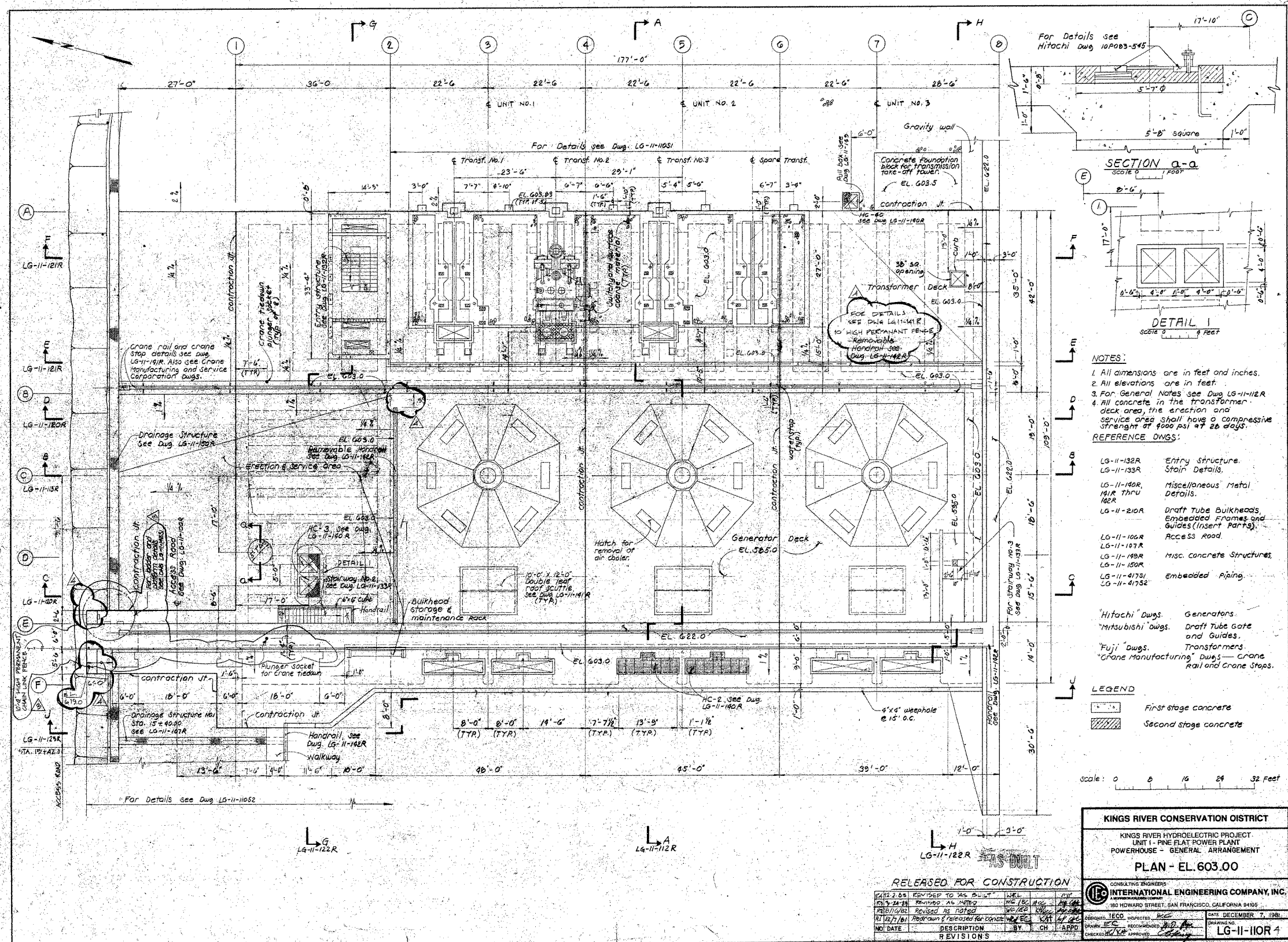
<u>Item</u>	<u>Reference</u>	<u>Milestone Event</u>	<u>Event Completion (Weeks after Receipt of PO)</u>
1		Receive purchase order	
2	GR 1.5	Design review meeting at KRCD (max 4 weeks after PO)	
3	GR 3.1	Submit design drawings and documents for acceptance (max 6 weeks after Design Review Meeting)	
4	GR 3.4	Submit Certified for Construction drawings and docs (allow adequate time prior for KRCD review and possible revisions)	
5	GC 20.0	Furnish shop production schedule	
6		Order major materials	
7	GR 20	Submit production test plan (min 6 weeks prior to testing)	
8	GR 22.1	KRCD core inspection	
9		Complete fabrication, ready for initial tests	
10	GR 3.7	Submit certified test reports	
11	GR 3.10	Furnish transformer shipping data (min 13 weeks prior to shipping)	
12	GR 21	Factory acceptance tests completed	
13	GC 16	Furnish materials list to site	
14	GR 3.6	Furnish instruction books, maintenance manuals, parts bulletins, etc. (min 30 calendar days prior to shipping)	
15	GR 22.1	Final inspection prior to shipping	
16	GR 23	Shipment	
17		Arrival at KRCD destination	
18		Assemble Transformer	
19		Fill Transformer with insulating fluid	
20		Set transformers on foundation	
21		Acceptance Tests	

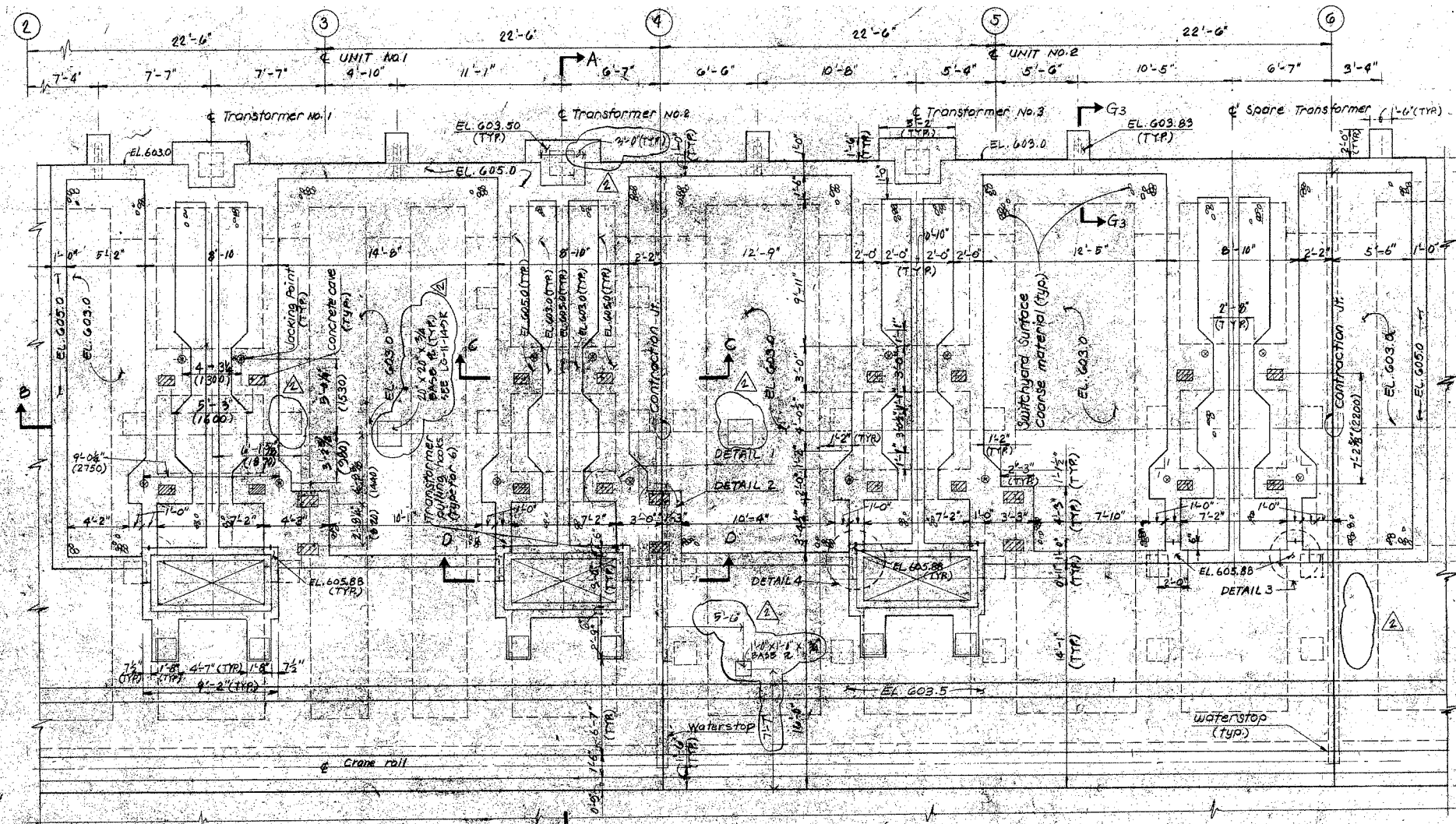
GC = General Conditions GR = General Requirements

Bidder warrants that this schedule is reasonable and practicable based on its facilities, resources, and past experience in designing and manufacturing like transformers, and that if awarded a purchase order, fully intends to adhere to this schedule except as may be tangibly impacted by delay or request of change by KRCD, or otherwise negotiated with KRCD.

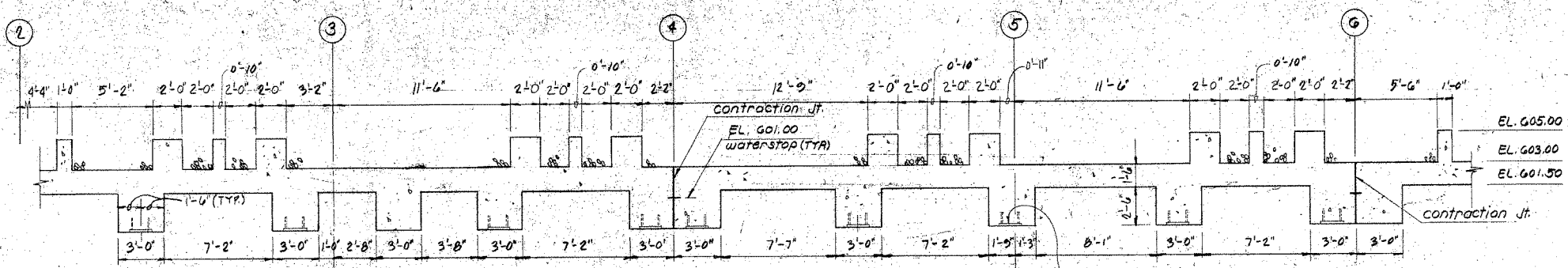
ATTACHMENT D

KRCD Pine Flat Reference Drawings

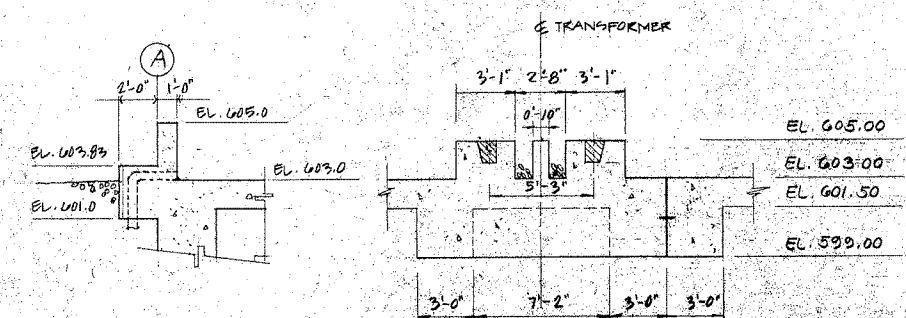




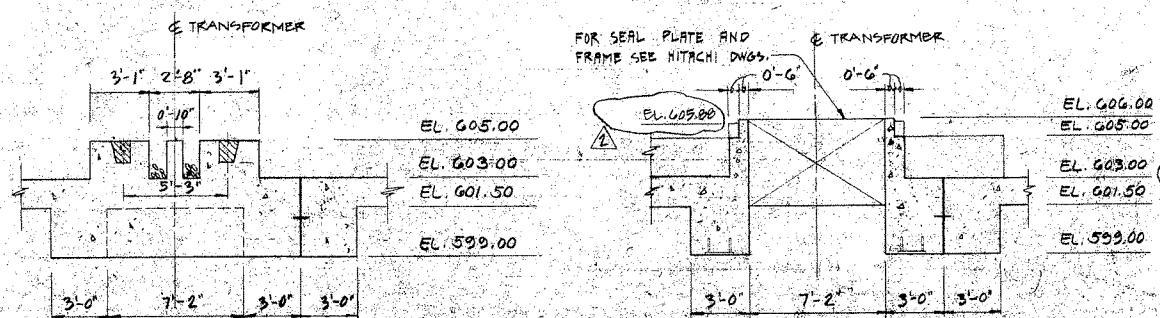
PLAN - EL. 603.00



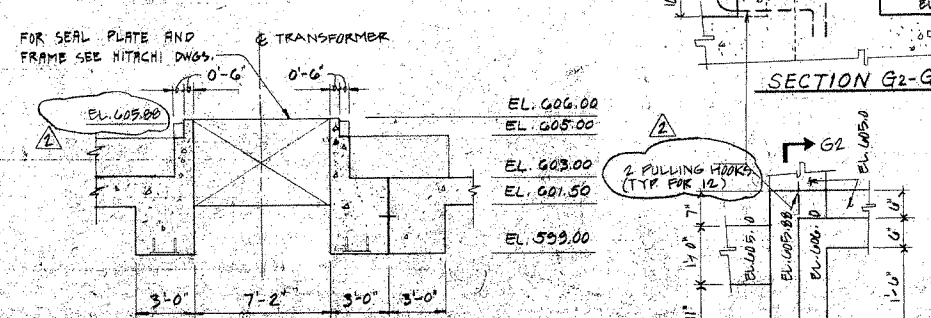
SECTION B-B



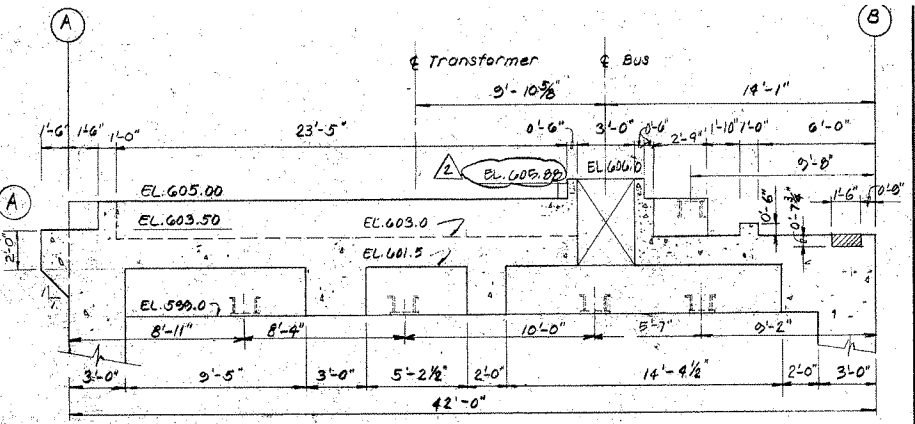
SECTION G3-G3



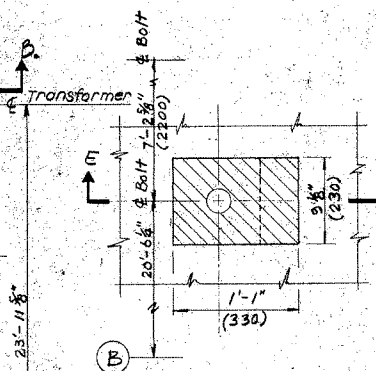
SECTION C-C



SECTION D-D

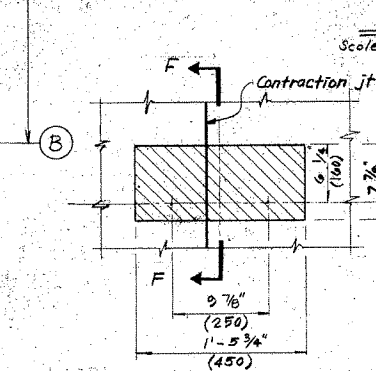


SECTION A-A



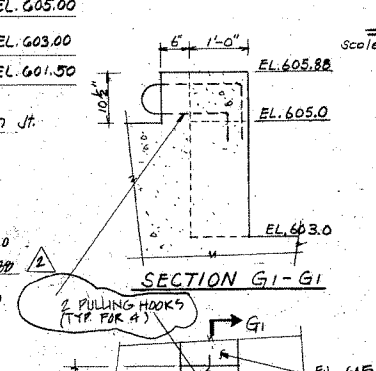
PLAN

SECTION E-E

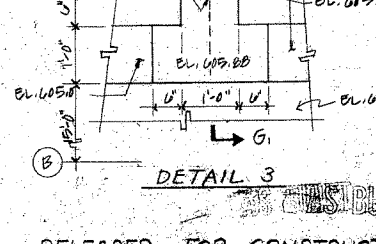


PLAN

SECTION F-F



SECTION G1-G1



SECTION G2-G2

RELEASED FOR CONSTRUCTION

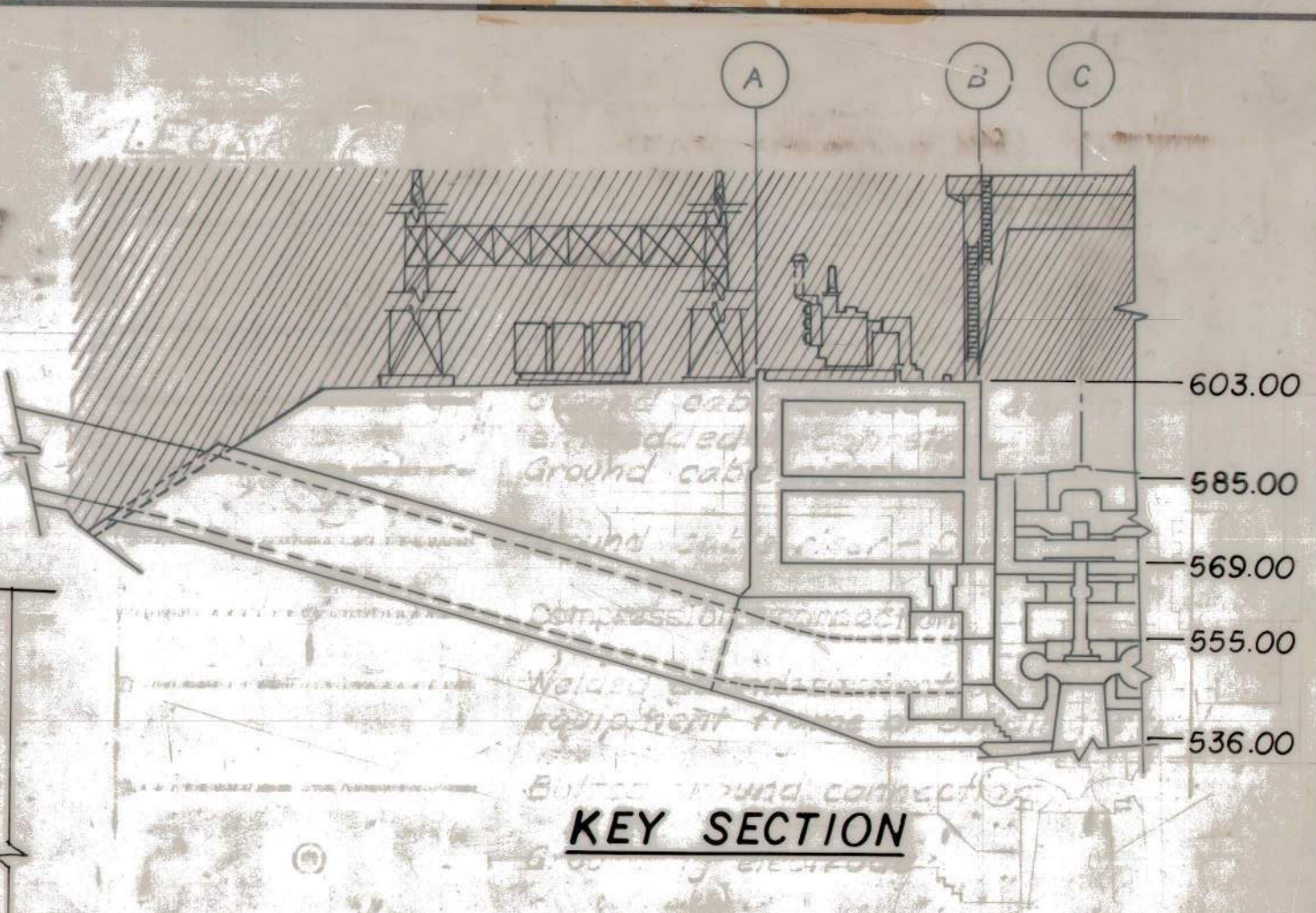
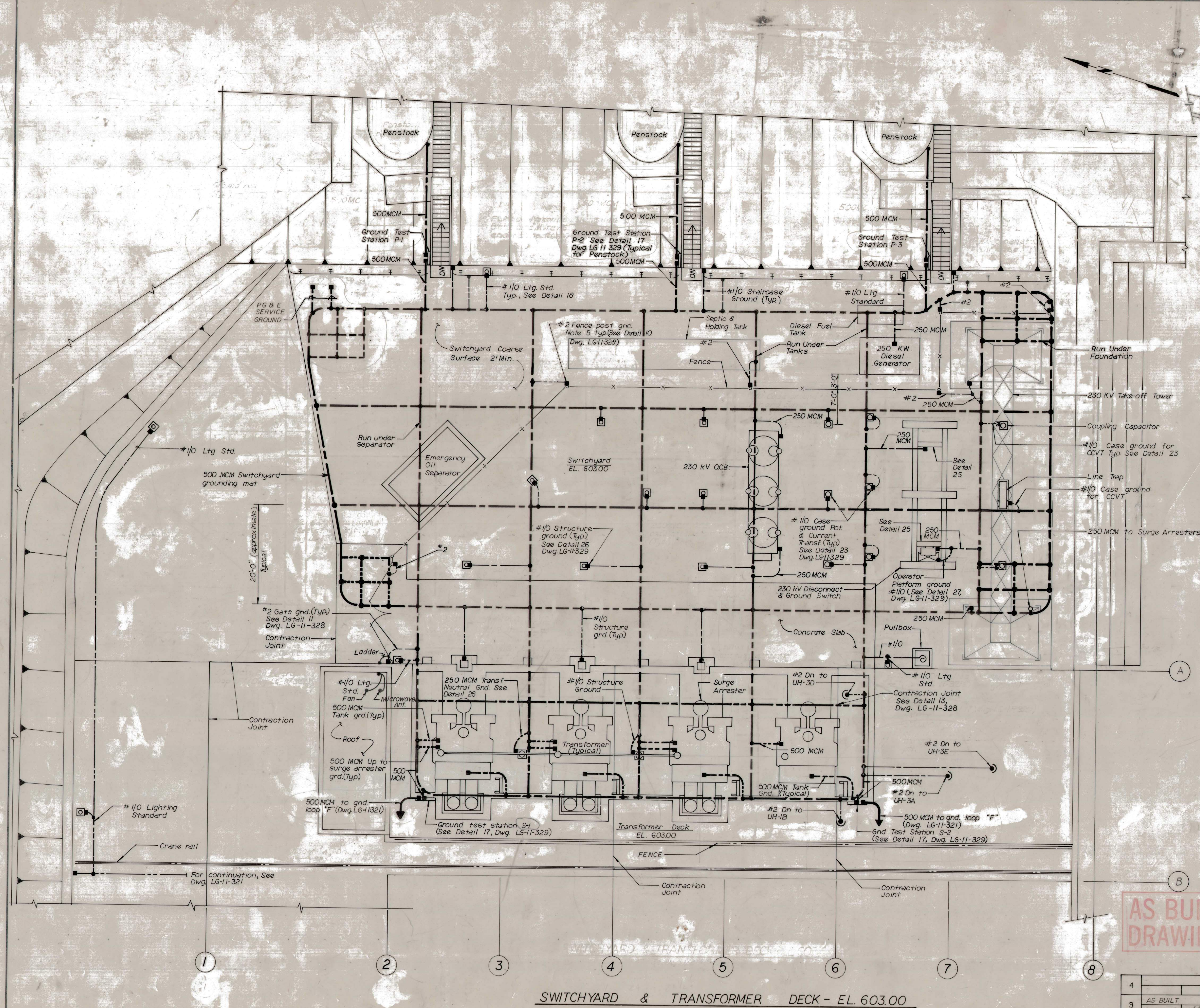
NOTES:
1. All dimensions are shown in feet and inches. Some dimensions are shown in millimeters within parenthesis.
2. All elevations are in feet.

REFERENCE DWGS:
LG - 11 - 110R Plan - EL. 603.00
"Fuji" Dwgs. Transformer Dwgs.
"Hitachi" Dwgs. Busduct Dwgs.

Scale 0 4 8 12 16 Feet
Except as noted

KINGS RIVER CONSERVATION DISTRICT			
KINGS RIVER HYDROELECTRIC PROJECT UNIT 1 - PINE FLAT POWER PLANT POWERHOUSE			
PLAN EL. 603.00 (SH. 1) CONCRETE DETAILS			
CONSULTING ENGINEERS INTERNATIONAL ENGINEERING COMPANY, INC. 180 HOWARD STREET, SAN FRANCISCO, CALIFORNIA 94105			
DESIGNED BY EC	INSPECTED BY NCC	DATE DECEMBER 7, 1981	DRAWING NO. LG-11-110SR2
CHECKED BY VH	APPROVED BY CCH	REVISIONS	

REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS
NO.	DATE	DESCRIPTION	BY	CH	APPD
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					



LEGEND:

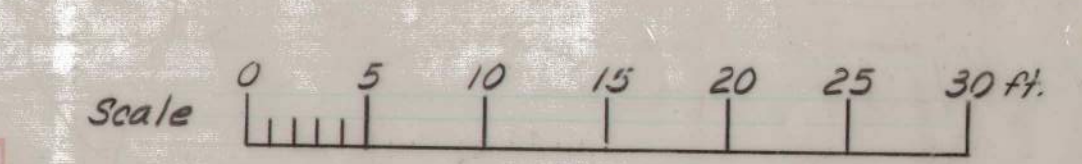
- Ground cable embedded in concrete.
- Ground cable buried in earth.
- Ground cable riser—Up.
- Ground cable riser—Down.
- Compression connection.
- Thermo-welded ground connection to equipment frame or building steel.
- Bolted ground connection.
- Grounding electrode.

GENERAL NOTES:

1. Ground runs are shown diagrammatically in their approximate locations. Exact locations to be determined in the field.
2. Ground wires for connections to equipment not embedded in concrete shall extend 5'-0" above floor, unless otherwise noted.
3. All embedded grounding cable connections to be compression type.
4. All horizontal runs buried in earth to be at least 36" below finished grade.
5. The fence shall be connected to the ground grid at intervals of not more than 50 feet, using #2. Ground connections shall be made at all corners and gate posts.

REFERENCE DRAWINGS:

- Grounding Layouts—Erection and Service Area EL. 603.00 LG-11-321
- Grounding Layout—Details (Sheet 1) LG-11-328
- Grounding Layout—Details (Sheet 2) LG-11-329



**AS BUILT
DRAWING**

SWITCHYARD & TRANSFORMER DECK - EL. 603.00

RELEASED FOR CONSTRUCTION

4		AS BUILT	
3		AS SHOWN	
2		6-8-82	
1		Released for Construction	
4-5-82		DRAWN BY: [Signature] RECOMMENDED BY: [Signature]	
NO.		DATE	
CHECKED		APPROVED	
REVISIONS			

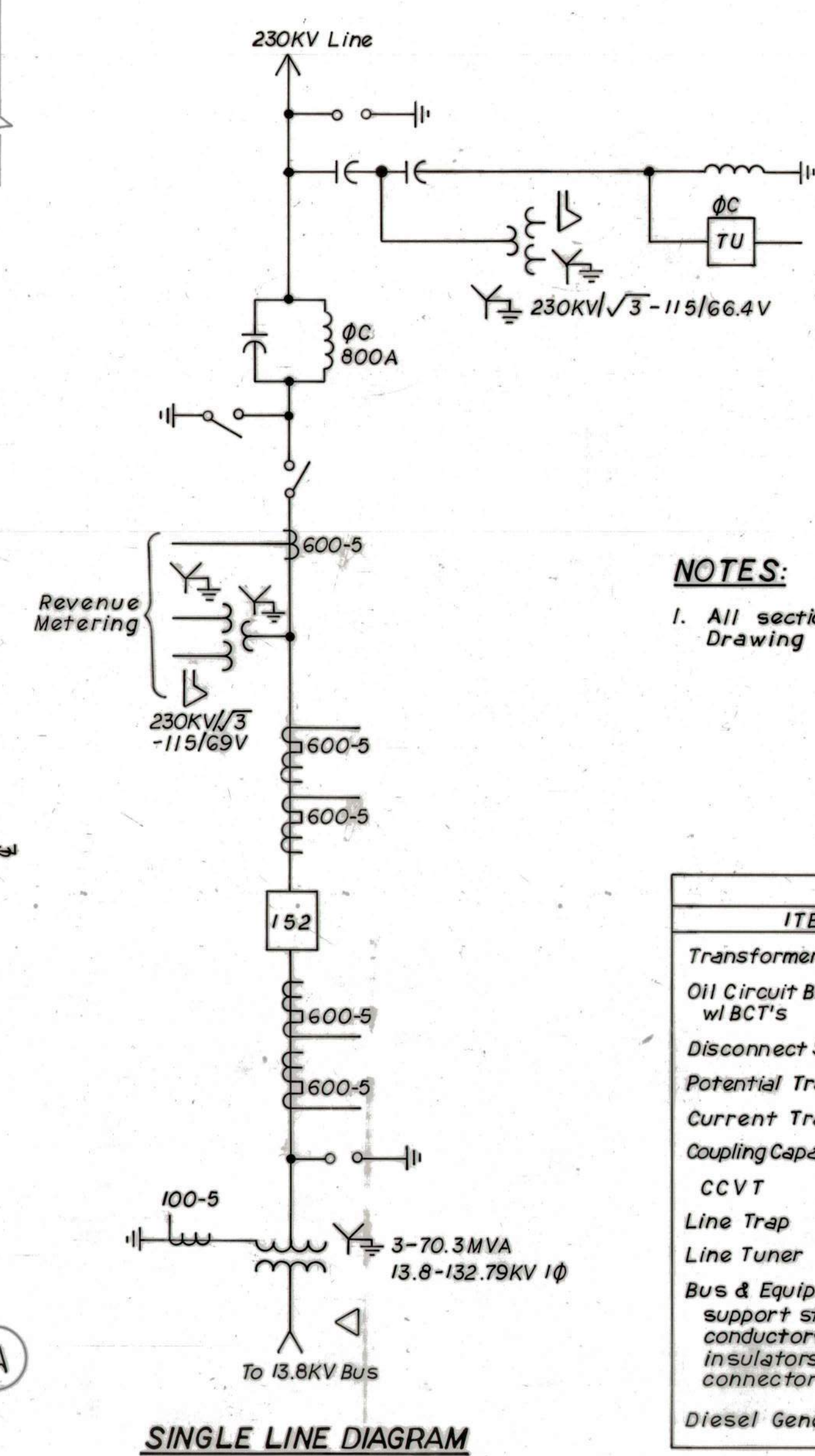
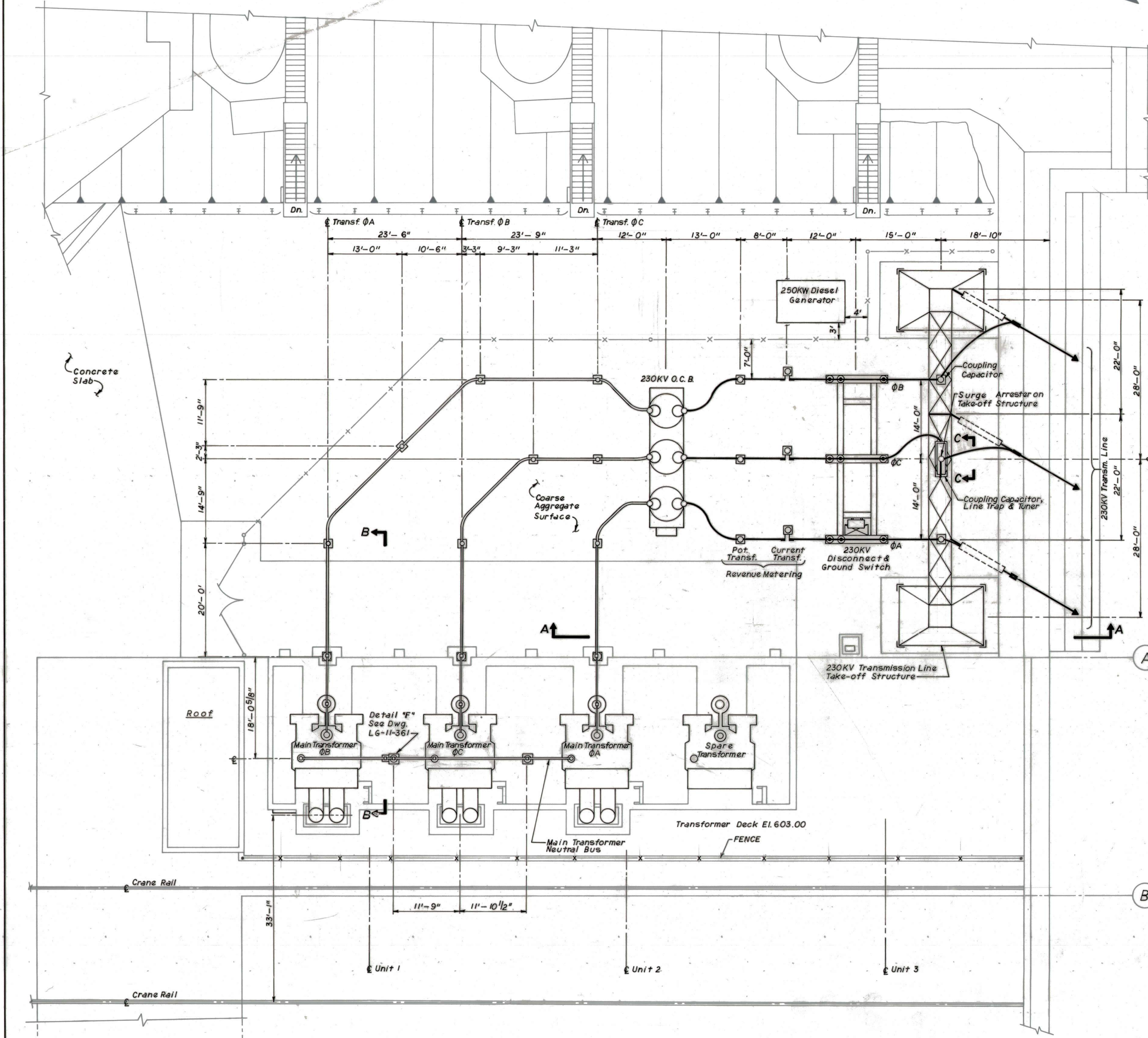
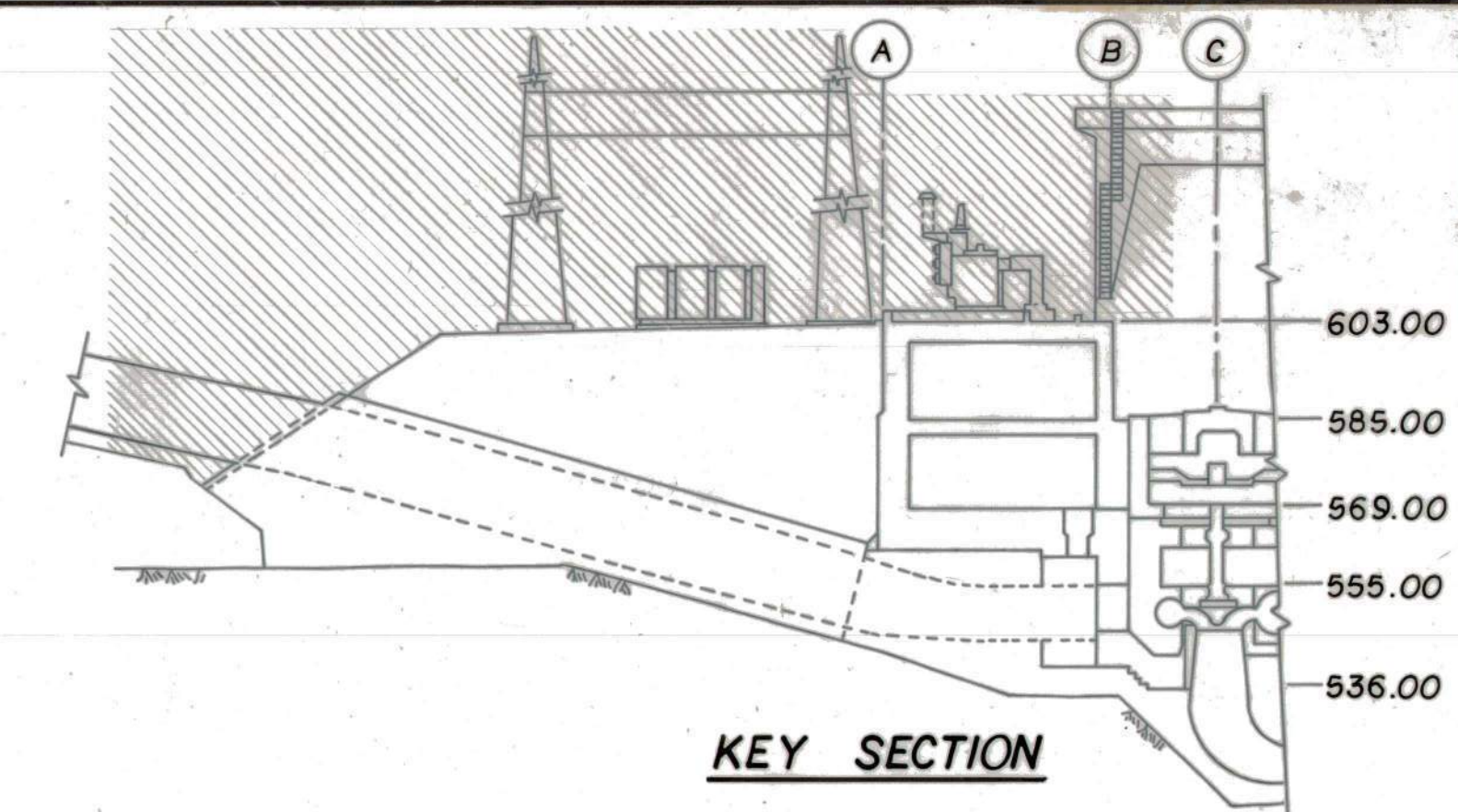
KINGS RIVER CONSERVATION DISTRICT

KINGS RIVER HYDROELECTRIC PROJECT
UNIT I - PINE FLAT POWER PLANT

**GROUNDING LAYOUT
SWITCHYARD & TRANSFORMER DECK**

CONSULTING ENGINEERS
INTERNATIONAL ENGINEERING COMPANY, INC.
180 HOWARD STREET, SAN FRANCISCO, CALIFORNIA 94105

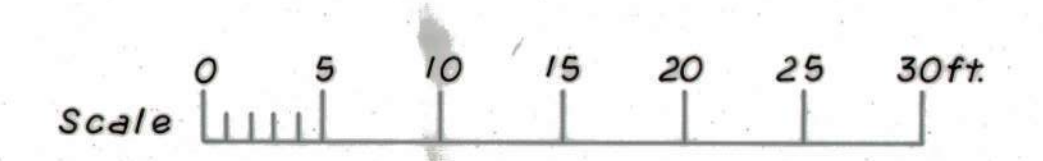
DESIGNED: [Signature] INSPECTED: [Signature] DATE: June 4, 1980
DRAWN: [Signature] CHECKED: [Signature] APPROVED: [Signature]
DRAFTING NO. **LG -11-320R3**



NOTES:
1. All sections are shown on Drawing LG-11-361.

MAJOR EQUIPMENT			
ITEM	QUANTITY	MANUFACTURER'S	DRAWING NO.
Transformer	4	FUJ1	TR 238363
Oil Circuit Breaker w/ BCT's	3	Westinghouse	7338D 96
Disconnect Switch	1	USCO Power Equip.	C-2302 Sht. 32
Potential Transf.	3	Westinghouse	Type MSV-900
Current Transf.	3	Westinghouse	227 C 455
Coupling Capacitor	3	Westinghouse	5485 C 52
CCVT	3	Westinghouse	5485 C 52
Line Trap	1	Westinghouse	8030A 19
Line Tuner	1	Westinghouse	50B-7683
Bus & Equip. support stands, conductors, insulators, connectors, etc.	—	Westinghouse	SP 80444
Diesel Generator	1	ILI	3CM3W7004

REFERENCE DRAWINGS:
230KV Switchyard Sections & Details LG-11-361
Transmission Take-Off Tower LG-11-143



**AS BUILT
DRAWING**

3	7-4-84	222	00	Pick
2	4-22-83			
1	5-12-82	98	11	Pick
0	6-4-80	112	11	Pick

KINGS RIVER CONSERVATION DISTRICT

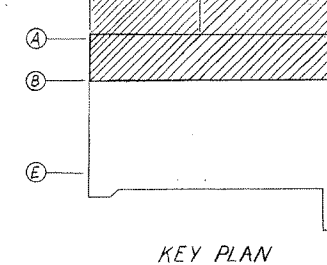
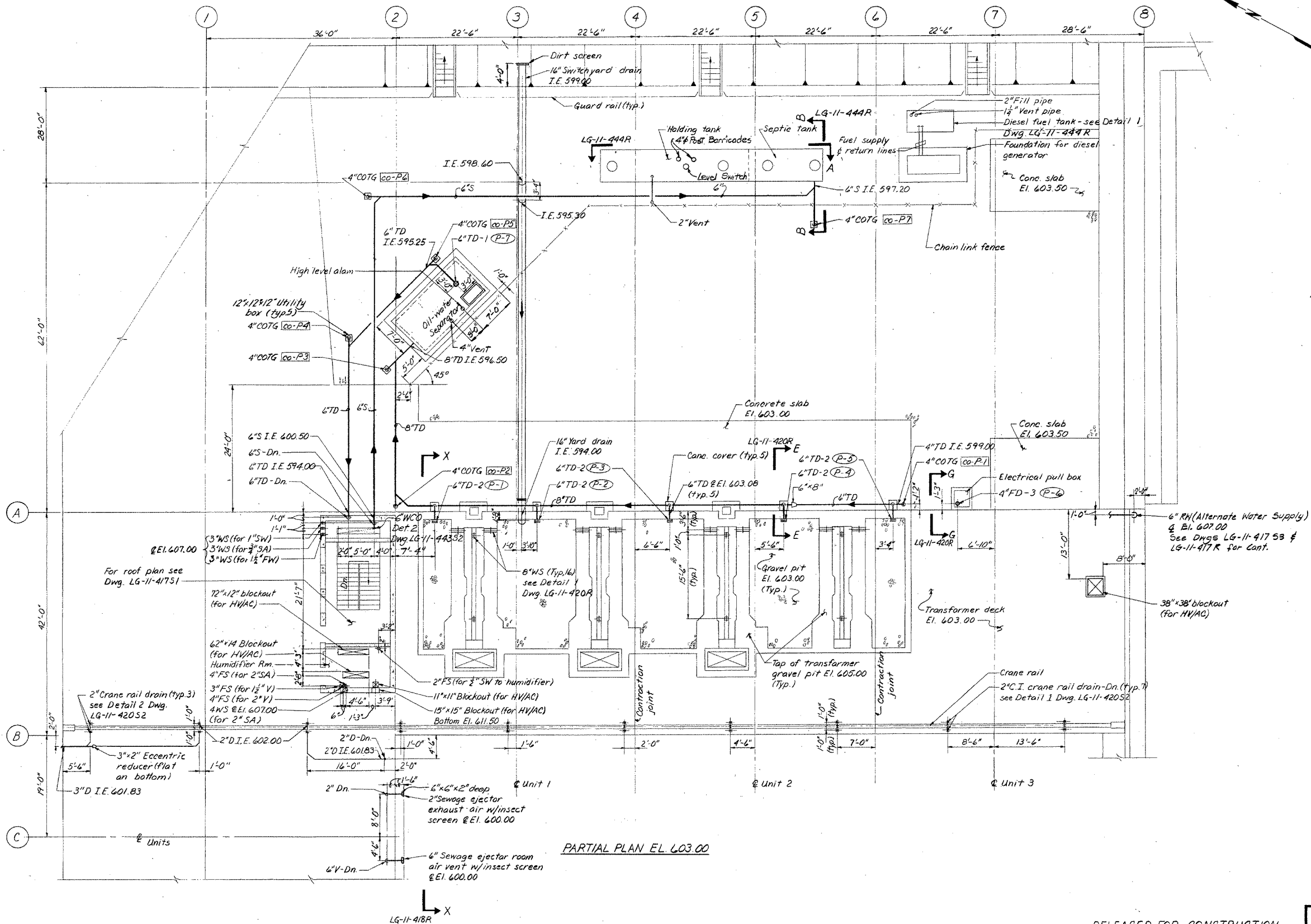
KINGS RIVER HYDROELECTRIC PROJECT
UNIT I - PINE FLAT POWER PLANT

230KV SWITCHYARD LAYOUT PLAN

CONSULTING ENGINEERS
INTERNATIONAL ENGINEERING COMPANY, INC.
180 HOWARD STREET, SAN FRANCISCO, CALIFORNIA 94105

DESIGNED: **MHK** INSPECTED: **CFA** AOP
DRAWN: **CR** RECOMMENDED: **CFA**
CHECKED: **MHK** APPROVED: **C B K**

DATE: **June 4, 1980**
DRAWING NO.: **LG-11-360R3**



NOTES:
1. For symbols, abbreviations and general notes see Dwg. LG-11-400 R.

PARTIAL PLAN EL. 603.00

AS BUILT

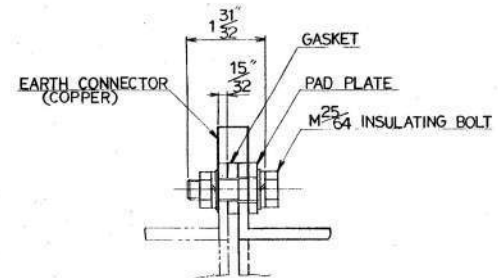
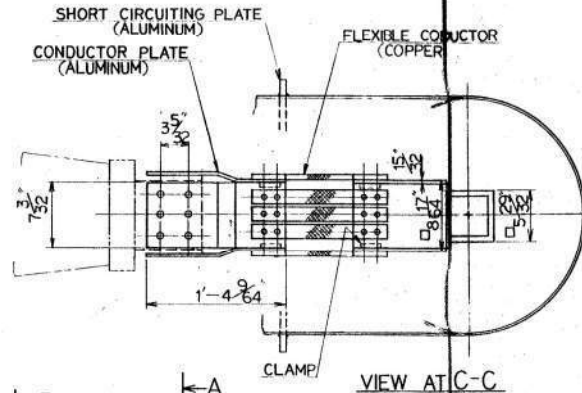
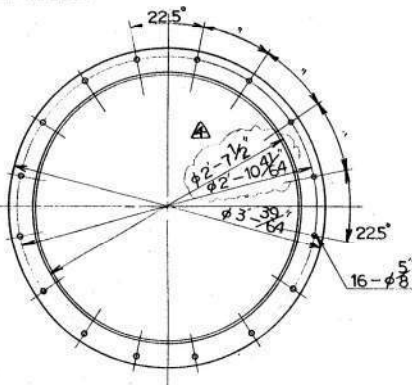
Scale 0 8 16 feet

RELEASED FOR CONSTRUCTION

NO	DATE	DESCRIPTION	BY	CH	APPD
1	1-8-82	Revised as noted	DW	CH	APPD
2	2-9-82	Relocate FS for humid. piping	DW	CH	APPD
3	4-12-82	Add Sect. A-B & Det. ref.	DW	CH	APPD
4	6-22-82	Separator chg. rev. as noted	HJ	CH	APPD
5	6-15-84	As built per FJE records	HJ	CH	APPD

KINGS RIVER CONSERVATION DISTRICT	
KINGS RIVER HYDROELECTRIC PROJECT UNIT 1 - PINE FLAT POWER PLANT POWERHOUSE - MECHANICAL	
EMBEDDED PIPING PLAN EL. 603.0 SHT. 1	
DESIGNED <i>DW</i>	INSPECTED <i>J. Chen</i>
DRAWN <i>DW</i>	RECOMMENDED <i>Frank</i>
CHECKED <i>CH</i>	APPROVED <i>Chen</i>
DATE November 30, 1981	DRAWING NO. LG-11-417S1-R5

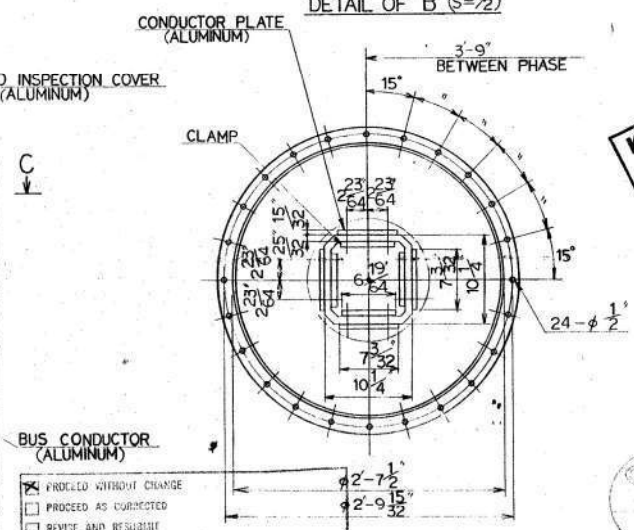
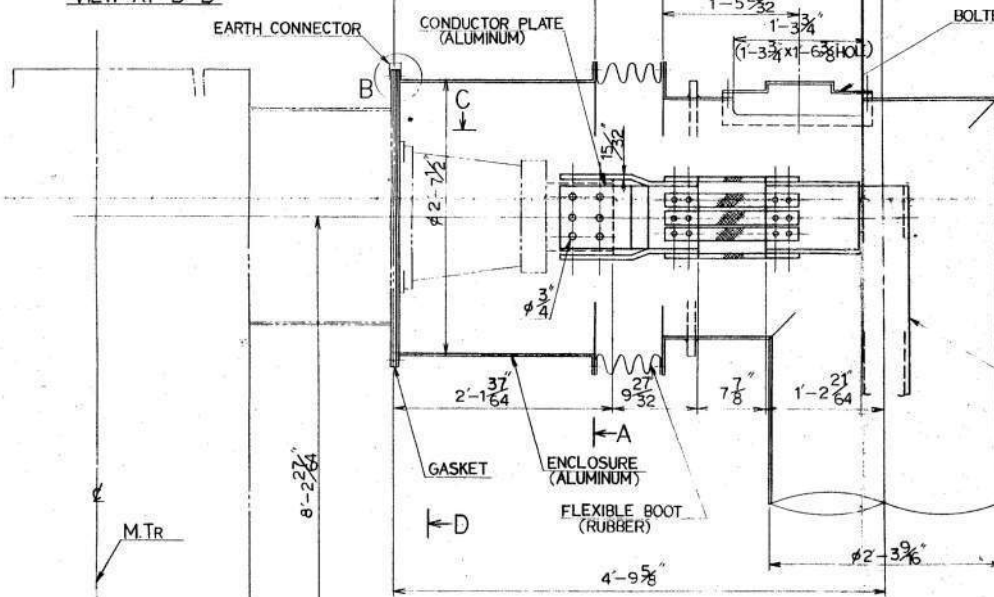
311-2W24075



VIEW AT D-D

VIEW AT C-C

DETAIL OF B (S=1/2)



- ☒ PROCEED WITHOUT CHANGE
- ☐ PROCEED AS DIRECTED
- ☐ REVISE AND RESUBMIT
- ☐ R/REJECT

Checked by: *[Signature]* Date: 9/1/02
 Approved by: *[Signature]* Date: 7/1/02
 Supervisor: *[Signature]* Date: 7/1/02

NOTE
 1) SILVER PLATED CONTACT SURFACES

NO.	REVISIONS	DATE	REVISED	CHECKED
1	REVISED DIMENSION & ADDED NOTE	12 AUG 01	S. Sato	K. Sasaki
2	CHANGED DRAWING	15 JUN 02	S. Sato	K. Sasaki
3	CHANGED DRAWING & DIMENSION AT MEETING	15 MAR 02	S. Sato	K. Sasaki
4	CHANGED DIMENSION	27 DEC 01	S. Sato	K. Sasaki

KINGS RIVER CONSERVATION DISTRICT			
KINGS RIVER HYDROELECTRIC PROJECT			
UNIT 1 - PINE FLAT POWER PLANT			
DWG. <i>K. Sasaki</i>	21 Jul '01	THIRD	TITLE
CHKD. <i>K. Sasaki</i>	27 Jul '01	ANG. PROJ.	DETAIL OF
APPD. <i>P. Kama</i>	27 July '01	SCALE	IPB ~ M.Tr CONNECTION
Hitachi, Ltd.			KOKUBU WORKS DWG. NO.
Tokyo, Japan			311-2W24075

KRCD
 PINE FLAT
 FIELD COPY

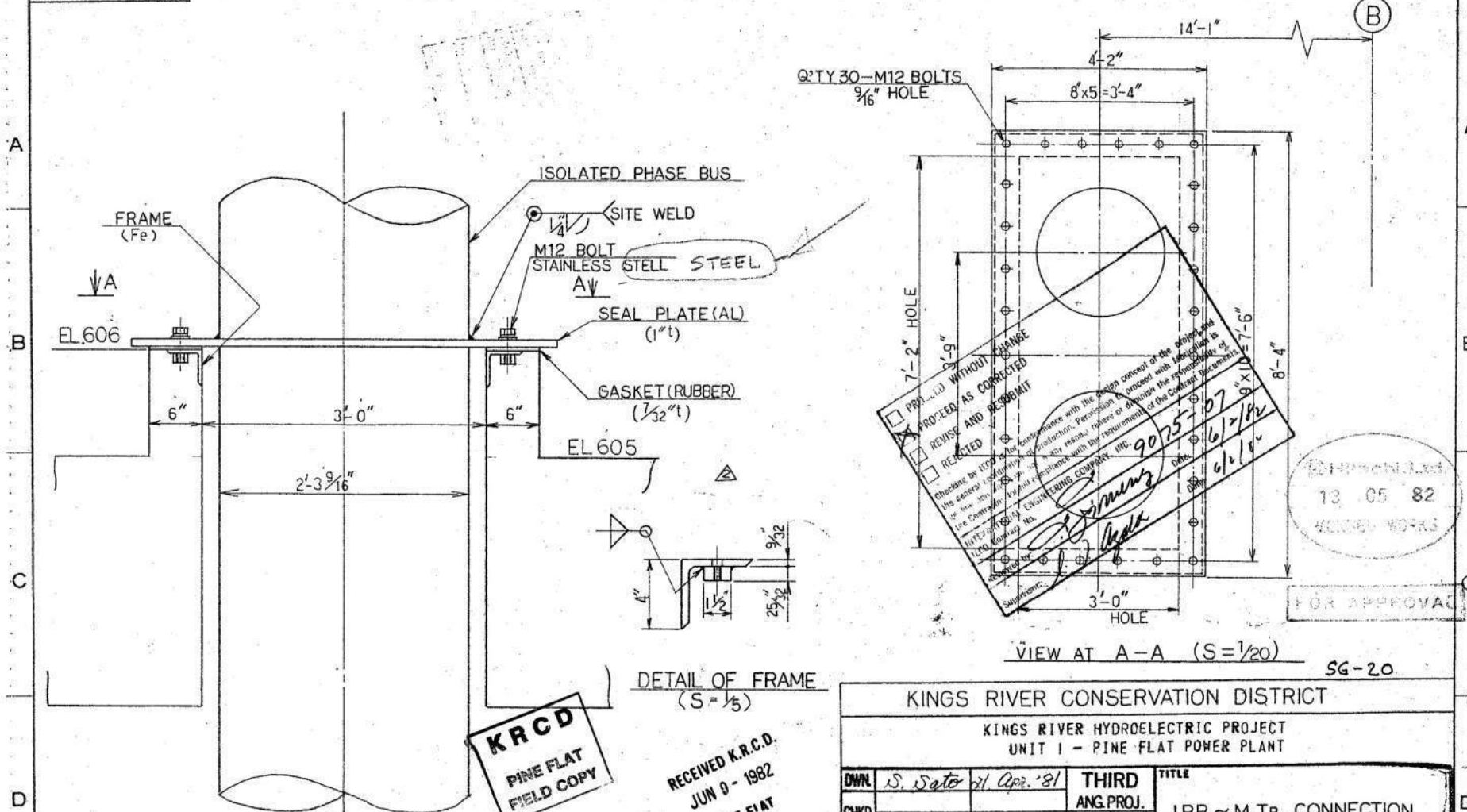
RECEIVED K.R.C.D.
 SEP 10 1992
 PINE FLAT

82 07 10

54-16

EL. 605

311-3W23446



KINGS RIVER CONSERVATION DISTRICT

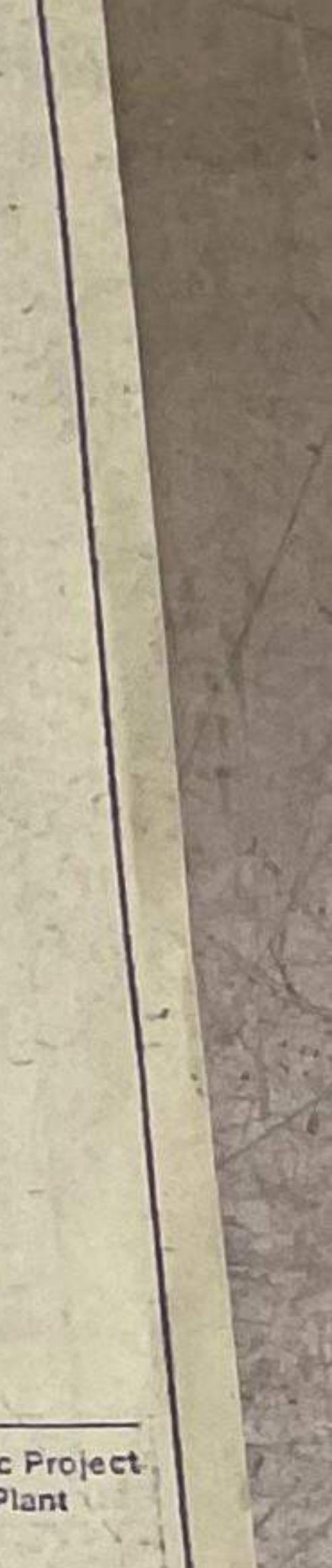
KINGS RIVER HYDROELECTRIC PROJECT
UNIT 1 - PINE FLAT POWER PLANT

OWN	S. Sato	21 Apr. '81	THIRD	TITLE
CHKD	K. Sasaki	21 Apr. '81	ANG. PROJ.	IPB ~ M.Tr. CONNECTION
APPD	A. Kimura	27 Jul. '81	SCALE	FLOOR ENTRANCE PART
			10	
Hitachi, Ltd.				KOKUBU WORKS DWG. NO.
Tokyo Japan				311-3W23446
				REVD
				1/8

NO	REVISIONS	DATE	REVISED	CHECKED
1	ADDED DRAWING AT MEETING	25 Mar. 82	N. Sato	K. Sasaki
2	ADDED WARD & DRAWING	27 Dec. '81	N. Sato	K. Sasaki

ATTACHMENT E

FUJI Electric Drawings



3222112

7R238363

ATTACHMENT F

Main Power Transformers, Bushing Details

REQUIRED INFORMATION AND DATAMAIN POWER TRANSFORMERS

(Attached Sheet)

8. Bushing Data:

	HV	Neutral	LV
a. Manufacturer	LAPP (USA)	LAPP (USA)	NGK (Japan)
b. Catalog Number (Drawing No.)	B67688-70 B67670-70 (TR 5F0272) (TR 5F1788)	B82014-70 (TR 5F7215) (TR 5F1740)	FA-71415-A (TR 5F8249) (TR 5F1784)
c. BIL	900 kV 1600' [©]	110 kV	110 kV
d. Rating	1,200 A	1,200 A	6,000 A
e. Creep distance	170 in.	17 in.	26 in.
f. Terminals	2-12 1 1/2-12 threads 2 in. min. use [©] 2 1/2 usable threads Silver plated	1 1/2-12 1 1/8-12 threads 2 1/8 min. usable threads Silver plated	mm 4 x (200x160) Flat terminal Silver plated

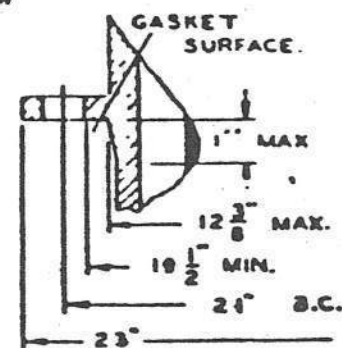
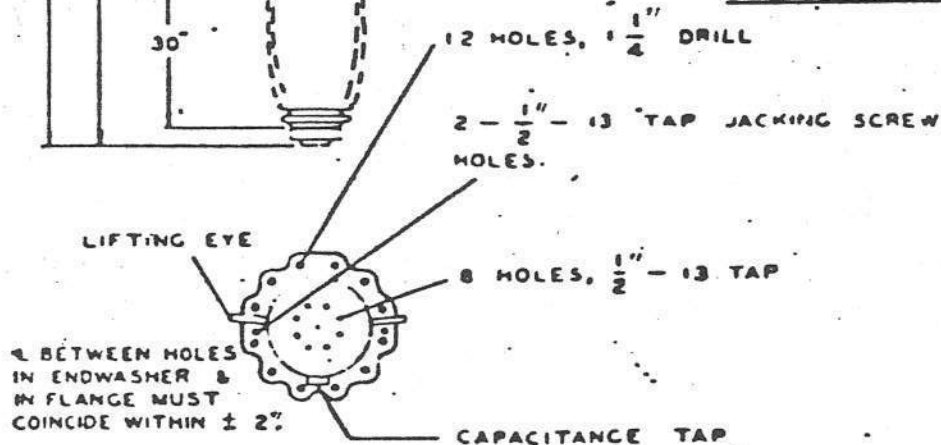
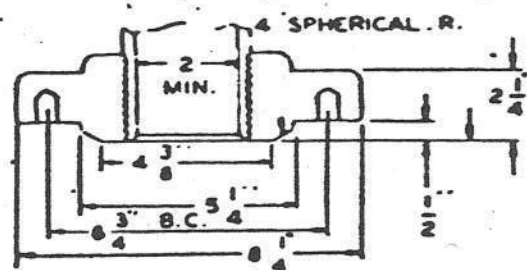
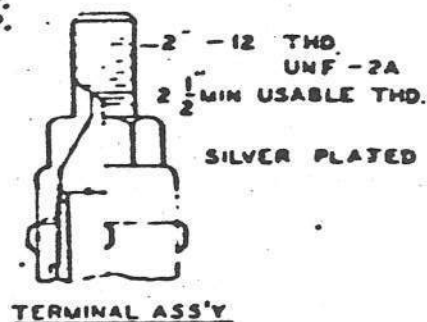
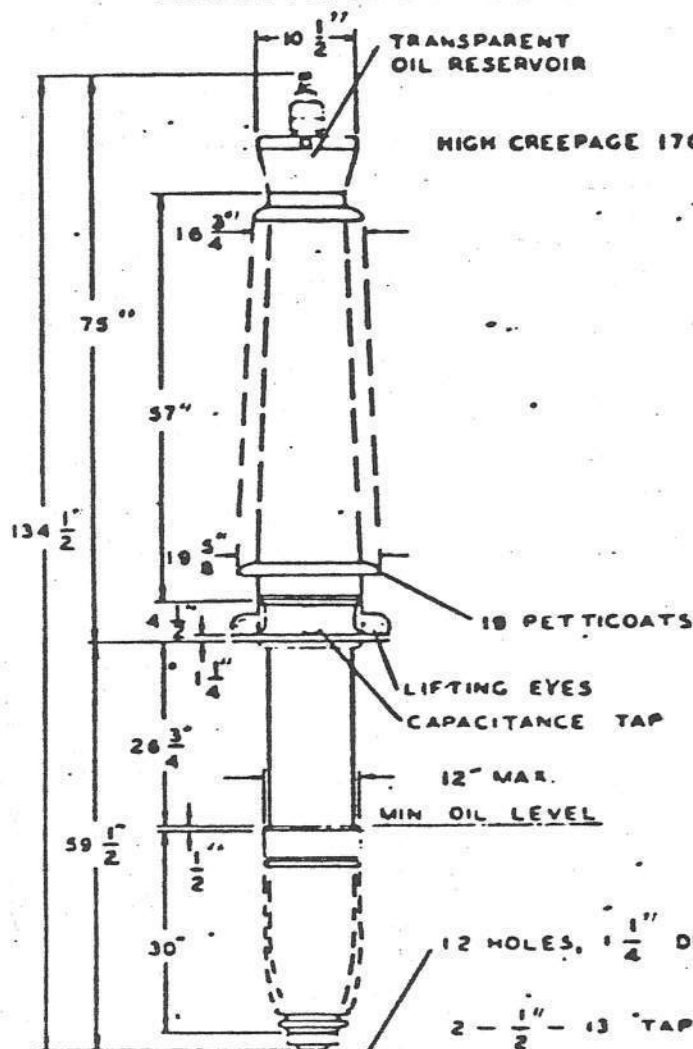
9. Protection Devices:

	a. Manufacturer	b. Drawing Catalog Number
(1) Buchholtz Relay	Fukuda Instruments LTD. (Japan)	Trin E 16102 INT-TR716020-E
(2) Dial Type Oil Level Indicator	Ditto	Trin E 15101 TR5F7946
(3) Dial Type Oil Temp- erature Indicator	Ditto	Trin E 14113 TR5F7947
(4) Winding Temperature Indicator	Ditto	Trin E 14111
(5) Oil Flow Indicator	Ditto	Trin E 17101 TR5F7948
(6) Pressure Relief Device	Qualitrol Corporat- ion (Canada)	Trin E 12103 TR5F7949

HV BUSHING OUTLINE. (196 KV, 1600 A)

LAPP INSULATOR CO., INC.	TITLE 196 KV POC-A BUSHING, ANSI STANDARD		
LEADY, N.Y. 4 - 1 - 71	DWG. NO.	CAT. NO.	GLAZE
REV 11 - 27 - 72	SDB67688	B67688	CHOCOLATE
	SDB67688-70	B67688-70	LIGHT GRAY NO.70

1600 AMP-FOR TRANS. APP. 95°C MAX. OIL TEMP.
2000AMP-FOR CIR. BR. APP. 80°C MAX. OIL TEMP.



ALIGNMENT OF FLANGE, & BOTTOM TERMINAL.

NET WEIGHT 1000 LBS. APP.

Kings River Hydroelectric Project
Unit 1 - Pine Flat Power Plant

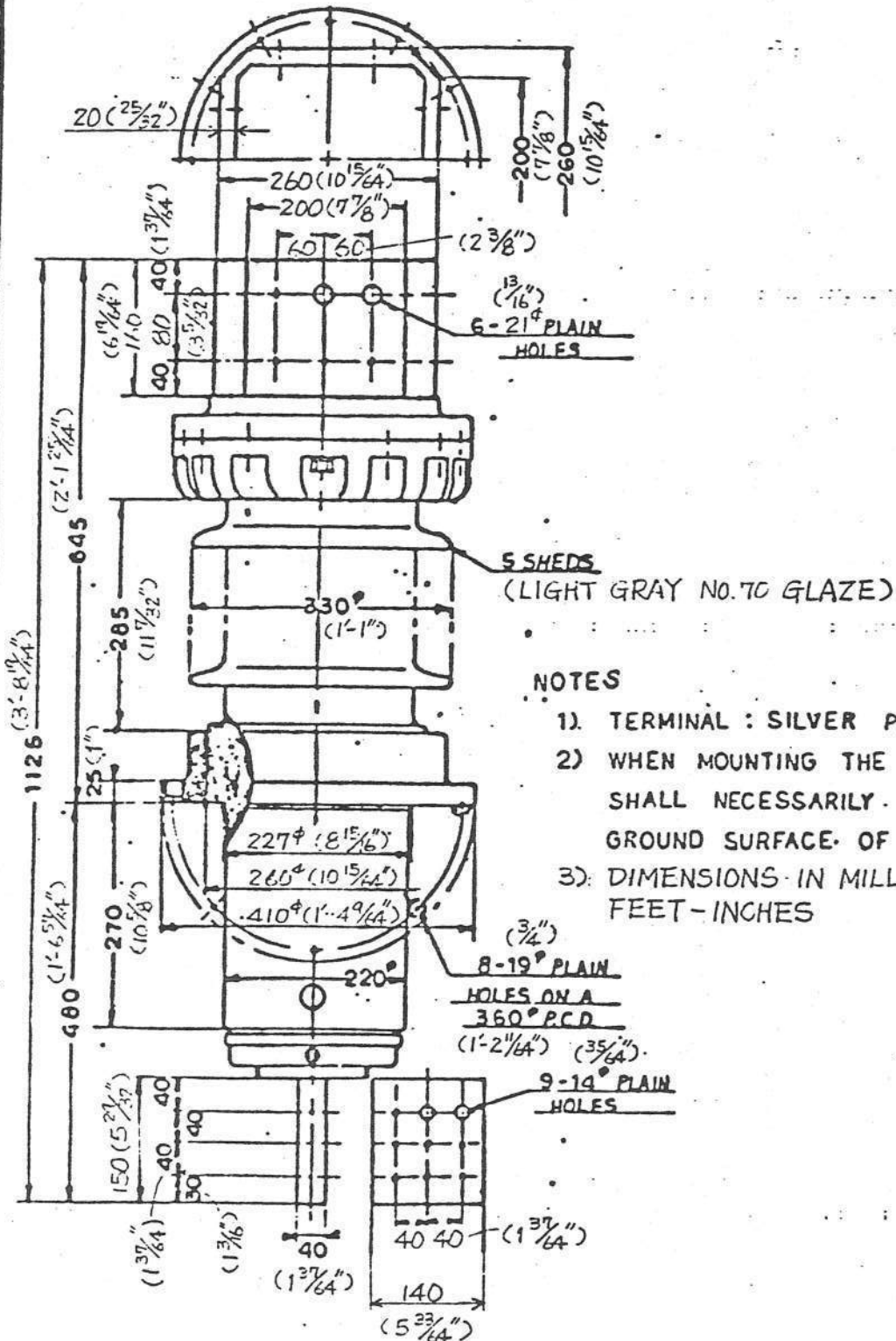
Main Power Transformers

Contract Documents No. 9075-06

1788

(15 kV 6000 A)

TR. EF 1789



MIN. CREEPAGE DISTANCE 660 (26")

EIL 110 kV

**Kings River Hydroelectric Project
Unit 1 - Pine Flat Power Plant**

Man Power Transistors

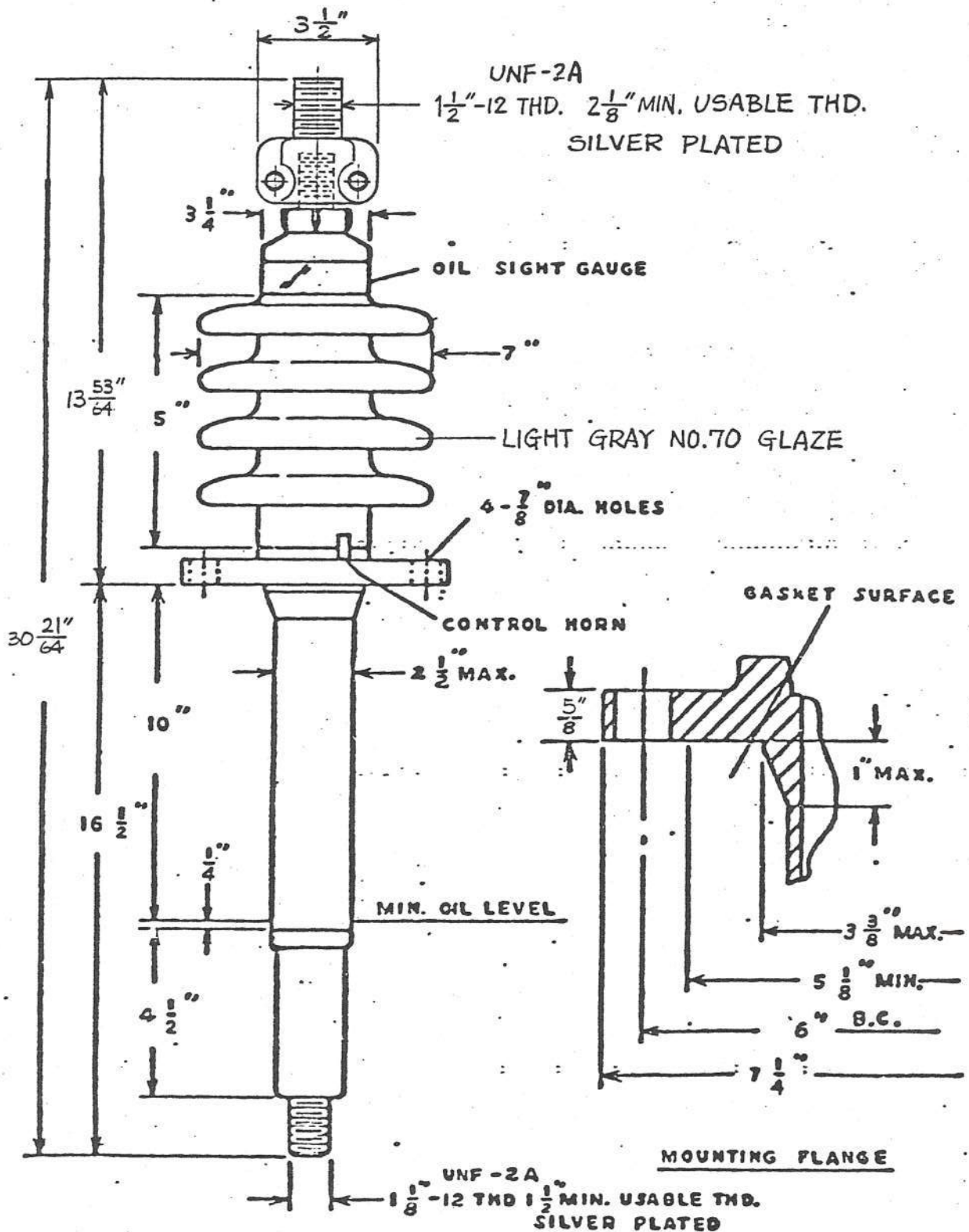
Contract Documents No. 9075-C6

DATE	NAME
------	------

BUSHING OUTLINE

(15kV 1200A)

TR5F1790



MIN. CREEPAGE DISTANCE 17"
 BIL 110 kV

1790

Kings River Hydroelectric Project
 Unit 1 - Pine Flat Power Plant

Main Power Transformers

Contract Documents No. 5075-C6

DATE	NAME
------	------

ATTACHMENT G

Existing Main Transformer Nameplate Photos

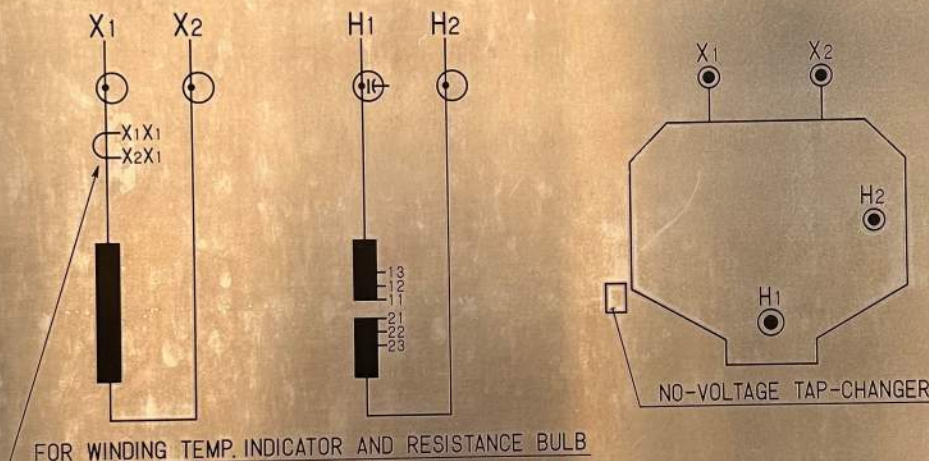
FUJI ELECTRIC

TRANSFORMER

STANDARD	ANSI C57.12.00-1980	
CLASS	FOA	
NUMBER OF PHASE	1	
FREQUENCY	60 Hz	
RATED KVA	70270 kVA	
RATED VOLTAGES	HV	230/ $\sqrt{3}$ kV
	LV	13.8 kV
IMPEDANCE VOLTAGE (AT 70270 kVA)	12.25 %	

AMBIENT TEMP.	46 °C
WINDING TEMP. RISE	65 °C
OIL TEMP. RISE	65 °C

INSULATION LEVELS		
HV	BIL	900 kV
LV	BIL	110 kV
HV NEUTRAL	BIL	110 kV



TERMINAL	TAP NO.	VOLTAGES(kV)	CURRENTS(A)	CONNECTION
H1	1	F 241.50/ $\sqrt{3}$	504	11 - 21
	2	F 235.75/ $\sqrt{3}$	516	12 - 21
	3	R 230.00/ $\sqrt{3}$	529	12 - 22
	4	F 224.25/ $\sqrt{3}$	543	13 - 22
	5	F 218.50/ $\sqrt{3}$	557	13 - 23
X1	—	13.8	5092	—

WARNING / NO-VOLTAGE TAP-CHANGER MUST
BE OPERATED ONLY AT NO-
VOLTAGE

WEIGHTS	OIL	22820 lbs
	TANK & FITTINGS	28440 lbs
	UNTANKING	79370 lbs
	TOTAL	130630 lbs

OIL PRESERVATION SYSTEM	DIAPHRAGM-SEAL CONSERVATOR
OIL QUANTITY	3040 us gals
OIL SPECIFICATION	ASTM D3487-76 TYPE I
OPERATING PRESSURE	—
TANK WITHSTAND VACUUM	0.03 PSI ABSOLUTE
AUDIBLE SOUND LEVEL	91 dB

PURCHASE ORDER
NUMBER
PURCHASE ORDER ITEM
NUMBER
SERIAL NUMBER
INSTRUCTION NUMBER

9075-06
AB690721-1
TR5F6995

YEAR OF MANUFACTURE

OCT. 1982

TR365788b

Fuji Electric Co., Ltd.

Japan

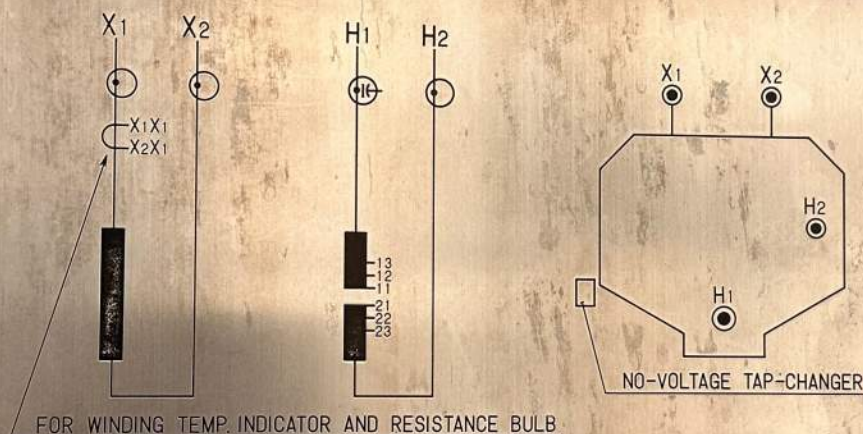
FUJI
ELECTRIC

TRANSFORMER

STANDARD	ANSI C57.12.00-1980
CLASS	FOA
NUMBER OF PHASE	1
FREQUENCY	60 Hz
RATED kVA	70270 kVA
RATED VOLTAGES	HV 230/ $\sqrt{3}$ kV
	LV 13.8 kV
IMPEDANCE VOLTAGE (AT 70270 kVA)	12.22 %

AMBIENT TEMP.	46 °C
WINDING TEMP. RISE	65 °C
OIL TEMP. RISE	65 °C

INSULATION LEVELS		
HV	BIL	900 kV
LV	BIL	110 kV
HV NEUTRAL	BIL	110 kV



TERMINAL	TAP NO.	VOLTAGES(kV)	CURRENTS(A)	CONNECTION
H1	1	F 241.50/ $\sqrt{3}$	504	11 - 21
	2	F 235.75/ $\sqrt{3}$	516	12 - 21
	3	R 230.00/ $\sqrt{3}$	529	12 - 22
	4	F 224.25/ $\sqrt{3}$	543	13 - 22
	5	F 218.50/ $\sqrt{3}$	557	13 - 23
X1	—	13.8	5092	—

WARNING / NO-VOLTAGE TAP-CHANGER MUST
BE OPERATED ONLY AT NO-
VOLTAGE

WEIGHTS	OIL	22320 lbs
	TANK & FITTINGS	28440 lbs
	UNTANKING	79370 lbs
	TOTAL	130830 lbs

OIL PRESERVATION SYSTEM	DIAPHRAGM-SEAL CONSERVATOR
OIL QUANTITY	304.9 us gals
OIL SPECIFICATION	ASTM D3487-76 TYPE I
OPERATING PRESSURE	—
TANK WITHSTAND VACUUM	0.03 PSI ABSOLUTE
AUDIBLE SOUND LEVEL	91 dB

PURCHASE ORDER
NUMBER
PURCHASE ORDER ITEM
NUMBER
SERIAL NUMBER
INSTRUCTION NUMBER

9075-06
1
AB69072T1-2
TR5F6995

YEAR OF MANUFACTURE

OCT. 1932
TR365788b

Fuji Electric Co., Ltd.

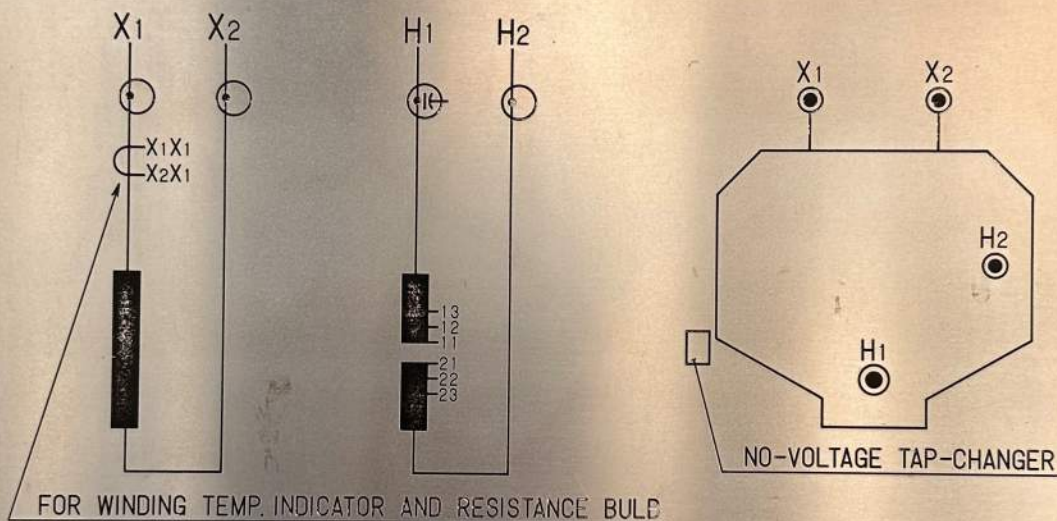
Japan

TRANSFORMER

STANDARD	ANSI C57.12.00-1980	
CLASS	FOA	
NUMBER OF PHASE	1	
FREQUENCY	60 Hz	
RATED KVA	70270 KVA	
RATED VOLTAGES	HV	230/ $\sqrt{3}$ kV
	LV	13.8 kV
IMPEDANCE VOLTAGE (AT 70270 KVA)	12.06 %	

AMBIENT TEMP.	46 °C
WINDING TEMP. RISE	65 °C
OIL TEMP. RISE	65 °C

INSULATION LEVELS		
HV	BIL	900 kV
LV	BIL	110 kV
HV NEUTRAL	BIL	110 kV



TERMINAL	TAP NO.	VOLTAGES(kV)	CURRENTS(A)	CONNECTION
H1	1	F 241.50/ $\sqrt{3}$	504	11 - 21
	2	F 235.75/ $\sqrt{3}$	516	12 - 21
	3	R 230.00/ $\sqrt{3}$	529	12 - 22
	4	F 224.25/ $\sqrt{3}$	543	13 - 22
	5	F 218.50/ $\sqrt{3}$	557	13 - 23
X1	—	13.8	5092	—

WARNING / NO-VOLTAGE TAP-CHANGER MUST
BE OPERATED ONLY AT NO-
VOLTAGE

WEIGHTS	OIL	22320 lbs
	TANK & FITTINGS	28440 lbs
	UNTANKING	79370 lbs
	TOTAL	130630 lbs

OIL PRESERVATION SYSTEM	DIAPHRAGM-SEAL CONSERVATOR
OIL QUANTITY	3040 us gals
OIL SPECIFICATION	ASTM D3487-76 TYPE I
OPERATING PRESSURE	—
TANK WITHSTAND VACUUM	0.03 PSI ABSOLUTE
AUDIBLE SOUND LEVEL	91 dB

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9075-06
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AB69072T 1-3
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YEAR OF MANUFACTURE

OCT 1982

TR365788b