



## Department of Energy

Bonneville Power Administration  
P.O. Box 3621  
Portland, Oregon 97208-3621

PUBLIC AFFAIRS

August 24, 2009

In reply refer to: DK-7

Scott C. Johnson  
ABB, Inc.  
10 Monticello Drive  
Lake Oswego, OR 97035

RE: FOIA #09-043

Dear Mr. Johnson:

Thank you for your request for information that you made to the Bonneville Power Administration (BPA), under the Freedom of Information Act (FOIA), 5 U.S.C. 552.

**You requested the following:**

Copy of contract and supporting material that resulted from RFP 1831-Allston Substation Spare Transformer, for which bids were submitted to Christina Craig on 4/20/2009. Letter of notice of award to Hyundai Heavy Industries was sent July 6. To the extent allowable, include Technical Data submitted by the successful bidder in Appendix G.

**Response:**

BPA has located and provided all responsive documents in their entirety.

If you are dissatisfied with this determination, you may make an appeal within thirty (30) days of receipt of this letter to the Director of Office of Hearings and Appeals, Department of Energy, 1000 Independence Avenue SW, Washington, DC 20585. Both the envelope and the letter must be clearly marked "Freedom of Information Act Appeal." There are no additional charges for your request.

I appreciate the opportunity to assist you in this matter. If you have any questions, please contact Laura M. Atterbury, FOIA/Privacy Act Specialist, at 503-230-7305.

Sincerely,

A handwritten signature in cursive script that reads "Christina J. Brannon".

Christina J. Brannon  
Freedom of Information/Privacy Act Officer

Enclosures: Responsive documents

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BPA F 4220.36e  
(06-05)  
(Replaces BPA F 4220.04 which  
is unusable after 10/1/93)

U.S DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION  
REQUEST FOR OFFERS AND AWARD

Electronic Version Approved  
by Forms Mgmt. - 06/15/2005

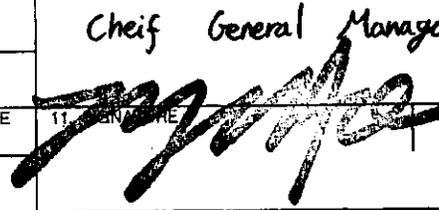
A. REQUEST		
1. REQUEST NUMBER <b>1831</b>	2. DATE ISSUED (MM/DD/YYYY) <b>03/06/2009</b>	3. CONTRACT NUMBER
4. ADDRESS OFFER TO (Include 9-Digit ZIP Code) <b>U.S. Department of Energy Bonneville Power Administration Attn: Christina Craig - NSSM-MODW P.O. Box 491 Vancouver, WA 98660-0491</b>		5. ISSUED BY <b>U.S. Department of Energy Bonneville Power Administration Attn: Christina Craig - NSSM-MODW 5411 N.E. Highway 99 Vancouver, WA 98663</b>
6. SUBMISSION OF OFFERS. (a) Offers in original and handcarried, at the location specified in Block 5 until <u>5</u> copies are due at the place specified in Block 4 or, if local time on (MM/DD/YYYY): <u>4:00 p.m.</u> <u>04/06/2009</u>		
7A. FOR INFORMATION CALL (Include Area Code) NO COLLECT CALLS <b>Theresa L. Harty - Contracting Officer (360) 418-2710</b>		7B. FAX NUMBER (Include Area Code) <b>(360) 418-2362</b>

8. DESCRIPTION  
Unprotected Form Field.

1 ea. Three-Phase, 230/115-13.8kV Autotransformer for  
Allston Substation

Technical Proposals Due April 6, 2009

Please note: The requirements for U.S. Flag Vessels Clause (14-16) may be enforced.

B. OFFER (Completed by Offeror)			
9. OFFEROR A. NAME <b>Justin Cho</b>		10. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER (Type or print) <b>Justin CHO Chief General Manager</b>	
B. ADDRESS <b>15th Fl., Hyundai Bldg. 140-2 Gye-dong</b>			
C. CITY <b>Jongno-gu</b>	COUNTY <b>KOREA</b>		
D. STATE <b>Seoul</b>	8-DIGIT ZIP CODE <b>110-793</b>	11. SIGNATURE	OFFER DATE (MM/DD/YYYY) <b>04/17/2009</b>
E. TELEPHONE NO. (Include Area Code) <b>02-746-7441</b>			
C. AWARD (Completed by Bonneville Power Administration)			
13. ACCEPTED AS TO ITEMS NUMBERED		16. UNITED STATES OF AMERICA	
14. AMOUNT		BY (Contracting Officer Signature)	
15. PERFORMANCE PERIOD/DELIVERY DATE (MM/DD/YYYY)		17. CONTRACTING OFFICER (Typed/printed name)	17. EFFECTIVE DATE (MM/DD/YYYY)

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## ATTACHMENT 2 -- REPRESENTATIONS AND CERTIFICATIONS

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#### TAXPAYER IDENTIFICATION NUMBER (4-1) (DEC 98)(BPI 4.1.2.1)

**NOTE:**

- (1) Taxpayer Identification Number (TIN) reporting does not apply to a Federal agency, a foreign government or a foreign business not engaged in business or trade or without an agent capable of receiving payment within the United States.
- (2) The TIN for BPA is 93-0334712.

All offerors, other than noted above, are required to submit its Taxpayer Identification Number requested below in order to comply with the Department of Treasury payment processing requirements of 31 U.S.C. 3332 and 7701, and the reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M and implementing regulations issued by the Internal Revenue Service. If the resulting contract is subject to those requirements, the failure or refusal by the offeror to furnish the information may result in a suspension of payment and a thirty-one (31) percent reduction of payments otherwise due under the contract.

Taxpayer Identification Number

59-3324992

#### TYPE OF BUSINESS ORGANIZATION (11-1) (SEP 02)(BPI 11.10.2.1)

The offeror, by checking the applicable box, represents that-

- (a) It operates as  a corporation incorporated under the laws of the State of \_\_\_\_\_,  an individual,  a partnership,  a nonprofit organization, or  a joint venture; or
- (b) It is a  local,  state,  federally recognized Indian tribe, or  other governmental entity, (*describe* \_\_\_\_\_); or
- (c) If the offeror is a foreign entity, it operates as  an individual,  a partnership,  a nonprofit organization,  a joint venture, or  a corporation, registered for business in KOREA (country) and  does /  does not have an office or fiscal paying agent in the United States; or
- (d) It is  /  a type of business organization not otherwise listed above (*describe* \_\_\_\_\_).

**PREFERENCE AWARD REPRESENTATION (8-1)**  
**(SEP 98)(BPI 8.1.3)**

(a) The offeror represents that:

- (1) it is  /, is not  a small business concern and that, if supplies/equipment are offered, all  /, not all  end items to be furnished will be manufactured or produced by a small business concern in the United States, its territories or possessions, or Puerto Rico, or the Trust Territory of the Pacific Islands.
- (2) it is  /, is not  a small disadvantaged business concern.
- (3) it is  /, is not  a women-owned small business concern.

(b) Definitions.

- (1) Small Business Concern. The North American Industry Classification System (NAICS) code for this solicitation is 335311. "Small Business Concern" means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is competing for Government contracts, and its average annual receipts for its preceding three fiscal years do not exceed 750 employees.
- (2) Small Disadvantaged Business Concern: See BPI Appendix 8-A for a detailed definition.

**BUY AMERICAN CERTIFICATE (9-1)**  
**(FEB 08)(BPI 9.1.6)**

(a) The Offeror certifies that each end product, except the end products listed below, is a domestic end product (as defined in the clause entitled "Buy American Act - Supplies"), and that components of unknown origin have been considered to have been mined, produced, or manufactured outside the United States.

EXCLUDED END PRODUCTS AND COUNTRY OF ORIGIN  
(List as necessary)

HMI dose not provide domestic end product.

Therefore this is not applicable.

(b) An Offeror who proposes to furnish domestic source end products containing components of foreign origin the cost of which exceeds 15 percent of the offered price, shall furnish in the spaces below a complete list of components of foreign origin in sufficient detail to clearly identify each.

FOREIGN COMPONENTS AND POINT OF ORIGIN

HMI dose not furnish domestic (US) source end product

Majority of our compnents are foreign origin

Therefore, this is not applicable.

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**UNIT 1 — SCHEDULE**

**CONTRACT TYPE (7-1)**  
**(SEP 98)(BPI 7.1.9)**

This is a firm-fixed price type contract.

**DELIVERY DATES/TERMS (SUPPLY) (7-53)**  
**(SEP 98)**

(a) Required delivery dates are as follows:

**REQUIRED DELIVERY SCHEDULE**

<u>Item No.</u>	<u>Quantity</u>	<u>On or Before</u>
1010196	1	12/30/2010

(b) Offeror's proposed delivery schedule, if different from above, is as follows:

**OFFEROR'S PROPOSED DELIVERY SCHEDULE**

<u>ITEM NO.</u>	<u>QUANTITY</u>	<u>DELIVERY DATES</u>
_____	_____	_____ <b>US Flag</b>
_____	_____	_____ <b>Non-US Flag</b>

(c) All equipment shall be shipped F.O.B. Destination to the Pad as follows:

- All Items: Bonneville Power Administration  
Allston Substation  
Approx. 6 miles Northwest of Rainier,  
Columbia County, OR
- Proceed West on US 30
- Approx. 5 miles, then North on Heath Rd.,
- Approx. 1.3 miles to the site.

(d) See the Specifications for packing requirements.

**SCHEDULE OF PRICES (22-51)  
(MAY 08)**

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The contractor shall provide the following in accordance with all of the attached specifications.

<u>Item No</u>	<u>Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Total Amount</u>
1010196	Transformer, Power, 230/115-13.8KV, Autotransformer, 180/240/300MVA, Three Phase – Without Transportation Costs	1	EA	\$ <u>2,305,537</u>	\$ <u>2,305,537</u>
	Transportation Costs				
	Utilizing US Flag Vessel			\$ <u>N/A</u>	\$ <u>N/A</u>
	Utilizing Non-US Flag Vessel			\$ <u>342,000</u>	\$ <u>342,000</u>
	Installation Engineer	<u>27</u>	Days	\$ <u>1,250</u>	\$ <u>33,750</u>
	Travel for Installation Engineer (These rates are limited to Clause 22-50)				\$ <u>4,000</u>

**TECHNICAL DATA (TO BE COMPLETELY BY OFFEROR)**

Provide the following information : (either on these sheets or similarly organized on another sheet). The information provided below will be used to evaluate the proposals. It will be to the Offer' s advantage to provide sufficient pertinent information in a clear, concise manner to adequately demonstrate the quality of their equipment.

1. Manufacturing location :	Ulsan, Korea	
Indicate whether transformer will be :	Core form <u>  X  </u>	Shell Form <u>          </u>
The manufacturer shall provide verification that proposed equipment will meet transportation requirements for road and rail shipment to destination at the time approval drawings are submitted.		

2. Rating			
Type :	Auto-transformer, Oil-immersed type		
Phase :	3		
Hertz :	60		
Temp Rise :	65 deg. C		
Winding	Nominal phase-to-phase voltage, kV		Connection
H	230		Gnd. Wye
X	115		Gnd. Wye
Y	13.8		Delta
Elevation	6000 feet		
Cooling class	Stage 1	Stage 2	Stage 3
H Winding	180 MVA	240 MVA	300 MVA
X Winding	180 MVA	240 MVA	300 MVA
Y Winding	15 MVA	20 MVA	25 MVA

3. MINIMUM WINDING INSULATION LEVELS				
Winding	H	X	Y	Neutral
Basic Lightning Impulse Insulation Level (BIL) (kV Crest)	750	450	150	150
Chopped Wave Test Level Crest Voltage, kV	825	495	165	NA
Switching Impulse Level (BSL) (kV Crest)	620	375	NA	NA
Induced Voltage Test (phase to ground)				
One Hour Test Level (kV rms)	210	105	NA	NA
Enhancement Level (kV rms)	240	120	NA	NA
Applied Voltage Test Level (kV rms)				
	NA	NA	50	50

4. LOAD TAP CHANGER : (LTC)				
Winding Location (H or X)	Tap capacity (Full or Reduced)	Mfg. Model #	Oil / Vacuum	Current Rating
H	Full	VRC 1001 or eq.	Vacuum	1000
Oil Filter(if needed)	NA			

5. DE-ENERGIZED TAP CHANGER : (DETC)		
Winding Location (H or X)	Current Rating	Mfg. Model #
X	1600	DUIII

6. PERCENT IMPEDANCE VOLTS					
% IZ	Between Windings	At MVA	% IZ	Between Windings	At MVA
8.6	H-X (max.)	300	5.94	H-Y	25
7.6	H-X (nom.)	300	5.86	H-Y	25
6.9	H-X (min.)	300	5.71	H-Y	25
% IZ	Between Windings	At MVA			
	X-Y	-			
4.68	X-Y	25			
	X-Y	-			

Note) The above mentioned impedance is based on LV tap position is at nominal.

7. LOSSES AT NOMINAL TAP		
Loss Evaluation Factors (See Clause 3-M.2.1 for definitions)		
Reference Loading (MVA)	Reference No-Load Losses (RCL in kW)	Reference Variable Losses (RVL in kW)
300	80	500

Note) Reference variable losses are based on HV & LV tap position is at nominal.

8. PERFORMANCE DATA. Based on 85 °C Reference Temperature						
Losses (kW) and Exciting Current					Voltage Regulation	
Excitation	No Load Loss (kW)	Exciting Current (%)	Load Loss(Rated Tap)		Power Factor	% Regulation
			Loss (kW)	Reference Load(MVA)		
100%	62	0.03	490	300	1.0	Approx. 0.97
110%	80	0.04			0.8	Approx 8.24

9. AUXILIARY LOSSES			
Cooling Stage	Load MVA	Cooling Class Designation	Watts Aux. Loss (kW)
First	180	ONAN	-
Second	240	ONAF	3
Third	300	ONAF	6

10. BUSHINGS FOR PROPOSED TRANSFORMER :						
	Manuf.	Cat. No.	BIL (kV)	Creep (mm)	Rated Current	Seismic Performance Capability
H-Bushing	ABB	196W1216AZ	900	≥ 3720	1200	High
X-Bushing	ABB	1ZUA138020	650	≥ 2.235	2000	High
Neutral	ABB	IZUA034012	200	≥ 560	1200	High
Y Bushings	ABB	IZUA034012	200	≥ 560	1200	High

Indicate the proposed seismic performance capability of the bushings in the space provided above. Indicate the qualification method used or that will be used to prove its seismic performance capabilities. Provide sufficient documentation so BPA can assess the bushing's seismic performance capability or the proposed test procedure that will be used to qualify the seismic performance of the bushings.

11. BUSHING CURRENT TRANSFORMERS (BCT)			
Bushing	BCT per Bushing	Current Rating	Accuracy
H	2	MR 1200-5A	C800
X	2	MR 2000-5A	C800
Y	3	MR 2000-5A & 3000-5A	C800
NEUTRAL	2	MR 1200-5A	C800

12. BUSHING POTENTIAL DEVICE		
Bushing Location	Mfg.	Type
H.V	GE or ABB	KA-108 or PBA-2

13. SOUND LEVEL		
Transformer Condition		Sound Level, dBA
First Cooling Stage at	180 MVA	<70
Second Cooling Stage at	240 MVA	<70
Third Cooling Stage at	300 MVA	<70
Top rated MVA/Voltage with 0.5 A DC superimposed		<78
Top rated MVA/Voltage with 1.0 A DC superimposed		<84

14. DRAWING SUBMITTAL	
Indicate schedule for preliminary drawing submittal (earlier submittal desired. Not to exceed the number of days, shown in parenthesis, after award of contract) for the following :	
Days after Award	
60	Detailed dimensioned transformer drawings including base dimensions, equipment location, material list, etc.
70	Nameplate drawings and equipment layout.
70	Wiring detail and other drawings.

15. Indicate core steel used and maximum core flux density at nameplate rating for proposed transformer :		
Manufacturer and Type	Flux Density at Maximum Name plate Rating, Tesla	Thickness
POSCO/23PH095	< 1.6	0.23mm

16. Indicate kind of windings to be used for the proposed transformer for the following :	
	ITEM 1
H (series) :	Disk
X (common) :	Disk
Y (tertiary) :	Layer
LTC Reg. Winding :	Helical
DETC Reg. Winding :	Helical

17. MECHANICAL DATA.		
Provide the following information. Provide an outline drawing or sketch of the unit with the bid. (the information provided shall be within 10% of the final)		
Dimensions (Approximate, inches)	Fully Assembled	Shipping
Height	315	179
Length	425	387
Width	270	127.6
Untanking Height	480	480
Mass (Approximate, in Lbs) (liquid in gallons)		
Core and Coils	236,220	
Tank and Fittings	111,260	
Liquid (in gallons)	19,696	
Total Mass (Installed)	495,400	
Largest Shipping Mass	315,400	

18. Provide a winding schematic diagram. Show the LTC in the diagram.  
=> Please refer to attached winding schematic diagram.

19. Indicate what winding insulation will be used (name/description & manufacturer) for the proposed transformer :

Winding insulation	Description & Manufacturer	Remarks
Dennison paper	Dennison / USA	
Kraft paper	MUNKSJO / SWEDEN	

20. Indicate what pressboard insulation will be used (name/description & Manufacturer) for the proposed transformer :

Description	Manufacturer	Remarks
Press Board	Honshu / Japan	
Press Board	Weidmann / China	

21. Indicate whether active parts will be treated by vapor phase process or not :

=> All the active parts will be dried by vapor phase drying plant two times ; First time after winding and second time upon completion of core & coil assembly.

To what percent water content will insulation be dried :

=> Through the vapor phase process, moisture content for insulation material is controlled not to exceed 0.5%.

22. List what the maximum water content of the insulation will be when the transformer is shipped and the method used to determine this degree of dryness. The maximum allowed water content of the insulation when received at the BPA site is 0.5%

=> We keep the maximum water content of the insulation should be below 0.5% when the transformer is shipped. If the dew point is below -40 deg.C, it may be assumed that the transformer has not been contaminated with air or moisture in transit. And, if the dew point is kept as close as possible to the value as measured at the factory, it may be assumed that the transformer has not been contaminated with air or moisture in transit.

23. Indicate the insulation processing required at site, which includes any required drying prior to oil filling, vacuum levels and time and any required set time under oil or circulation of oil and temperature after filling.

=> Please refer to attached "Shipment, Storage and Erection Manual"

24. Indicate how core material will be cut to length :

=> The oriented silicon steel strip is cut by computerized machinery (cut-to-length machine), thus minimizing air gap in the joint during assembly. This enables the core to minimize core loss and sound level during operation.

Indicate what maximum burr will be allowed on edges and end cuts :

=> Burr height limit : 0.7 mils.

25. Has or will electrostatic stress analysis been done on design? How?

=> Yes, we perform electric field analysis. For electric field calculation, we use AXIAL97E (BEM) and HTREM(FEM)

26. Has or will impulse distribution analysis been done on design? Will it be based on capacitance and inductance?

=> Yes, we perform impulse distribution analysis. The voltage distribution in the transformer

winding which is subject to transient over voltage depend on the capacitance at the early time (transient-state) and on the inductance to calculate voltage distribution in winding and transferred voltage as time goes on. We have our own program which uses a circuit model which include capacitive and inductive elements.

27. Indicate what is done to ensure the short circuit strength of the unit exceeds the force that may be generated under short circuit conditions :

=> By analyzing short circuit, short circuit current incoming to transformer are calculated for all possible failure modes. For the mechanical analysis, transformer is designed according to HHI standard to withstand calculated forces on the conductor through design parameter adjustments. Programmed software do all these calculations using IMAGE methods and checked using the FEM method. All design parameters which have affect on the short circuit forces and stress are considered during calculation by computer.

27. What will be the cross-section of the leads? What will be the lead material? How many layers of paper will it have? What will be the temperature rise of the leads at full load?

H : Cross-section(mm<sup>2</sup>) : approx. 300, Lead material:Cu wire, Layer:6mm one side, Temp. rise:<20K  
 X : Cross-section(mm<sup>2</sup>) : approx. 300, Lead material:Cu rod, Layer:5mm one side, Temp. rise:<20K  
 Y : Cross-section(mm<sup>2</sup>) : approx. 240, Lead material:Cu rod, Layer:0.4mm one side, Temp. rise:<20K

28. Indicate what is done to ensure the short circuit strength of the unit exceeds the forces that may be generated under short circuit conditions:

29. Has any transformer, out of factory from which this transformer will be manufactured, experienced a field failure within the last 5 years? What kind? What was the cause? What corrective action has been taken to prevent future failures? Name of purchaser.

=> Please refer to attached " Field failure rate "

30. Has any transformer out of factory from which this transformer will be manufactured, has experienced a test floor failure within the last 5 years? What kind? What kind of failures? What was the cause? What corrective action has been taken to prevent future failures? Name of purchaser

=> Please refer to attached " Test floor failure rate "

31. Indicate the person(s) that will be doing the design and overseeing construction. List and describe their experience with the design and construction of similar units (including the name of the company and their position at that time, i.e. Lead Designer, training, etc.).

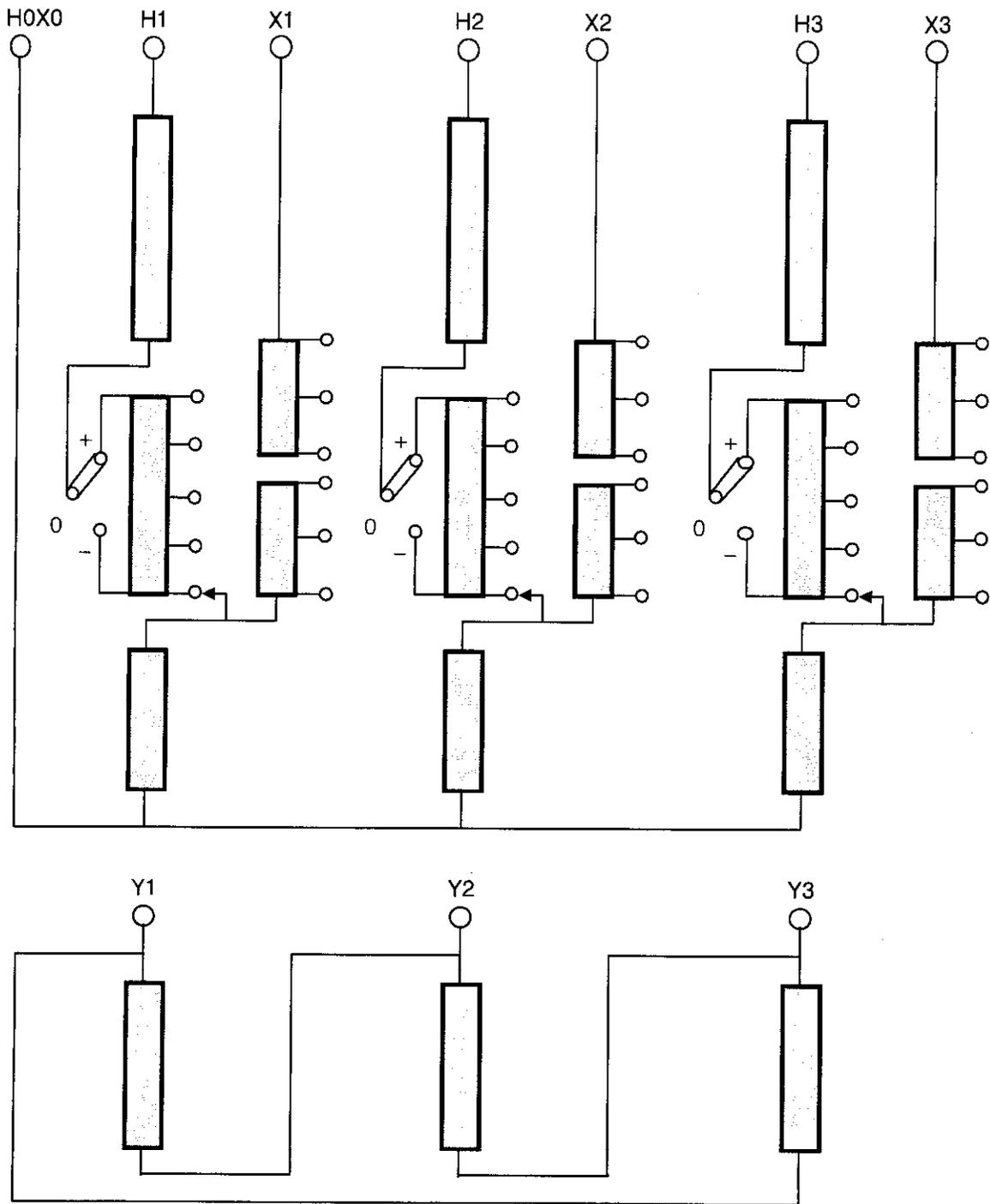
Section Name	Name	Educational / Professional Certifications	Experience	Remarks
Transformer Design Department	Gue-Chel Lee	B.S. Electrical Eng	25years	General Manager
Quotation	Moo-Geun Park	B.S. Electrical Eng	25years	General Manager
Technical calculation	Ho-Young Kim	B.S. Electrical Eng.	25years	General Manager
	Jae-cheol Yang	Master of Mechanical Eng.	14years	Manager

Project Managing	Jung-soo Lee	B.S. Electrical Eng.	31years	General Manager
	Ki-Hyun Park	B.S. Electrical Eng.	15years	Manager
Detail Design for Electrical Construction	Yong-su Lee	B.S. Electrical Eng.	21years	General Manager
Detail Design for Mechanical Construction	Tae-Bong Hwang	B.S. Electrical Eng.	31years	General Manager

32. Indicate whether CAD drawings will be supplied in addition to hard copies :  
=> The CAD drawings will be supplied together with hard copies.

Indicate format : AUTOCAD.DWG

33. Identify any conduit or factory installed wiring that needs to be removed for shipping?  
=> The transformer will be shipped without removing any conduit or factory installed wiring.
34. Will the control cabinet be removed or any other auxiliary equipment be removed for shipping?  
=> The control cabinet isn't removed from the transformer for shipping. For more information, please refer to packing list.



WINDING SCHEMATIC DIAGRAM (III)

**SCHEDULE OF PRICES (22-51)  
(MAY 08)**

The contractor shall provide the following in accordance with all of the attached specifications.

<u>Item No</u>	<u>Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Total Amount</u>
1010196	Transformer, Power, 230/115-13.8KV, Autotransformer, 180/240/300MVA, Three Phase – Without Transportation Costs	1	EA	\$ 2,170,642	\$ 2,170,642
	Transportation Costs				
	Utilizng US Flag Vessel			\$ N/A	\$ N/A
	Utilizng Non-US Flag Vessel			\$ 342,000	\$ 342,000
	Installation Engineer	27	Days	\$ 1,250	\$ 33,750
	Travel for Installation Engineer (These rates are limited to Clause 22-50)				\$ 4,000

Clarification Regarding BPA RFP 1831  
Allston Spare Transformer

1. Can you provide a transformer that is close to the profile and size requirements as stated in the RFP under Unit 3, BPA STS 22-11, section L Transportation and Appendix A, Transformer Outline Sketch?

HHI's answer

- HHI tried to meet the required weight and dimension as per BPA specification and found that we can meet the shipping weight limit however we are not sure whether we can meet the section L which says the width limit corresponding to the several heights.

The technical data summary sheet was revised and attached .Please be noted that the performance data including load loss ,D.C sound level and Etc was changed correspondingly.

- In case BPS accepts the max. width 12 feet at any height for shipping width, we can completely meet it, please recheck this and let us know your clarification.

When we see the Appendix A, transformer outline sketch, it show only max. width as 12 feet without corresponding height like section L of specification BPS STS 22-11.

Please, review this and let us know your final limitation on width at heights for further study and clarification of HHI.

**COMPLIANCE SUMMARY (TO BE COMPLETED BY OFFEROR AND SUBMITTED WITH THE PROPOSAL) (APPENDIX F)**

OF OFFERED TRANSFORMER

**WITH BPA SPECIFICATION 22-11 AND  
SPECIFIC TECHNICAL SPECIFICATION 22-11STS**

M = meets requirement  
D = does not meet the requirement  
E = exceeds the requirement  
NA = is not applicable

**3-1 SCOPE**

**3-2 GENERAL**

3-2.1	REFERENCED DOCUMENTS	M
3-2.2	DEFINITIONS	M
3-2.3	IDENTIFICATION	M
3-2.4	MANUFACTURER DRAWINGS	M
3-2.5	INSTRUCTION BOOKS	M
3-2.6	ORDER OF TECHNICAL DOCUMENT PRECEDENCE	M
3-2.7	LOSS EVALUATION AND PAYMENT	M

**3-3 PERFORMANCE**

3-3.1	TRANSFORMER LOADING	M
3-3.2	SHORT CIRCUIT CAPABILITY	M
3-3.3	EARTHQUAKE STRENGTH	M
3-3.4	WIND LOADING STRENGTH	M
3-3.5	AUXILIARY EQUIPMENT	M
3-3.6	SOUND LEVEL	M
3-3.7	VIBRATION	M
3-3.8	EXTERNAL CLEARANCES	M

**3-4 DESIGN AND CONSTRUCTION**

3-4.1	MATERIALS	M
3-4.2	WINDINGS AND WINDING CONFIGURATIONS	M
3-4.3	LOAD TAP CHANGER (LTC)	M
3-4.4	DE-ENERGIZED TAP CHANGER (DETC)	M
3-4.5	LEAD-LAG SWITCH	NA
3-4.6	FRAME AND CORE GROUNDING	M
3-4.7	BUSHING CURRENT TRANSFORMERS (BCT)	M
3-4.8	BUSHINGS AND TERMINALS	M
3-4.9	BUSHING POTENTIAL DEVICE (BPD)	M
3-4.10	GASKETS AND O-RINGS	M
3-4.11	TANK	M
3-4.12	MANHOLES	M
3-4.13	VAPOR TRAP FLANGE	M
3-4.14	VALVES	M
3-4.15	TRANSFORMER TANK GROUNDING	M
3-4.16	OIL PRESERVATION SYSTEM	M
3-4.17	COOLING SYSTEM	M
3-4.18	COMBUSTIBLE GAS PIPING SYSTEM	M
3-4.19	LIFTING FACILITIES	M
3-4.20	MOVING FACILITIES	M
3-4.21	JACKING FACILITIES	M
3-4.22	FALL PROTECTION	M
3-4.23	SURGE ARRESTER BRACKETS	M
3-4.24	CONDUIT AND WIRE	M

3-4.25	CONTROL CABINET POWER REQUIREMENTS	M
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M  
M  
M  
M

**TECHNICAL DATA (TO BE COMPLETED AND SUBMITTED BY OFFEROR WITH THE PROPOSAL (APPENDIX G))**

Provide the following information: (either on these sheets or similarly organized on another sheet). The information provided below will be used to evaluate the proposals. It will be to the Offer's advantage to provide sufficient pertinent information in a clear, concise manner to adequately demonstrate the quality of their equipment.

<b>1. Manufacturing location:</b>		
Indicate whether transformer will be:	Core Form	Shell Form
The Manufacturer shall provide verification that proposed equipment will meet transportation requirements for road and rail shipment to destination at the time approval drawings are submitted.		

<b>2. RATING</b>			
Type:			
Phase:			
Hertz:			
Temp Rise:			
<b>Winding</b>	<b>Nominal phase-to-phase voltage, kV</b>	<b>Connection</b>	
H			
X			
Y			
<b>Elevation</b>			
<b>Cooling Class</b>	<b>Stage 1</b>	<b>Stage 2</b>	<b>Stage 3</b>
H Winding	MVA	MVA	MVA
X Winding	MVA	MVA	MVA
Y Winding	MVA	MVA	MVA

**TECHNICAL DATA (TO BE COMPLETELY BY OFFEROR)**

Provide the following information : (either on these sheets or similarly organized on another sheet). The information provided below will be used to evaluate the proposals. It will be to the Offer' s advantage to provide sufficient pertinent information in a clear, concise manner to adequately demonstrate the quality of their equipment.

1. Manufacturing location :	Ulsan, Korea	
Indicate whether transformer will be :	Core form <input checked="" type="checkbox"/> X <input type="checkbox"/>	Shell Form <input type="checkbox"/>
The manufacturer shall provide verification that proposed equipment will meet transportation requirements for road and rail shipment to destination at the time approval drawings are submitted.		

2. Rating			
Type :	Auto-transformer, Oil-immersed type		
Phase :	3		
Hertz :	60		
Temp Rise :	65 deg. C		
Winding	Nominal phase-to-phase voltage, kV		Connection
H	230		Gnd. Wye
X	115		Gnd. Wye
Y	13.8		Delta
Elevation	6000 feet		
Cooling class	Stage 1	Stage 2	Stage 3
H Winding	180 MVA	240 MVA	300 MVA
X Winding	180 MVA	240 MVA	300 MVA
Y Winding	15 MVA	20 MVA	25 MVA

3. MINIMUM WINDING INSULATION LEVELS				
Winding	H	X	Y	Neutral
Basic Lightning Impulse Insulation Level (BIL) (kV Crest)	750	450	150	150
Chopped Wave Test Level Crest Voltage, kV	825	495	165	NA
Switching Impulse Level (BSL) (kV Crest)	620	375	NA	NA
Induced Voltage Test (phase to ground)				
One Hour Test Level (kV rms)	210	105	NA	NA
Enhancement Level (kV rms)	240	120	NA	NA
Applied Voltage Test Level (kV rms)				
	NA	NA	50	50

4. LOAD TAP CHANGER : (LTC)				
Winding Location (H or X)	Tap capacity (Full or Reduced)	Mfg. Model #	Oil / Vacuum	Current Rating
H	Full	VRC 1001 or eq.	Vacuum	1000
Oil Filter(if needed)	NA			

5. DE-ENERGIZED TAP CHANGER : (DETC)		
Winding Location (H or X)	Current Rating	Mfg. Model #
X	1600	DUIII

6. PERCENT IMPEDANCE VOLTS					
% IZ	Between Windings	At MVA	% IZ	Between Windings	At MVA
8.3	H-X (max.)	300	5.8	H-Y	25
7.6	H-X (nom.)	300	5.7	H-Y	25
6.5	H-X (min.)	300	5.6	H-Y	25
% IZ	Between Windings	At MVA			
	X-Y	-			
4.6	X-Y	25			
	X-Y	-			

Note) The above mentioned impedance is based on LV tap position is at nominal.

7. LOSSES AT NOMINAL TAP		
Loss Evaluation Factors (See Clause 3-M.2.1 for definitions)		
Reference Loading (MVA)	Reference No-Load Losses (RCL in kW)	Reference Variable Losses (RVL in kW)
300	80	500

Note) Reference variable losses are based on HV & LV tap position is at nominal.

8. PERFORMANCE DATA, Based on 85 °C Reference Temperature						
Losses (kW) and Exciting Current					Voltage Regulation	
Excitation	No Load Loss (kW)	Exciting Current (%)	Load Loss		Power Factor	% Regulation
			Loss (kW)	Reference Load(MVA)		
100%	62	0.06	395	300	1.0	Approx. 0.5
110%	80	0.08			0.8	Approx. 5.2

9. AUXILIARY LOSSES			
Cooling Stage	Load MVA	Cooling Class Designation	Watts Aux. Loss (kW)
First	180	ONAN	-
Second	240	ONAF	3
Third	300	ONAF	6

10. BUSHINGS FOR PROPOSED TRANSFORMER :						
	Manuf.	Cat. No.	BIL (kV)	Creep (mm)	Rated Current	Seismic Performance Capability
H-Bushing	ABB	196W1216AZ	900	≥ 3720	1200	High
X-Bushing	ABB	1ZUA138020	650	≥ 2,235	2000	High
Neutral	ABB	IZUA034012	200	≥ 560	1200	High
Y Bushings	ABB	IZUA034012	200	≥ 560	1200	High

Indicate the proposed seismic performance capability of the bushings in the space provided above. Indicate the qualification method used or that will be used to prove its seismic performance capabilities. Provide sufficient documentation so BPA can assess the bushing' s seismic performance capability or the proposed test procedure that will be used to qualify the seismic performance of the bushings.

11. BUSHING CURRENT TRANSFORMERS (BCT)			
Bushing	BCT per Bushing	Current Rating	Accuracy
H	2	MR 1200-5A	C800
X	2	MR 2000-5A	C800
Y	3	MR 2000-5A & 3000-5A	C800
NEUTRAL	2	MR 1200-5A	C800

12. BUSHING POTENTIAL DEVICE		
Bushing Location	Mfg.	Type
H.V	GE or ABB	KA-108 or PBA-2

13. SOUND LEVEL		
Transformer Condition		Sound Level, dBA
First Cooling Stage at	180 MVA	<70
Second Cooling Stage at	240 MVA	<70
Third Cooling Stage at	300 MVA	<70
Top rated MVA/Voltage with 0.5 A DC superimposed		<74
Top rated MVA/Voltage with 1.0 A DC superimposed		<74

14. DRAWING SUBMITTAL	
Indicate schedule for preliminary drawing submittal (earlier submittal desired. Not to exceed the number of days, shown in parenthesis, after award of contract) for the following :	
Days after Award	
60	Detailed dimensioned transformer drawings including base dimensions, equipment location, material list, etc.
70	Nameplate drawings and equipment layout.
70	Wiring detail and other drawings.

15. Indicate core steel used and maximum core flux density at nameplate rating for proposed transformer :		
Manufacturer and Type	Flux Density at Maximum Name plate Rating, Tesla	Thickness
POSCO/23PH095	< 1.6	0.23mm

16. Indicate kind of windings to be used for the proposed transformer for the following :	
	ITEM 1
H (series) :	Disk
X (common) :	Disk
Y (tertiary) :	Layer
LTC Reg. Winding :	Helical
DETC Reg. Winding :	Helical

17. MECHANICAL DATA.		
Provide the following information. Provide an outline drawing or sketch of the unit with the bid. (the information provided shall be within 10% of the final)		
Dimensions (Approximate, inches)	Fully Assembled	Shipping
Height	310	182
Width	490	420
Length	280	150
Untanking Height	570	570
Mass (Approximate, in Lbs) (liquid in gallons)		
Core and Coils	310,000	
Tank and Fittings	107,300	
Liquid (in gallons)	21,664	
Total Mass (Installed)	580,000	
Largest Shipping Mass	396,000	

18. Provide a winding schematic diagram. Show the LTC in the diagram.  
=> Please refer to attached winding schematic diagram.

19. Indicate what winding insulation will be used (name/description & manufacturer) for the proposed transformer :

Winding insulation	Description & Manufacturer	Remarks
Dennison paper	Dennison / USA	
Kraft paper	MUNKSJO / SWEDEN	

20. Indicate what pressboard insulation will be used (name/description & Manufacturer) for the proposed transformer :

Description	Manufacturer	Remarks
Press Board	Honshu / Japan	
Press Board	Weidmann / China	

21. Indicate whether active parts will be treated by vapor phase process or not :

=> All the active parts will be dried by vapor phase drying plant two times ; First time after winding and second time upon completion of core & coil assembly.

To what percent water content will insulation be dried :

=> Through the vapor phase process, moisture content for insulation material is controlled not to exceed 0.5%.

22. List what the maximum water content of the insulation will be when the transformer is shipped and the method used to determine this degree of dryness. The maximum allowed water content of the insulation when received at the BPA site is 0.5%

=> We keep the maximum water content of the insulation should be below 0.5% when the transformer is shipped. If the dew point is below -40 deg.C, it may be assumed that the transformer has not been contaminated with air or moisture in transit. And, if the dew point is kept as close as possible to the value as measured at the factory, it may be assumed that the transformer has not been contaminated with air or moisture in transit.

23. Indicate the insulation processing required at site, which includes any required drying prior to oil filling, vacuum levels and time and any required set time under oil or circulation of oil and temperature after filling.

=> Please refer to attached "Shipment, Storage and Erection Manual"

24. Indicate how core material will be cut to length :

=> The oriented silicon steel strip is cut by computerized machinery (cut-to-length machine), thus minimizing air gap in the joint during assembly. This enables the core to minimize core loss and sound level during operation.

Indicate what maximum burr will be allowed on edges and end cuts :

=> Burr height limit : 0.7 mils.

25. Has or will electrostatic stress analysis been done on design? How?

=> Yes, we perform electric field analysis. For electric field calculation, we use AXIAL97E (BEM) and HTREM(FEM)

26. Has or will impulse distribution analysis been done on design? Will it be based on capacitance and inductance?

=> Yes, we perform impulse distribution analysis. The voltage distribution in the transformer

winding which is subject to transient over voltage depend on the capacitance at the early time (transient-state) and on the inductance to calculate voltage distribution in winding and transferred voltage as time goes on. We have our own program which uses a circuit model which include capacitive and inductive elements.

27. Indicate what is done to ensure the short circuit strength of the unit exceeds the force that may be generated under short circuit conditions :

=> By analyzing short circuit, short circuit current incoming to transformer are calculated for all possible failure modes. For the mechanical analysis, transformer is designed according to HHI standard to withstand calculated forces on the conductor through design parameter adjustments. Programmed software do all these calculations using IMAGE methods and checked using the FEM method. All design parameters which have affect on the short circuit forces and stress are considered during calculation by computer.

27. What will be the cross-section of the leads? What will be the lead material? How many layers of paper will it have? What will be the temperature rise of the leads at full load?

H : Cross-section(mm2) : approx.530, Lead material:Cu wire, Layer:10mm one side, Temp. rise.:<20K  
 X : Cross-section(mm2) : approx.346, Lead material:Cu rod, Layer:5mm one side, Temp. rise.:<20K  
 Y : Cross-section(mm2) : approx. 200, Lead material:Cu rod, Layer:2mm one side, Temp. rise.:<20K

28. Indicate what is done to ensure the short circuit strength of the unit exceeds the forces that may be generated under short circuit conditions:

29. Has any transformer, out of factory from which this transformer will be manufactured, experienced a field failure within the last 5 years? What kind? What was the cause? What corrective action has been taken to prevent future failures? Name of purchaser.

=> Please refer to attached " Field failure rate"

30. Has any transformer out of factory from which this transformer will be manufactured, has experienced a test floor failure within the last 5 years? What kind? What kind of failures? What was the cause? What corrective action has been taken to prevent future failures? Name of purchaser

=> Please refer to attached "Test floor failure rate"

31. Indicate the person(s) that will be doing the design and overseeing construction. List and describe their experience with the design and construction of similar units (including the name of the company and their position at that time, i.e. Lead Designer, training, etc.).

Section Name	Name	Educational / Professional Certifications	Experience	Remarks
Transformer Design Department	Gue-Chel Lee	B.S. Electrical Eng	25years	General Manager
Quotation	Moo-Geun Park	B.S. Electrical Eng.	25years	General Manager
Technical calculation	Ho-Young Kim	B.S. Electrical Eng.	25years	General Manger
	Jae-cheol Yang	Master of Mechanical Eng.	14years	Manager

Project Managing	Jung-soo Lee	B.S. Electrical Eng.	31years	General Manager
	Ki-Hyun Park	B.S. Electrical Eng.	15years	Manager
Detail Design for Electrical Construction	Yong-su Lee	B.S.ElectricalEng.	31years	General Manger
Detail Design for Mechanical Construction	Tae-Bong Hwang	B.S.ElectricalEng.	31years	General Manger

32. Indicate whether CAD drawings will be supplied in addition to hard copies :

=> The CAD drawings will be supplied together with hard copies.

Indicate format : AUTOCAD.DWG

33. Identify any conduit or factory installed wiring that needs to be removed for shipping?

=> The transformer will be shipped without removing any conduit or factory installed wiring.

34. Will the control cabinet be removed or any other auxiliary equipment be removed for shipping?

=> The control cabinet isn' t removed from the transformer for shipping. For more information, please refer to packing list.

UNITED STATES  
GOVERNMENT

PURCHASE ORDER

Bonneville Power  
Administration

Mail Invoice To:  
DISBURSEMENT OPERATIONS -FTD  
BPA TRANSMISSION  
P.O. BOX 3621  
PORTLAND OR 97208-3621

Purchase Order : 00043128  
Revision :  
Release :  
Printed : 07/14/09  
Page : 1

Contractor:  
HYUNDAI HEAVY INDUSTRIES COMPANY LTD  
15TH FL HYUNDAI BLDG  
140-2 KYE-DONG, CHONGRO-GU  
SEOUL KO 110793

Please Direct Inquiries to:

HSIAO-LAN MCGEE  
Title: CONTRACT SPECIALIST  
Phone: 360-418-8701  
Fax : 360-418-2362

Attn: BRAD VANPELT

SHIPMENT & INVOICE MUST BE MARKED WITH  
BPA PO # TO BE ACCEPTED. NOTIFY CONTACT  
ABOVE WITH UPDATED SHIPPING SCHEDULES

Payment Terms	%	Days Net	30	Days	ERS: N	Tax Exempt: 93-0334712
---------------	---	----------	----	------	--------	------------------------

Primary Ship To: See SPECIAL DELIVERY ADDRESS  
SEE INSTRUCTIONS

Attention :

Instructions & Notes

\*\*\*NOTE:  
FREIGHT TERMS ARE D.D.P TO THE PAD, WITH  
FREIGHT PRE-PAID AND CHARGED. SEE  
CONTRACT PAGE 4\*\*\*

Header Terms and Conditions - Text Attached

Standard Name	Revision	Title
1006037	000	22-11STS - POWER TRANSFORMER
A ATTACH 3	000	CONTRACT TERMS AND CONDITIONS
BPA22-11	000	POWER TRANSFORMER
BPA50-05	000	APPARATUS BUSHINGS

Line	Qty	UP	Item Description	Unit Price	Extended Price
0001	1	EA	Catalog ID: 0001010196	0 \$2,170,642.000000	\$2,170,642.00

TRANSFORMER, POWER, 230/115-13.8KV,  
AUTOTRANSFORMER, 180/240/300MVA, THREE  
PHASE, HIGH

UNITED STATES GOVERNMENT	PURCHASE ORDER	<u>Bonneville Power</u> <u>Administration</u>
Mail Invoice To: DISBURSEMENT OPERATIONS -FTD BPA TRANSMISSION P.O. BOX 3621 PORTLAND OR 97208-3621		Purchase Order : 00043128 Revision : Release : Printed : 07/14/09 Page : 2

SEISMIC QUALIFICATION, 9 POSITION  
LTC IN H WINDING, 5 POSITION DETC  
IN X WINDING, ONAN/ONAF/ONAF,  
6000 FEET ELEVATION, NO BPD,  
125VDC POSITIVE POLARITY CONTROL.  
DESIGN OPTIMIZED FOR EASE OF  
TRANSPORTATION. SYSTEM SPARE  
TRANSFORMER. SPECIAL DIMENSIONAL  
SHIPPING CONFIGURATION.  
\*\*\*\*\*WARRANTY\*\*\*\*\*  
WARRANTY EXPIRATION = 5 YEARS  
FROM DELIVERY  
\*\*\*\*\*  
SER Tag # T-1835  
Site: Allston Substation  
See Contract Page 4 for  
delivery address  
\*\*\*\*\*  
Mfr/Vendor: HYUNDAI HEAVY INDUSTRIES  
Model : 230/115-13.8KV  
Part : 0001010196  
Qty: 1 Delivery Date: 10/01/10

*Line Terms and Conditions - Text Attached*

<u>Standard Name</u>	<u>Revision</u>	<u>Title</u>
BPA22-11	000	POWER TRANSFORMER

*Purchase Order Total Amount*

TOTAL THIS PO:	\$2,170,642.00
BPA Contracting Officer	Vendor Signature (If Req'd)
_____	_____

*Standards and Procedures Text Attached*

\* \* \* End of Purchase Order \* \* \*

**ATTACHMENT 3**

**CONTRACT #43128**

**ALLSTON SUBSTATION TRANSFORMER**

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# UNIT 1 — SCHEDULE

**CONTRACT TYPE (7-1)**  
**(SEP 98)(BPI 7.1.9)**

This is a firm-fixed price type contract.

**DELIVERY DATES/TERMS (SUPPLY) (7-53)**  
**(SEP 98)**

(a) Required delivery dates are as follows:

## REQUIRED DELIVERY SCHEDULE

<u>Item No.</u>	<u>Quantity</u>	<u>On or Before</u>
1010196	1	10/01/2010

(b) All equipment shall be shipped D.D.P. to the Pad, with freight pre-paid and charged, to the following location:

All Items: Bonneville Power Administration  
Aliston Substation  
Approx. 6 miles Northwest of Rainier,  
Columbia County, OR  
Proceed West on US 30  
Approx. 5 miles, then North on Heath Rd.,  
Approx. 1.3 miles to the site.

(c) See the Specifications for packing requirements.

**SCHEDULE OF PRICES (22-51)  
(MAY 08)**

The contractor shall provide the following in accordance with all of the attached specifications.

<u>Item No</u>	<u>Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Total Amount</u>
1010196	Transformer, Power, 230/115-13.8KV, Autotransformer, 180/240/300MVA, Three Phase – Without Transportation Costs	1	EA	\$ 2,170,642	\$2,170,642
Option 1	Installation Engineer At \$1,250 per day, plus travel **See Clause 22-50 for limitations on travel rates	1	Job	Not To Exceed	\$ 33,750

## UNIT 2 — CONTRACT CLAUSES

### PAYMENT AND TAXES

#### ELECTRONIC FUNDS TRANSFER PAYMENT (22-20) (OCT 07)(BPI 22.6.2)

- (a) Payment Method. Payments under this contract, including invoice and contract financing payments, will be made by electronic funds transfer (EFT). Contractors are required to provide its taxpayer identification number (TIN) and other necessary banking information as per paragraph (c) of this clause to receive EFT payment.
- (b) Contractor EFT arrangement with a financial institution or authorized payment agent. The Contractor shall designate to BPA, as per paragraph (c) of this clause, and maintain at its own expense, a single financial institution or authorized payment agent capable of receiving and processing EFT using the Automated Clearing House (ACH) transfer method. The most current designation and EFT information will be used for all payments under all BPA contracts, unless the BPA Vendor File Maintenance Team is notified of a change as per paragraph (d) of this clause. An initial designation should be submitted after award, but no later than three weeks before an invoice or contract financing request is submitted for payment.
- (c) Submission of EFT banking information to BPA. The Contractor shall submit EFT enrollment banking information directly to BPA Vendor File Maintenance Team, using Substitute IRS Form w9e, Request for Taxpayer Identification Number and Certification. This form is available either from the Contracting Officer(CO) or from the Vendor File Maintenance Team. Submit completed enrollment form to the Vendor Team. Contact and mailing information:
- Bonneville Power Administration  
PO Box 491  
ATTN: NSTS - MODW Vendor Maint.  
Vancouver, WA 98666-0491
- E-mail Address: VendorMaintenance@BPA.gov  
Phone: (360) 418-2800  
Fax: (360) 418-8904
- (d) Change in EFT information. In the event that EFT information changes or the Contractor elects to designate a different financial institution for the receipt of any payment made using EFT procedures, the Contractor shall be responsible for providing the changed information to the BPA Vendor File Maintenance Team office. The Vendor Maintenance Team must be notified 30 days prior to the date such change is to become effective.
- (e) Suspension of Payment. BPA is not required to make any payment under this contract until receipt of the correct EFT payment information from the Contractor.
- (f) EFT and prompt payment. BPA shall pay no penalty on delay of payment resulting from defective EFT information. BPA will notify the Contractor within 7 days of its receipt of EFT information which it determines to be defective.
- (g) EFT and assignment of claims. If the Contractor assigns the proceeds of this contract as provided for in the Assignment of Claims clause of this contract, the assignee shall provide the assignee's EFT information required by paragraph (c) of this clause.

**PAYMENT UPON RECEIPT OF EACH ITEM (SUPPLY) (22-52)  
(SEP 98)**

Payment will be made for each item as follows:

- (a) Ninety percent (ninety-five in the case of small businesses) of the contract price will be paid upon receipt (as applicable) of:
  - (1) Evidence of passage of the required tests,
  - (2) BPA approval of test reports and data,
  - (3) Submittal of instruction books, drawings and data for review,
  - (4) Inspection of all equipment, materials and supplies for each line item, and
  - (5) Receipt of all equipment, materials and supplies for each line item at the F.O.B. point.
- (b) The remainder will be paid upon receipt and approval of the following data, as applicable:
  - (1) Final instruction books, drawings, and data;
  - (2) Manufacturer's complete parts list data; and provided, that the Contracting Officer may authorize payments of any part of the remainder prior to receipt and approval of all required data. Where no data is required or where all required data is received concurrently or before the contract items, payment will be made in full upon successful completion of the items listed in Paragraph (a).

**PAYMENT (22-12)  
(NOV 08)(BPI 22.2.5)**

- (a) **Payment Due Date.** Payment (including partial payments or progress payments, if authorized, shall be due not later than thirty (30) calendar days after the later of the date on which BPA actually receives a proper invoice in the designated billing office or the date when the items delivered or completed services are accepted by BPA. According to the Prompt Payment Act, a proper invoice to a Federal Agency is to include bank account information requisite to enable Electronic Funds Transfer (EFT) as method of payment. For purposes of payment only, items will be deemed accepted not later than seven (7) working days after proper delivery. If delivered items or completed services are found defective, the provisions of this paragraph will be reapplied upon receipt of a corrected item or service.
- (b) **Billing Instructions.**
  - (1) Invoices must include the contractor's name and address, invoice date, contract number, task order number (if applicable), contract line item number, description of products delivered or work performed, price and quantity of item(s) actually delivered or rendered (amounts billed for work performed under a task order must be separately identified by task order number), and the name and address of the person to whom payment will be made, and name (where practicable), title, phone number, mailing address of person to be notified in event of a defective invoice and bank account information required to enable Electronic Funds Transfer (EFT) as method of payment (Invoices will not require banking information if the contractor has that information on file at BPA). Failure to submit a proper invoice may result in a delay in payment including a rejection of invoice pending receipt of a properly amended invoice.
  - (2) Contractors may bill monthly, or at more frequent intervals as may be agreed to by the CO.
- (c) **Payment Method.** Payments under this contract will be made by electronic funds transfer whenever possible, or by check in very limited circumstances, at the option of BPA.
- (d) **Prompt Payment Act.** This contract is subject to the provisions of the Prompt Payment Act (31 U.S.C. 3901 et seq.), and regulations at 5 CFR Part 1315.

- (e) Interest Penalty Payments. If interest penalty payments are determined due under the provisions of the Prompt Payment Act, payment shall be made at the rates determined by the U.S. Treasury Section 12 of the Contract Disputes Act of 1978 (41 U.S.C. 611).

**LIMITATION ON TRAVEL COSTS (22-50)**  
**(MAY 05)**

Costs incurred for lodging, meals, and incidental expenses shall be reimbursed on an actual cost basis to the extent that they do not exceed, on a daily basis, the per diem rates in effect at the time of travel as set forth in the Federal Travel Regulation, prescribed by the General Services Administration, for travel in the conterminous 48 United States. Per Diem shall be authorized for travel in excess of 12 hours and shall not exceed 75% of the daily rate for the first and last day of official travel. Lodging and other expenses exceeding \$75.00 must be supported with receipts, which shall be submitted with the request for payment.

Airline costs will be reimbursed on an actual cost basis to the extent determined reasonable and allocable under Part 13 of the Bonneville Purchasing Instructions. Generally, airline costs will be limited to coach or economy class. Any variation from these requirements must be approved by the Contracting Officer. Contractors may request a letter from the Contracting Officer, authorizing access to an airline, lodging, or other rates negotiated for government travel to the extent such authorization is honored by the service providers.

Per Diem rates are available at [http://www.gsa.gov/Portal/gsa/ep/contentView.do?programId=9704&channelId=-15943&oid=16365&contentId=17943&pageTypeId=8203&contentType=GSA\\_BASIC&programPage=%2Fep%2Fprogram%2FgsaBasic.jsp&P=MTT](http://www.gsa.gov/Portal/gsa/ep/contentView.do?programId=9704&channelId=-15943&oid=16365&contentId=17943&pageTypeId=8203&contentType=GSA_BASIC&programPage=%2Fep%2Fprogram%2FgsaBasic.jsp&P=MTT)

The Federal Travel Regulations are available at [http://www.gsa.gov/Portal/gsa/ep/contentView.do?P=MTT&contentId=14161&contentType=GSA\\_OVERVIEW](http://www.gsa.gov/Portal/gsa/ep/contentView.do?P=MTT&contentId=14161&contentType=GSA_OVERVIEW)

**DISCOUNTS FOR PROMPT PAYMENT (22-10)**  
**(SEP 98)(BPI 22.2.5)**

In connection with any discount offered for prompt payment, time shall be computed from the date shown on the invoice or if no date is shown then from the date BPA receives the invoice. For the purpose of computing the discount earned, payment shall be considered to have been made on the date which appears on the payment check or the date on which an electronic funds transfer was made.

**WITHHOLDING (22-9)**  
**(SEP 98)(BPI 22.1.5.1)**

- (a) The CO reserves the right to withhold an amount not to exceed ten (10) percent of the contract price if determined necessary to protect BPA's interests.
- (b) Upon completion and acceptance of each severable item of work for which the price is stated separately in the contract, payment shall be made for the completed work, less liquidated damages (if any), without withholding of a percentage.

**FEDERAL, STATE, AND LOCAL TAXES (22-15)**  
**(SEP 98)(BPI 22.5.3.4)**

- (a) The contract price shall include all applicable Federal, State, and local taxes and duties.
- (b) The contract price shall be increased by the amount of any after-imposed Federal excise tax or duty, provided the Contractor warrants in writing that no amount for such newly imposed Federal excise tax or duty or rate increase was included in the contract price.
- (c) The contract price shall be decreased by the amount of any after-relieved Federal excise tax or duty.

- (d) The contract price shall be decreased by the amount of any Federal excise tax or duty, except social security or other employment taxes, that the Contractor is required to pay or bear, or does not obtain a refund of, through the Contractor's fault, negligence, or failure to follow instructions of the CO.
- (e) No adjustment shall be made in the contract price under this clause unless the amount of the adjustment exceeds \$250.
- (f) Notwithstanding any of the above provisions for adjustment of the contract price in the event of a change in a Federal excise tax or duty after the contract date, no increase in the contract price shall be made for any duty imposed under the Tariff Act of 1930, as amended, (19 U.S.C. 1303) or the Anti-dumping Act of 1921, as amended (19 U.S.C. 160-171).

**INTEREST ON AMOUNTS DUE BPA (22-13)  
(SEP 98)(BPI 22.3.1)**

- (a) Notwithstanding any other clause of this contract, all amounts that become payable by the Contractor to BPA under this contract (net of any applicable tax credit under the Internal Revenue Code (26\*U.S.C.\*1481)) shall bear simple interest from the date due until paid unless paid within 30 days of becoming due. The interest rate shall be the interest rate established by the Secretary of the Treasury as provided in Section 12 of the Contract Disputes Act of 1978 (Public Law 95-563), which is applicable to the period in which the amount becomes due, as provided in paragraph (b) of this clause, and then at the rate applicable for each six month period as fixed by the Secretary until the amount is paid.
- (b) Amounts shall be due at the earliest of the following dates:
  - (1) The date fixed under this contract;
  - (2) The date of the first written demand for payment consistent with this contract, including any demand resulting from a default termination;
  - (3) The date BPA transmits to the Contractor a proposed supplemental agreement to confirm completed negotiations establishing the amount of debt; and
  - (4) If this contract provides for revision of prices, the date of written notice to the Contractor stating the amount of refund payable in connection with a pricing proposal or a negotiated pricing agreement not confirmed by contract modification;
- (c) Payment will be due within 30 days of the date of the invoice. The collection actions available under the Debt Collection Act of 1982 (Public Law 97-365), as amended, and the revised Federal Claims Collections Standards (4 CFR 102), will be utilized. Administrative charges and penalties will be charged in accordance with 31 USC 3717, except where prohibited or explicitly provided for by statute or regulation required by statute.

**GENERAL CONTRACT ADMINISTRATION**

**APPLICABLE REGULATIONS (1-1)  
(NOV 08)(BPI 1.3.1)**

Purchases made by the Bonneville Power Administration are subject to the policies and procedures outlined in the Bonneville Purchasing Instructions. The BPI is available without charge on the Internet at <http://www.bpa.gov>. Copies are available for purchase from the Head of the Contracting Activity. The public may purchase unbound copies of the BPI from the Head of the Contracting Activity – DGP-7, Bonneville Power Administration, P.O. Box 3621, Portland, Oregon 97208. The cost is \$30.00. Subscriptions are not available.

**FACTORY REPRESENTATIVE SERVICES (14-50)**  
**(MAR 04)**

- (a) BPA may require the Contractor to furnish Factory Representatives that are responsible, competent, have a thorough technical knowledge of the equipment involved, and are well versed and can communicate in the English language. The Factory Representative will be responsible for monitoring and providing instructions during the assembly of the equipment. The direct responsibility for supervising and executing the work shall remain with BPA.
- (b) The Factory Representative will be paid the amount per day, including Sundays and National holiday's, stated in the Schedule of Items. This payment shall cover up to 10 hours a day.
- (c) Costs incurred for lodging, meals, and incidental expenses shall be reimbursed on an actual cost basis to the extent that they do not exceed the daily per diem rates in effect at the time of travel as set forth in the Federal Travel Regulations, prescribed by the General Services Administration, for travel in the contiguous 48 United States. Airline costs will be reimbursed on an actual cost basis to the extent determined reasonable and allocable under Part 13 of the BPI. The COTR must approve any variation from these requirements. Contractors may request a letter from the Contracting Officer authorizing access to airline, lodging, or other rates negotiated for Government travel to the extent such authorization is honored by the service providers.
- (d) The contractor shall make available the agreed upon number of Factory Representatives to BPA as soon as reasonably possible following notification by the Contracting Officer or Contracting Officers Technical Representative. Under no circumstances will the arrival of the Factory Representative(s) be delayed longer than 3 weeks from date of such notification.
- (e) BPA will designate the headquarters point from which the Factory Representative will work. It will be BPA's prerogative to direct the Factory Representative's movements while in the field. BPA will either furnish or allow any additional transportation if needed.
- (f) The Factory Representative may be required to remain at the headquarters point until the completion of energization and final acceptance is made.
- (g) The Factory Representative will align his working hours with those of the BPA's construction personnel to ensure that he is available for consultation at all times while installation of the equipment is in progress.
- (h) The responsibility of the Factory Representative begins from the time of arrival at the installation job site through installation and energization. The Factory Representative shall be available for consultation, although he need not be actually present at the installation over and above the normal working day if he does not so desire.
- (i) Any cost incurred to BPA due to oversight or negligence of the Factory Representative shall be the responsibility of the Contractor up to the time of energization and final acceptance. However, the Contractor shall not be responsible for defects in the installation of the equipment due to refusal or failure of BPA to follow reasonable instructions of the Factory Representative.
- (j) The Factory Representative shall furnish to the BPA Construction Foreman a written report of the complete installation, all modifications made, and any problems encountered during the installation, as well as any unusual conditions or special instructions.

**SUBCONTRACTS (14-7)**  
**(SEP 98)(BPI 14.9.1)**

The Contractor shall not subcontract any work without prior approval of the Contracting Officer, except work specifically agreed upon at the time of award. BPA reserves the right to approve specific subcontractors for work considered to be particularly sensitive. Consent to subcontract any portion of the contract shall not relieve the contractor of any responsibility under the contract.

**CONTRACT ADMINISTRATION REPRESENTATIVES (14-2)**  
**(SEP 98)(BPI 14.3.2)**

- (a) In the administration of this contract, the Contracting Officer may be represented by one or more of the following: Contracting Officer's Representative for administrative matters, and Contracting Officer's Technical Representative, Receiving Inspector, and/or Field Inspector for technical matters.

- (1) The Contracting Officer's Representative shall be:

Christina Craig  
Phone: (360) 418-2710  
Fax: (360) 418-2362  
E-mail: [cmcraig@bpa.gov](mailto:cmcraig@bpa.gov)

- (2) The Contracting Officer's Technical Representative shall be:

Fred Elliott  
Phone: (360) 418-2269  
Fax: (360) 418-2958  
E-mail: [feelliott@bpa.gov](mailto:feelliott@bpa.gov)

- (b) These representatives are authorized to act on behalf of the Contracting Officer in all matters pertaining to the contract, except: (1) contract modifications that change the contract price, technical requirements or time for performance, unless delegated field modification authority (see clause 24-25); (2) suspension or termination of the Contractor's right to proceed, either for default or for convenience of BPA; and (3) final decisions on any matters subject to appeal, as provided in a disputes clause. In addition, Field Inspectors may not make final acceptance under the contract.

**STOP WORK ORDER (14-14)**  
**(SEP 98)(BPI 14.12.1)**

- (a) The Contracting Officer may order the Contractor to suspend all or any part of the work of this contract for the period of time that the Contracting Officer determines appropriate for the convenience of BPA.
- (b) The contractor shall immediately comply with the Contracting Officer's order and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order.
- (c) If a stop work order is issued for the convenience of BPA, the Contracting Officer shall make an equitable adjustment in the delivery schedule or contract price, or both, if the order results in a change in the time required for, or the costs properly allocable to, the performance of any part of this contract.
- (d) A claim under this clause shall not be allowed (1) for any cost incurred more than 20 days before the Contractor notified the Contracting Officer of the basis of the claim in writing, and (2) unless the claim stating the amount of time or money requested, is asserted in writing as soon as practicable after the termination of the delay or interruption, but not later than the day of final payment under the contract.

**CHANGES - FIXED-PRICE (14-8)**  
**(SEP 98)(BPI 14.10.5.1.1)**

- (a) The Contracting Officer may at any time, by written order, and without notice to the sureties, if any, make changes within the general scope of this contract to any one or more of the following:
- (1) Drawings, designs, or specifications when the supplies to be furnished are to be specially manufactured for BPA in accordance with the drawings, designs, or specifications.
  - (2) Method of shipment or packing.
  - (3) Place of delivery or performance.
  - (4) Description of services to be performed.
  - (5) Time of performance (i.e., hours of the day, days of the week, etc.).
  - (6) BPA-furnished property.
  - (7) Place of inspection or acceptance.
- (b) If any such change causes an increase or decrease in the cost of, or the time required for, performance of any part of the work under this contract, whether or not changed by the order, the Contracting Officer shall make an equitable adjustment in the contract price, the delivery schedule, or both, and shall modify the contract.
- (c) The Contractor must assert its right to an adjustment under this clause within 30 days from the date of receipt of the written order, but not later than final payment.
- (d) Failure to agree to any adjustment shall be a dispute under a disputes clause if one is included in this contract. However, nothing in this clause shall excuse the Contractor from proceeding with the contract as changed.
- (e) Constructive Changes. If the Contractor considers that a BPA action or inaction constitutes a change to the contract (constructive change), and the change is not identified as such in writing and signed by the CO, the Contractor shall promptly notify the CO in writing. No equitable adjustment will be made for costs incurred more than 20 days before the Contractor gives written notice of the constructive change.
- (f) Notwithstanding other provisions herein, only the Contracting Officer, or persons specifically delegated authority to do so by the Contracting Officer, are authorized to orally modify or affect the terms of this contract. Contractor response to oral direction from any other source is at its own risk of liability.

**MODIFICATION COST PROPOSAL - PRICE BREAKDOWN (14-13)**  
**(SEP 98)(BPI 14.10.5.1.1)**

- (a) The contractor, in connection with any proposal it makes for a contract modification, shall furnish a price breakdown, itemized as required by the Contracting Officer. The breakdown shall be in enough detail to permit an analysis of all material, labor, equipment, subcontract, and overhead costs, as well as profit, and shall cover all work involved in the modification, whether such work was deleted, added or changed. Any amount claimed for subcontracts shall be supported by similar price breakdowns from those subcontractors.
- (b) In addition, if the proposal includes a time extension, a justification thereof shall also be furnished. Notwithstanding any other provisions of this contract, it is mutually understood that the time extension for changes in the work will depend upon the extent, if any, by which the changes cause delay in the completion of the various elements of work. The contract completion dates will be extended only for those specific elements so delayed and the remaining contract completion dates for all other portions of the work will not be altered.

- (c) The proposal, together with the price breakdown and time extension justification, shall be furnished by the date specified by the Contracting Officer.

**PRICING OF ADJUSTMENTS (14-12)**  
**(SEP 98)(BPI 14.10.5.1.1)**

When costs are a factor in any determination of a contract price adjustment pursuant to the Changes clause or any other modification in connection with this contract, such costs shall be in accordance with the contract cost principles and procedures in Part 13 of the Bonneville Purchasing Instructions which are in effect on the date of this contract.

**EXAMINATION OF RECORDS (12-3)**  
**(SEP 98)(BPI 12.8.8.1)**

- (a) The contractor shall keep accurate and complete accounting records in support of all cost-based billings to BPA in accordance with generally accepted accounting principles and practices. The Comptroller General of the United States, the Contracting Officer, or their representatives, shall have the right to examine, audit, and reproduce any of the Contractor's pertinent records involving transactions related to this contract or any subcontract hereunder. Records includes, but is not limited to, books, documents, and other information regardless of form (e.g., machine readable data) or type (e.g. data bases, applications software, data base management software, utilities, etc.) including computations and projections related to proposing, negotiating, pricing, subcontracting, modifying or performing the contract. The purpose of such examination shall be to determine the accuracy, completeness, and currency of costs charged under the contract and/or to verify cost or pricing information submitted to BPA.
- (b) Such documents shall be available for three (3) years after final payment or, in the case of termination, three (3) years from the date of any final termination settlement. Records relating to appeals under the Disputes clause or to litigation or the settlement of claims arising under or relating to this contract shall be made available until such appeals, litigation, or claims have been disposed of.
- (c) The contractor shall insert a clause containing all the terms of this clause, including this paragraph (c), in other than fixed price subcontracts over \$100,000, altering the clause as necessary to identify the contracting parties and the Contracting Officer under the prime contract.

**REQUIREMENT FOR U.S. FLAG VESSELS (14-16)**  
**(NOV 08)(BPI 14.15.1)**

- (a) The Contractor shall use a privately owned U.S. flag commercial vessel, to ship no less than 50 percent of the gross tonnage involved in this contract (computed separately for dry bulk carriers, dry cargo liners, and tankers) whenever shipping any equipment, materials, or commodities to the extent such vessels are available at rates that are fair and reasonable for United States flag commercial vessels. Privately owned U.S. flag commercial vessel means one of the following: a vessel (1) registered and operated under the laws of the United States, (2) used in commercial trade of the United States, (3) owned and operated by U.S. citizens, including a vessel under voyage or time charter to the Government, or (4) a Government-owned vessel under bareboat charter to, and operated by U.S. citizens.
- (b) (1) The Contractor shall submit one legible copy of a rated on-board ocean bill of lading for each shipment to both (i) the Contracting Officer and (ii) the Division of National Cargo, Office of Market Development, Maritime Administration, U.S. Department of Transportation, Washington, D.C. 20590. Subcontractor bills of lading shall be submitted through the Prime Contractor.
- (2) The Contractor shall furnish these bill of lading copies (i) within 20 working days of the date of loading for shipments originating in the United States, or (ii) within 30 working days for shipments originating outside the United States. Each bill of lading copy shall contain the following information:

- (A) Sponsoring U.S. Government agency.
  - (B) Name of vessel.
  - (C) Vessel flag of registry.
  - (D) Date of loading.
  - (E) Port of loading.
  - (F) Port of final discharge.
  - (G) Description of commodity.
  - (H) Gross weight in kilograms and cubic meters if available.
  - (I) Total ocean freight revenue in U.S. dollars.
- (c) Guidance regarding fair and reasonable rates for privately owned U.S.-flag commercial vessels may be obtained from the Division of National Cargo, Office of Market Development, Maritime Administration, U.S. Department of Transportation, Washington, D.C. 20590, Phone: (202) 366-4610.
- (d) In the event that the contractor is unable to obtain a U.S. Flag Vessel, it may request BPA to waive the requirements of this clause. Such request will be supported by documentation showing that no U.S. flag vessel was available, and that a timely attempt was made to obtain one. If the CO waives the applicable clause, the difference in cost between the U.S. Flag and Foreign Flag Vessel shipping costs will be added to or deducted from the contract by modification, as appropriate.
- (e) Where a contract may involve shipment on U.S. Flag vessels, BPA may furnish information on the award to the Maritime Administration so that it can assist the Contractor in locating such vessels. However, Maritime's relationship to the Contractor is noncontractual.

**SCREENING REQUIREMENTS FOR PERSONNEL HAVING ACCESS TO BPA FACILITIES (23-4)  
(MAY 07)(BPI 23.4.1)**

- (a) The following definitions shall apply to this contract:
- (1) "Access" means the ability to enter BPA facilities as a direct or indirect result of the work required under this contract.
  - (2) "Sensitive unclassified data" means information requiring a degree of protection due to the risk and magnitude of loss or harm that could result from inadvertent or deliberate disclosures, alteration, or restriction. Sensitive unclassified data may include, but are not limited to: personnel data maintained in systems or records subject to the Privacy Act of 1974, Pub. L. 93-579 (5 U.S.C. 552a); proprietary business data within the meaning of 18 U.S.C. 1905 and the Freedom of Information Act (5 U.S.C. 552); unclassified controlled nuclear information within the meaning of 42 U.S.C. 2168; critical infrastructure information, energy supply data; economic forecasts; and financial data.
- (b) BPA personnel screening activities are based on the Homeland Security Presidential Directive 12 (HSPD-12), and DOE rules and guidance as implemented at BPA. The background screening process to be conducted by the Office of Personnel Management is called a National Agency Check with Inquiries (NACI). The results of the NACI process will provide BPA with information to determine an individual's initial eligibility or continued eligibility for access to BPA facilities including IT access. Such a determination shall not be construed as a substitute for determining whether an individual is technically suitable for employment.

- (c) The contractor is responsible for protecting BPA property during contract performance, including sensitive unclassified data. Effective October 27, 2005, all new-hire contract employees expected to work at federal facilities for six or more consecutive months must be screened according to HSPD-12. To initiate the federal screening process discussed in paragraph (b) above, the contractor shall ensure that all prospective contract employees present the required forms of personal identification and complete SF85 - Questionnaire for Non Sensitive Positions and submit it to BPA for processing. All contract employees on board prior to that date will be screened in phases according to length of service. Rescreenings of longer-term contract employees will occur at periodic intervals, generally of five years.
- (d) As part of the NACI, the government's determination of approval for an individual's access shall be at least based upon criteria listed below. However, the contractor also has a responsibility to affirm that permitting the individual access to BPA facilities and/or computer systems is an acceptable risk which will not lead to improper use, manipulation, alteration, or destruction of BPA property or data, including unauthorized disclosure. Positive findings in any of these areas shall be sufficient grounds to deny access.
  - (1) Any behavior, activities, or associations that may show the individual is not reliable or trustworthy.
  - (2) Any deliberate misrepresentations, falsifications, or omissions of material facts.
  - (3) Any criminal, dishonest or immoral conduct (as defined by local Law), or substance abuse.
  - (4) Any illness, including any mental condition, of a nature which, in the opinion of competent medical authority, may cause significant defect in the judgment or reliability of the employee, with due regard to the transient or continuing effect of the illness and the medical findings in such case.
- (e) If the NACI screening process described above prompts a determination to disapprove access, BPA shall notify the contractor, who will then inform the individual of the determination and the reasons therefore. The contractor shall afford the individual an opportunity to refute or rebut the information that has formed the basis for the initial determination, according to the appeal process prescribed by HSPD-12 and supplemental implementing guidance.
- (f) If the individual is granted access, the individual's employment records or personnel file shall contain a copy of the final determination as described in paragraph (e) above and the basis for the determination. The contractor shall conduct periodic reviews of the individual's employment records or personnel file to reaffirm the individual's continued suitability for access. The reviews should occur annually, or more often as appropriate or necessary. If the contractor becomes aware of any new information that could alter the individuals' continued eligibility for approved access, the contractor shall notify the COTR immediately.
- (g) If a security clearance is required, then the applicant's job qualifications and suitability must be established prior to the submission of a security clearance request to DOE. In the event that an applicant is specifically hired for a position that requires a security clearance, then the applicant shall not be placed in that position until a security clearance is granted by DOE.
- (h) In addition to the requirements described elsewhere in this clause, all contractor employees who may be accessing any of BPA's information resources must participate annually in a BPA-furnished information resources security training course.
- (i) The contractor is responsible for obtaining from its employees any BPA-issued identification and/or access cards immediately upon termination of an employee's employment with the contractor, and for returning it to the COTR, who will forward it to Security Management.
- (j) The substance of this clause shall be included in any subcontracts in which the subcontractor employees will have access to BPA facilities and/ or computer systems.

**ORDER OF PRECEDENCE (14-3)**  
**(SEP 98)(BPI 14.4.1.1)**

Any inconsistency in this solicitation or contract shall be resolved by giving precedence in the following order: (a) the Schedule (excluding the specifications or statement of work); (b) contract clauses; (c) the specifications or statement of work; and (d) other documents, exhibits, and attachments.

**BANKRUPTCY (14-18)**  
**(OCT 05)(BPI 14.19.1)**

In the event the Contractor enters into proceedings relating to bankruptcy, whether voluntary or involuntary, the Contractor agrees to furnish written notification of the bankruptcy to the Contracting Officer responsible for administering the contract. This notification shall be furnished within five days of the initiation of the proceedings relating to bankruptcy filing. This notification shall include the date on which the bankruptcy petition was filed, the identify of the court in which the bankruptcy petition was filed, and a listing of Government contract numbers and contracting officers for all Government contracts against final payment has not been made. This obligation remains in effect until final payment under this contract.

## STANDARDS OF CONDUCT AND BUSINESS PRACTICES

### CERTIFICATION, DISCLOSURE, AND LIMITATION REGARDING PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (3-3) (SEP 98)(BPI 3.5.6)

(a) As used in this clause:

"Covered Federal action" means

- (1) The awarding of any Federal contract.
- (2) The extension, continuation, renewal, amendment, or modification of any Federal contract.

"Indian tribe" and "tribal organization" have the meaning provided in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450B) and includes Alaskan Natives.

"Influencing or attempting to influence" means making, with the intent to influence, any communication to or appearance before an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any covered Federal action.

"Local government" means a unit of government in a State and, if chartered, established, or otherwise recognized by a State for the performance of a governmental duty, includes a local public authority, a special district, an intrastate district, a council of governments, a sponsor group representative organization, and any other instrumentality of a local government.

"Person" means an individual, corporation, company, association, authority, firm, partnership, society, State, and local government, regardless of whether such entity is operated for profit or not for profit. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Reasonable compensation" means, with respect to a regularly employed officer or employee of any person, compensation that is consistent with the normal compensation for such officer or employee for work that is not furnished to, not funded by, or not furnished in cooperation with the Federal Government.

"Reasonable payment" means, with respect to professional and other technical services, a payment in an amount that is consistent with the amount normally paid for such services in the private sector.

"Recipient" includes all contractors and subcontractors. The term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Regularly employed" means, with respect to an officer or employee of a person requesting or receiving a Federal contract, an officer or employee who is employed by such person for at least 130 working days within one year immediately preceding the date of the submission that initiates agency consideration of such person for receipt of such contract. An officer or employee who is employed by such person for less than 130 working days within one year immediately preceding the date of the submission that initiates agency consideration of such person shall be considered to be regularly employed as soon as he or she is employed by such person for 130 working days.

"State" means a State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, a territory or possession of the United States, an agency or instrumentality of a State, and a multi-State, regional, or interstate entity having governmental duties and powers.

(b) The offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief that:

- (i) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of

Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract or the extension, continuation, renewal, amendment, or modification of any Federal contract.

- (2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the offeror shall complete and submit, with its offer, Standard Form-LLL, Disclosure of Lobbying Activities, to the Contracting Officer.
  - (3) He or she will include the language of this certification in all subcontract awards at any tier and that all sub-recipients of subcontract awards in excess of \$100,000 shall certify and disclose accordingly.
- (c) Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, U.S. Code. Any person who makes an expenditure prohibited under this provision or who fails to file or amend the disclosure form to be filed or amended by this provision, shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.
- (d) A contractor who requests or receives from an agency a Federal contract shall file with that agency a disclosure form, OMB standard form LLL, Disclosure of Lobbying Activities, if such person has made or has agreed to make any payment using non appropriated funds (to include profits from any covered Federal action), which would be prohibited under this clause if paid for with appropriated funds.
- (e) The contractor shall file a disclosure form at the end of each calendar quarter in which there occurs any event that materially affects the accuracy of the information contained in any disclosure form previously filed by such person under paragraph (b) of this clause. An event that materially affects the accuracy of the information reported includes--
- (1) A cumulative increase of \$25,000 or more in the amount paid or expected to be paid for influencing or attempting to influence a covered Federal action; or
  - (2) A change in the person(s) or individual(s) influencing or attempting to influence a covered Federal action; or
  - (3) A change in the officer(s), employee(s), or Member(s) contacted to influence or attempt to influence a covered Federal action.
- (f) The contractor shall require the submittal of a certification, and if required, a disclosure form, by any person who requests or receives any subcontract exceeding \$100,000 under the Federal contract.
- (g) All subcontractor disclosure forms (but not certifications), shall be forwarded from tier to tier until received by the prime contractor. The prime contractor shall submit all disclosure forms to the Contracting Officer at the end of the calendar quarter in which the disclosure form is submitted by the subcontractor. Each subcontractor certification shall be retained in the subcontract file of the awarding contractor.
- (h) Any person who makes an expenditure prohibited under this clause or who fails to file or amend the disclosure form to be filed or amended by this clause shall be subject to a civil penalty as provided by 31 U. S. Code 1352. An imposition of a civil penalty does not prevent the Government from seeking any other remedy that may be applicable.

**DRUG-FREE WORKPLACE (3-6)**  
**(SEP 98)(BPI 3.6.4)**

- (a) The contractor agrees that with respect to all employees to be employed under this contract it will provide a drug-free workplace as described in this clause.

- (b) Definitions. As used in this clause "Controlled substance" means a controlled substance in schedules I through V of section 202 of the Controlled Substances Act (21 U.S.C. 812), as from time to time amended, and as further defined in regulation at 21 CFR 1308.11-1308.15, as amended.

"Conviction" means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes.

"Criminal drug statute" means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, possession or use of any controlled substance.

"Drug-free workplace" means the site(s) for the performance of work done by the contractor in connection with a specific contract at which employees of the contractor are prohibited from engaging in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance.

"Employee" means an employee of a contractor directly engaged in the performance of work under a Government contract. "Directly engaged" is defined to include all direct cost employees and any other contractor employees who have other than a minimal impact or involvement in contract performance.

"Individual" means an offeror/contractor that has no more than one employee including the offeror/contractor.

- (c) The Contractor, if other than an individual, shall -- within 30 calendar days after award (unless a longer period is agreed to in writing for contracts of 30 calendar days or more performance duration); or as soon as possible for contracts of less than 30 calendar days performance duration--

(1) Publish a statement notifying its employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establish an on-going drug-free awareness program to inform such employees about--

(A) The dangers of drug abuse in the workplace;

(B) The contractor's policy of maintaining a drug-free workplace;

(C) Any available drug counseling, rehabilitation, and employee assistance programs; and

(D) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace.

(3) Provide all employees engaged in performance of the contract with a copy of the statement required by subparagraph (c)(1) of this clause;

(4) Notify such employees in writing in the statement required by subparagraph (c)(1) of this clause that, as a condition of continued employment on this contract, the employee will--

(A) Abide by the terms of the statement; and

(B) Notify the employer in writing of the employee's conviction under a criminal drug statute for a violation occurring in the workplace no later than five (5) days after such conviction.

(5) Notify the Contracting Officer in writing within ten (10) days after receiving notice under subdivision (c)(4)(B) of this clause, from an employee, or otherwise receiving actual notice of such conviction. The notice shall include the position title of the employee;

(6) Within 30 days after receiving notice under subparagraph (c)(4)(B) of this clause of a conviction, take one of the following actions with respect to any employee who is convicted of a drug abuse violation occurring in the workplace:

- (A) Taking appropriate personnel action against such employee, up to and including termination; and/or
  - (B) Require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.
- (7) Make a good faith effort to maintain a drug-free workplace through implementation of subparagraphs (c)(1) through (c)(6) of this clause.
- (d) In addition to other remedies available to the Government, the Contractor's failure to comply with the requirements of paragraph (c) of this clause may, pursuant to BPI 3.6.3 render the contractor subject to suspension of contract payments, termination of the contract for default, and suspension or debarment.

**CONTRACTOR COMPLIANCE WITH BPA POLICIES (3-8)  
(NOV 08)(BPI 3.7.1)**

- (a) The contractor shall comply with all BPA policies affecting the BPA workplace environment. Examples of specific policies are:
- (1) Harassment-free workplace;
  - (2) Non-smoking workplace;
  - (3) Firearms and other weapons (BPAM 1086);
  - (4) Safety and health clauses in this contract;
  - (5) Visits to BPA substations, rights-of-way work sites, other electrical hazardous work sites, and non-electrical hazardous work sites;
  - (6) Standards of conduct regarding transmission information (BPI 3.2);
  - (7) Dissemination of Critical and Sensitive Information, Including Information Pertaining to Critical Infrastructure (BPAM 1081); and
  - (8) Identity verification and background screening for all contractors, and pre-approval for non-US Citizen access to BPA facilities, as prescribed by the BPA Security office procedures.
- (b) The contractor shall obtain from the CO information describing the policy requirements. A contractor who fails to enforce workplace policies is subject to suspension or default termination of the contract.

**RESTRICTION ON COMMERCIAL ADVERTISING (3-9)  
(OCT 05) (BPI 3.8.1)**

The Contractor agrees that without the Bonneville Power Administration's (BPA) prior written consent, the Contractor shall not use the names, visual representations, service marks and/or trademarks of the BPA or any of its affiliated entities, or reveal the terms and conditions, specifications, or statement of work, in any manner, including, but not limited to, in any advertising, publicity release or sales presentation. The Contractor will not state or imply that the BPA endorses a product, project or commercial line of endeavor.

## **SOCIO-ECONOMIC ISSUES**

### **UTILIZATION OF SMALL BUSINESS CONCERNS AND SMALL DISADVANTAGED BUSINESS CONCERNS (8-3) (SEP 98)(BPI 8.3.4)**

- (a) It is the policy of the United States that small business concerns, and small business concerns owned and controlled by socially and economically disadvantaged individuals shall have the maximum practicable opportunity to participate in the performance of contracts let by any Federal agency, including contracts and subcontracts.
- (b) Prime contractors shall establish procedures to ensure the timely payment of amounts due pursuant to the terms of their subcontracts with small business concerns and small business concerns owned and controlled by socially and economically disadvantaged individuals.
- (c) The Contractor hereby agrees to carry out the policies in (a) and (b) in the awarding of subcontracts to the fullest extent consistent with efficient contract performance. The Contractor agrees to cooperate in any studies or surveys as may be conducted by the United States Small Business Administration or the Department of Energy as may be necessary to determine the extent of the Contractor's compliance with this clause.
- (d) As used in this contract, the terms "small business concern" and "small business concern owned and controlled by socially and economically disadvantaged individuals" shall mean a small business as defined pursuant to section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto.

### **NONDISCRIMINATION AND AFFIRMATIVE ACTION (10-1) (NOV 08)(BPI 10.2.1)**

- (a) The Contractor shall not discriminate against its employees or applicants because of their race, color, religion, sex, national origin, age, status as Disabled or Vietnam Veterans, or physical or mental handicaps. The Contractor certifies that it does not, and will not, maintain segregated facilities or accommodations on the basis of race, color, religion or national origin. Regarding any position for which an employee or an applicant is qualified, the Contractor agrees to take affirmative action to employ, train, advance in employment and retain individuals in accordance with applicable laws and regulations including:
  - (1) For nondiscrimination based on race, color, religion, sex or national origin this includes, but is not limited to, the U. S. Constitution, and Parts II and IV of Executive Order 11246, September 24, 1965 (30 Fed. Reg. 12319). Contractor disputes related to compliance with its obligations shall be handled according to the rules, regulations and relevant orders of the Secretary of Labor (See 41 CFR 60).
  - (2) For nondiscrimination based on Disabled or Vietnam Veterans this includes, but is not limited to, the Vietnam Era Veterans Readjustment Assistance Act of 1972, as amended (38 U.S.C. 4012); Executive Order 11701, January 24, 1973 (38 CFR 2675); and the regulations of the Secretary of Labor (41 CFR Part 60-250).
  - (3) For nondiscrimination based on the Handicapped this includes, but is not limited to, Section 503 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 793); Executive Order 11758, January 15, 1974; and the regulations of the Secretary of Labor (41 CFR Part 60-741).
  - (4) For nondiscrimination based on Age this includes, but is not limited to, Executive Order 11141, February 12, 1964 (29 CFR 2477).
- (b) The Contractor shall include the terms of this clause in every subcontract or purchase order exceeding \$50,000 and shall act as specified by the Department of Labor to enforce the terms and implement remedies.

## **ENVIRONMENT AND SAFETY**

### **CLEAN AIR AND WATER (15-1) (SEP 98)(BPI 15.1.1)**

Facilities listed on the Environmental Protection Agency List of Violating Facilities shall not be used in the performance of this contract. The contractor agrees to meet Clean Air and Water standards as identified in 42 U.S.C. 7401 et seq., Executive Order 11738, and any implementation plan described in 42 U.S.C. 1342 as well as local government with pretreatment regulations (33 U.S.C. 1317). The contractor shall comply with all requirements of the Clean Air Act (42 U.S.C. 7414) and the Clean Water Act (33 U.S.C. 1318) relating to inspection, monitoring, entry, reports and information, and all regulations and guidelines.

### **HAZARDOUS MATERIAL IDENTIFICATION AND MATERIAL SAFETY DATA (15-6) (SEP 98)(BPI 15.3.1)**

- (a) The Contractor agrees to submit a Material Safety Data Sheet (Department of Labor Form OSHA-20), as prescribed in Federal Standard No. 313C, for all hazardous material 5 days before delivery of the material whether or not it is listed in Appendix A of the Standard. This obligation applies to all materials delivered under this contract which will involve exposure to hazardous materials or items containing these materials.
- (b) "Hazardous material," as used in this clause, is as defined in Federal Standard No. 313C, in effect on the date of this contract.
- (c) Neither the requirements of this clause nor any act or failure to act by BPA shall relieve the Contractor of any responsibility or liability for the safety of BPA, Contractor, or subcontractor personnel or property.
- (d) The Contractor shall comply with applicable Federal, state, and local laws, codes, ordinances, and with regulations (including the obtaining of licenses and permits) in connection with hazardous material.
- (e) The Contractor shall insert this clause, including this Paragraph (e), with appropriate changes in the designation of the parties, in subcontracts at any tier (including purchase orders) under this contract involving hazardous material.

### **SAFETY AND HEALTH - SUBSTATION CONSTRUCTION (15-52M) (FEB 09)(BPI 15.2.1)**

- (a) The Contractor shall assure that no person employed on this contract works in surroundings or under conditions that are unsanitary, hazardous, or dangerous to their health or safety. In fulfilling these requirements, the Contractor shall comply with:
  - (A) Department of Labor Safety and Health Standards for Construction under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3701 et seq.).
  - (B) Occupational Safety and Health Act of 1970, (Public Law 91-598) and applicable rules and regulations as may have been delegated to the States.
  - (C) All Federal and state safety and health rules and regulations applicable to the contract work, as supplemented by BPA safety and health requirements stated below or elsewhere in the contract.

## **INSPECTION AND WARRANTY**

### **INSPECTION - SUPPLIES (18-2) (SEP 98)(BPI 18.3.1)**

- (a) The Contractor shall provide and maintain a quality system covering supplies ("supplies" includes equipment, fabrication processes, raw materials, and intermediate assemblies) in accordance with Unit 3 of this contract.
- (b) BPA may inspect and test all supplies called for by the contract at any place and time. If inspection and tests are performed on the Contractor's site, the Contractor shall provide BPA reasonable facilities and assistance. Except as otherwise provided in the contract, BPA shall bear the expense of BPA inspections or tests made at other than the Contractor's or subcontractor's premises; provided that, in case of rejection, BPA shall not be liable for any reduction in the value of inspection or test samples. BPA is not obligated to perform any inspection and test for the benefit of the Contractor unless specifically set forth elsewhere in this contract. BPA will perform inspections and tests in a manner that will not unduly delay the work.
- (c) The Contractor may be charged for BPA's costs of inspection if supplies are not ready at the time specified by the contract for inspection and tests or where prior rejection makes reinspection and retesting necessary. If the Contractor fails to perform tests required by the contract, BPA may perform the tests and charge the Contractor for the costs of such.
- (d) BPA may either reject or require correction of nonconforming supplies.
- (e) If this contract provides for inspection at the factory (see Unit 3), supplies shall not be shipped until all factory tests and inspections have been made and the supplies released by BPA's Contracting Officer's Technical Representative (COTR), unless waived in writing by the Contracting Officer or an authorized representative.
  - (1) If the BPA COTR exercises BPA's right of inspection at the factory, then the materials and equipment will not be reinspected at destination other than for shipping damage and shortages; however, this will apply only to (i) those items specifically inspected at the factory, and (ii) those characteristics and attributes which are verified during factory inspection.
  - (2) Factory inspection and release for shipment shall not constitute acceptance of the contract items by BPA.
- (f) Inspections and tests by BPA do not relieve the Contractor of responsibility for defects or other failures to meet contract requirements discovered before acceptance. Lack of inspection by BPA shall not relieve the Contractor of any obligations under this contract.

### **ACCEPTANCE - SUPPLIES (18-3) (SEP 98)(BPI 18.3.1)**

Unless explicitly accepted or rejected earlier, acceptance shall occur 60 days after date of delivery. Acceptance shall be conclusive, except for latent defects, fraud, gross mistakes amounting to fraud, or as otherwise provided in this contract.

### **WARRANTY - HEAVY ELECTRICAL EQUIPMENT (18-9M) (FEB 09)(BPI 18.5.1)**

- (a) The Contractor warrants that all materials, equipment, and supplies (including replacements and corrective repairs) will conform to the requirements of this contract, will be reasonably fit for their intended use, and will be free from defects in materials, workmanship, and, design (except BPA designs). The Contractor will not be liable for any deficiencies not discovered within five (5) years from the date the equipment was placed in service. If installation of the equipment is delayed through no fault of the Contractor, the date of placing the equipment in service shall be presumed to be 240 days after the date the equipment was received at the specified contract destination.

(b) Correction or Replacement--

- (1) Promptly after notice of deficiencies, the Contractor shall, as directed by BPA, either remove the materials, equipment, or supplies referred to in the notice and correct or replace and retest them, or correct and retest them in place.
  - (2) If immediate correction would tend to mitigate damages or if time limitations will not permit correction by the Contractor, BPA may proceed with such necessary correction, without prior notice to the Contractor.
- (c) The Contractor shall bear the expense of removal, correction or replacement, transportation charges, and reinstallation and retesting, whether incurred by or on behalf of BPA or the Contractor. The cost of removal of any appurtenant equipment shall be the responsibility of the Contractor. If BPA performs the corrective work, the Contractor shall reimburse BPA for direct costs for the corrective work plus the labor and material overhead rates that are in effect at the time work is performed. This procedure is called our DMCR (Defective Material Correction Reimbursement), see Attachment 4.
- (d) The rights and remedies of BPA provided in this clause are in addition to and do not limit any rights afforded to BPA by any other clause of this contract or under applicable Federal or State law, including the Uniform Commercial Code.

**EVENTS SCHEDULE (18-50)  
(DEC 00)**

The Contractor shall submit an Events Schedule with the critical milestones to the CO within thirty (30) calendar days after date of award. The Contractor shall submit an updated Events Schedule monthly.

**INSTRUCTION BOOKS (18-51M)  
(FEB 09)**

Prior to or at the time of shipment of the first piece of equipment, the Contractor shall be furnished as specified in Unit 3 Specification. If the equipment, as finally accepted, does not agree with that described in the final book, the Contractor shall furnish the necessary revisions for each book furnished and the transmittal shall identify the revised sections or paragraphs. Each instruction book shall contain one complete set of final drawings reviewed and revised per the Specification.

One instruction book shall be shipped with each piece of equipment. This book may be the manufacturer's standard instructions and the book shall be marked "For Construction Only" and have the equipment serial number noted.

Instruction books shall be delivered to the address below:

Bonneville Power Administration  
Instruction Book Review Unit – TESM-AMPN-2  
P.O. Box 491  
Vancouver, WA 98666-0491

OR:

Bonneville Power Administration  
Instruction Book Review Unit – TESM-AMPN-2  
5411 N.E. Highway 99  
Vancouver, WA 98663

A letter of transmittal shall accompany each submittal. A copy of the transmittal letter shall be forwarded to the CO and COTR. Each book shall be identified by the BPA Contract Number and Release Number when applicable, and Item Number(s) of all units to which the book applies.

**CONTRACTOR'S DRAWINGS (18-52M)  
(FEB 09)**

The Contractor shall submit drawings to the Substation Specification Group to be processed for review. The time consumed for this review shall be included in the time allowed for completion of the contract. The time consumed by BPA for this review will not exceed 30 calendar days after receipt of the drawings.

The Contractor shall submit one reproducible for each drawing and/or shall submit CAD data files in accordance with the specification requirements. The reproducible may be of any type; however, it must be of a quality that will provide clear and legible copies and shall be full size. Reduced size drawings are unacceptable.

Each drawing shall be identified by a drawing number and date, the BPA Purchase Order number and the Purchase Order Item number(s). The preferred location for this information is the lower right-hand corner of the drawing. All drawings and revisions shall be signed or initialed by a responsible representative of the Contractor. Only drawings with the latest revisions shall be submitted.

Each submittal shall be accompanied by a letter of transmittal. The letter of transmittal shall contain a list of the individual drawings including their title, drawing number, and revision number. If any drawing submitted for review deviates from previously reviewed drawings, these deviations shall be described in the letter of transmittal.

Drawings, which require changes, shall be resubmitted as soon as possible but not to exceed thirty (30) calendar days from the date the reviewed drawings were mailed to the Contractor. Any resubmittal shall be in accordance with the Section. Final drawings shall include one reproducible for each revised drawing and electronic files and a compact disc (CD) in accordance with this Section. Reduced size drawings are not acceptable.

Contractor's drawings shall be delivered to the following address:

For correspondence:  
Bonneville Power Administration  
Substation Specification and Document Group – TESD – CSB – 2  
P.O. Box 491  
Vancouver, WA 98666-0491

OR:

For parcels:  
Bonneville Power Administration  
Substation Specification and Document Group – TESD – CSB – 2.  
5411 N.E. Highway 99  
Vancouver, WA 98663-1302

OR:

For Electronic Copies:

[TESDVendorDocs@bpa.gov](mailto:TESDVendorDocs@bpa.gov)

**INSTRUCTION BOOK REVIEW (18-53)  
(DEC 00)**

Submittal of Instruction Books for preliminary review is only required if this is a first contract with BPA, or a new piece of equipment. Instruction books are to provide information necessary for construction, operation, and maintenance activities. Review is to assure that the instruction books contain the required information. Information supplied by manufacturers containing multiple listings of models, ratings, or part numbers shall have specific information pertinent to the equipment furnished, identified by highlighting, an arrow, or some other readily identifiable means. If preliminary review is required, the Contractor shall submit two copies of each book no later than sixty (60) days prior to the scheduled shipment of the first piece of equipment on the contract. BPA assumes no obligation to discover any deficiency in the Contractor's documentation. BPA will comment when

discrepancies from the Specifications are noted during review (see below). The CO will transmit comments to the Contractor within 30 calendar days after receipt of the Instruction Books for review.

Each instruction book will be stamped with one of the following categories:

- (a) REVIEWED – NO COMMENTS. The book has been reviewed and no comments are made.
- (b) REVIEWED – SEE COMMENTS. The book has been reviewed and comments noted thereon and/or in the return transmittal letter from the CO. This book shall be revised by the Contractor and resubmitted for review if requested by the CO.
- (c) NOT ACCEPTABLE. The book has been reviewed and is not acceptable. The reason will be stated in the return transmittal from the CO. The book shall be revised and resubmitted in accordance with Unit 3 Specification.

If any book submitted deviates from previously submitted books, these deviations shall be explained in the letter of transmittal.

**RELEASE FOR SHIPMENT (18-54)  
(JUN 07)**

No material or equipment shall be shipped until it has satisfactorily passed all applicable inspections and tests, and has been released for shipment by BPA CO/COTR.

**SHIPMENT COORDINATION (18-55)  
(DEC 06)**

Due to heightened security, ALL shipments to BPA (including the Ross Warehouse and all other BPA destinations) must be coordinated through the BPA Traffic Office. The vendor MUST contact the Traffic Office at 360-418-2472 or 360-418-2829, by FAX (360) 418-2461, or by e-mail at [traffic@bpa.gov](mailto:traffic@bpa.gov) at least two working days prior to anticipated shipping date with the carrier's name and phone number. The carrier must call at least 48 hours prior to delivery so that the Traffic Office can verify with the carrier the destination and to coordinate a specific date and time in advance of making the actual delivery.

BPA purchase order and/or release number along with the PO line item numbers must be included on all packing slips.

**SHIPPING DOCUMENTS (18-56)  
(JUN 07)**

Within 48 hours after each shipment, one copy of the shipping manifest and packing slip should be mailed to the address below:

Bonneville Power Administration  
Traffic Office, NSLT – Warehouse  
P.O. Box 491  
Vancouver, WA 98666-0491

OR:

By Fax (360) 418-2461

If a COTR is assigned to this contract, please forward two copies to the COTR.

**SHIPPING MARKS (18-57)  
(AUG 07)**

All shipping packages shall be plainly marked by indelible stencil or firmly fastened weatherproof tag with the following information:

Bonneville Power Administration (BPA)  
Destination  
Contract Number and Delivery Order Number (when applicable)  
Contract Item Number(s)  
Quantity & BPA Catalog ID Number (see top line on Schedule of Items)

**TERMINATION**

**TERMINATION FOR THE CONVENIENCE OF BPA (20-2)  
(MAY 07)(BPI 20.4.1)**

- (a) BPA may terminate all or any part of this contract, at any time, upon written notice to the contractor. Upon receipt of the termination notice, the contractor shall stop work on the terminated portion of the contract.
- (b) The contract amount shall be revised as a result of termination under this clause. On fixed-price contracts the revised amount shall not exceed the pre-termination contract price, excluding payments already received, plus reasonable termination expenses. On cost-reimbursement contracts it will not exceed the total of allowable and allocable costs of performance prior to termination, excluding payments already received, plus reasonable termination expenses, plus an adjustment of the fee on the terminated portion of the contract. No payment will be made for anticipated profits on the terminated portion, or consequential damages, of the contract. The contractor shall submit a settlement proposal within 30 days of the notice of termination.
- (c) The Contracting Officer may direct the disposition of material produced or acquired for the work terminated, or any completed or partially completed items.

**TERMINATION FOR DEFAULT (20-3.1) ALTERNATE I  
(OCT 93)(BPI 20.5.1)**

- (a) BPA reserves the right to terminate any or all of any undelivered or unexecuted portion of this contract for cause if the contractor fails to make any delivery, fails to prosecute the work, or to perform as scheduled, or if any of the contract terms are breached. However, the contractor shall not be terminated for default if the failure to perform arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of those causes are: (1) acts of God or of the public enemy, (2) acts of the Government in its sovereign or BPA in its contractual capacity, (3) fires, (4) floods, (5) epidemics, (6) quarantine restrictions, (7) strikes, (8) freight embargoes, and (9) unusually severe weather.
- (b) The Contracting Officer may direct the disposition of material produced or acquired for the work terminated, and the disposition of any completed or partially completed items.
- (c) BPA may acquire, under the terms and in the manner the Contracting Officer considers appropriate, supplies or services similar to those terminated, and the Contractor will be liable to BPA for any excess costs for those supplies or services, including administrative costs.

## **DISPUTES**

### **APPLICABLE LAW (21-5) (SEP 98)(BPI 21.3.12)**

Irrespective of the place of performance, this contract will be construed and interpreted according to the federal common law of government contracts, as enunciated and applied by federal judicial bodies, boards of contract appeals, and quasi-judicial agencies of the Federal Government. To the extent that the federal common law of government contracts is not dispositive, the laws of the State of Oregon shall apply.

### **RELEASE OF CLAIMS (21-4) (SEP 98)(BPI 21.3.12)**

After completion of work, and prior to final payment, the Contracting Officer may, at his or her option, require the Contractor to furnish a release of claims against BPA arising out of the contract, other than claims specifically excepted from the operation of the release.

### **DISPUTES RESOLUTION PROCESS (21-3) (OCT 05)(BPI 21.3.12)**

- (a) All disputes arising under or relating to this contract shall be resolved under this clause.
- (b) "Claim," as used in this clause, means a written demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to this contract. A claim arising under a contract, unlike a claim relating to that contract, is a claim that can be resolved under a contract clause that provides for the relief sought by the claimant. A voucher, invoice, or other routine request for payment or equitable adjustment that is not in dispute when submitted is not a claim. The submission may be converted to a claim, by complying with the requirements of this clause, if it is not disputed either as to liability or amount or is not acted upon in a reasonable time.
- (c) A claim by the Contractor shall be made in writing and submitted to the Contracting Officer for a written decision before final payment. A claim by BPA against the Contractor shall be subject to a written decision by the Contracting Officer.
- (d) For Contractor claims of \$100,000 or less, the Contracting Officer must, if requested in writing by the Contractor, render a decision within 60 days of receipt of the request. For Contractor claims in excess of \$100,000, the Contracting Officer must, within 60 days, decide the claim or notify the Contractor of the date when the decision will be made. At any time prior to issuance of the Contracting Officer's final decision, either party may request mediation or other alternate disputes resolution process (see paragraph (g)) by a third party in order to assist in settling the claim. Should the contractor request the use of an alternate disputes resolution process, the time frames for issuing a CO decision and payment of interest shall be suspended.
- (e) The decision of the Contracting Officer shall be final and conclusive and not subject to review by any forum, tribunal, or Government agency unless:
- (1) Within 90 days from the date of receipt of such decision the Contractor or Contracting Officer initiates disputes resolution processes described in Subchapter IV of the Administrative Disputes Resolution Act of 1990 (P. Law 101-552, 104 Stat. 2736) with the Seattle Office of the American Arbitration Association at the address,

American Arbitration Association  
701 Pike Street, Suite 950  
Seattle, WA 98101-4111

whose telephone number is (206) 622-6435 and facsimile number is (206) 343-5679; or

- (2) Within 90 days from the date of receipt of such decision the Contractor appeals the decision to the US Department of Energy, Board of Contract Appeals at either it's postal or courier address:

US Postal Service (USPS) mailing address: US Department of Energy  
Board of Contract Appeals  
HG-50, Building 950  
L'Enfant Plaza Building  
1000 Independence Avenue SW  
Washington, DC 20585-0116

Courier and other than USPS address: US Department of Energy  
Board of Contract Appeals  
Suite 810  
950 L'Enfant Plaza SW  
Washington, DC 20024

whose telephone number is (202) 287-1900 and facsimile (202) 287-1700, in the manner specified in the decision; or

- (3) Within 12 months from the date of receipt of such decision the Contractor brings an action thereon in the United States Court of Federal Claims.
- (f) The authority of the Contracting Officer under the Act does not extend to claims or disputes which by statute or regulation other agencies are expressly authorized to decide.
- (g) Alternative disputes resolution process.
- (1) The parties are encouraged to attempt an alternative dispute resolution as described by Subchapter IV of the Administrative Disputes Resolution Act of 1990 (P. Law 101-552, 104 Stat. 2736), including, at the request of any party, mediation or binding arbitration, prior to commencing litigation in any court, board or tribunal. Mediation shall be accomplished as agreed between the parties. Arbitration, if any, shall be done through the Seattle, Washington Office of the American Arbitration Association, and shall be done according to the Commercial Arbitration Rules of the American Arbitration Association, using one arbitrator unless otherwise agreed to by the parties. If the contractor rejects BPA's request to use an alternate dispute resolution process, the reason for its rejection shall be furnished to the Contracting Officer.
- (2) The parties stipulate that any tribunal to which any controversy or claim is brought should stay its proceedings, except in aid of arbitration, pending completion of arbitration and the issuance of the Arbitrator's award.
- (3) Service of summons in any court action to enforce or challenge an award must be effectuated according to Rule 4 of the Federal Rules of Civil Procedure for the United States District Courts or under the comparable rule of another court or tribunal with subject matter jurisdiction.
- (4) Except as specified below in this paragraph, there shall be no discovery in connection with any dispute resolution process. However, in the event that any party to such dispute resolution process shall receive information pertaining to the dispute through anyone's use of the Freedom of Information Act with the Department of Energy or Bonneville Power Administration, then, at the option of Bonneville Power Administration, other discovery shall be permitted and, if thus permitted at all, shall be opened fully to all parties. To the extent that such discovery cannot be effectuated by consent and agreement, it shall be under the supervision of the individual assisting with the dispute resolution.
- (h) BPA shall pay interest on the amount found due and unpaid from: (1) the date the Contracting Officer receives the claim, or (2) the date payment otherwise would be due, if that date is later, until the date of payment. Simple interest on claims shall be paid at the rate fixed by the Secretary of the Treasury, and applicable for each 6-month period as fixed by the Treasury Secretary during the pendency of the claim.

- (i) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal, or action arising under or relating to the contract, and comply with any decision of the Contracting Officer.

## UNIT 3 — SPECIFICATIONS

### POWER TRANSFORMERS, BPA 22-11STS, FEB 17, 2009

This specification prescribes the specific technical requirements applicable to a particular item of equipment being furnished. "NA" in any column means "not applicable" to the item.

For a complete technical description of the equipment, this specification is to be used in conjunction with the description and the GENERAL TECHNICAL SPECIFICATION.

**NOTE: This transformer is a system spare that will be moved around the BPA system as needed. Designs that are optimized for ease of transportation are essential to this use.**

#### Allston Spare Transformer

WO 194504

#### 3-A TYPE AND RATING

3-A.1	Type	Auto-transformer
3-A.2	No. of phases	3
3-A.3	MVA Rating, 65°C Rise	
	H-Winding	180/240/300
	X-Winding	180/240/300
	Y-Winding	*
	* The tertiary winding rating shall be determined by the manufacturer based on transformer design needs for non-simultaneous loading. The minimum acceptable rating is 25 MVA	
3-A.4	Cooling Class	
	First Stage	ONAN
	Second Stage	ONAF
	Third Stage	ONAF
3-A.5	Elevation	6000 feet

#### 3-B VOLTAGE RATINGS

3-B.1	Nominal phase-to-phase voltage, kV	
	H-Winding Connection	230 Gnd. Wye
	X-Winding Connection	115 Gnd. Wye

	Y-Winding Connection	13.8 Delta
3-B.2	Lead-lag switch	NA
3-B.3	Angular displacement (connection for shipment)	NA

### 3-C MINIMUM WINDING INSULATION LEVELS

#### 3-C.1 H Winding - Phase End

	Basic Lightning Impulse Insulation Level (BIL) (kV crest)	750
	Chopped Wave Test Level Crest Voltage, kV	825
	Switching Impulse Level (BSL) (kV crest)	620
	<b>Induced Voltage Test (phase to ground)</b>	
	One Hour Test Level (kV rms)	210
	Enhancement Level (kV rms)	240
	<b>Applied Voltage Test Level (kV rms)</b>	NA

#### 3-C.2 X Winding - Phase End

	Basic Lightning Impulse Insulation Level (BIL) (kV crest)	450
	Chopped Wave Test Level Crest Voltage, kV	495
	Switching Impulse Level (BSL) (kV crest)	375
	<b>Induced Voltage Test (phase to ground)</b>	
	One Hour Test Level (kV rms)	105
	Enhancement Level (kV rms)	120
	<b>Applied Voltage Test Level (kV rms)</b>	NA

#### 3-C.3 Y Winding

	Basic Lightning Impulse Insulation Level (BIL) (kV crest)	150
	Chopped Wave Test Level Crest Voltage, kV	165
	<b>Applied Voltage Test Level (kV, rms)</b>	50

#### 3-C.4 X Winding - Neutral End

	Basic Lightning Impulse Insulation Level (BIL) (kV crest)	150
	<b>Applied Voltage Test Level (kV, rms)</b>	50

**3-D TAPS AND TAP CHANGERS**

3-D.1 H-Winding

Tap Changer Type LTC

Full Capacity Taps, phase to phase, volts (rms)

LTC position	H - winding voltage
9	241500
8	238625
7	235750
6	232875
5	230000
4	227125
3	224250
2	221375
1	218500

Reduced Capacity Taps, volts, rms NA

3-D.1.1 LTC Control Voltage shall be 125 VDC Positive control as a default configuration.

(NOTE: If Reinhausen (MR) equipment is used, BPA will provide MR drawing numbers for a BPA standard control circuit which meets the requirements of this specification. Load tap changers other than Reinhausen (MR), will be subject to Contracting Officer/Contracting Officer Technical Representatives approval and BPA will provide interface drawings in these cases at the request of the manufacturer.)

3-D.1.2 Oil Filtration System Design: To eliminate trapping of air in the return line when changing filters the ball valve in the return line **MUST NOT** be located above the elevation of the bleeder.

3-D.2 X-Winding

Tap Changer Type DETC

DETC position X - winding voltage (kV)

5	120750
4	117875
3	115000
2	112125
1	109250

### 3-E IMPEDANCE

3-E.1	Winding-to-winding impedance in percent voltage	
	H to X Winding (Nominal 230 kV Tap at maximum nameplate MVA rating):	7.6% at 300 MVA
	H to Y Winding (_____ kV Tap):	Manufacturer's choice
	X to Y Winding (_____ kV Tap):	Manufacturer's choice
	Maximum short circuit current at the tertiary bushing terminals.	Limited to 32 kA rms symmetrical or less.

### 3-F REFERENCE LOSSES AT NOMINAL TAP

3-F.1	Reference Loading (MVA)	300
3-F.2	Reference No-Load Losses (RCL in kW)	80
3-F.3	Reference Variable Losses (RVL in kW)	500

### 3-G BUSHING ELECTRICAL REQUIREMENTS

Bushings shall comply with IEEE C57.19.01

3-G.1	<b>H Bushings</b> Nominal System Voltage (kV)	230
	BIL (kV crest)	900
	Chopped Wave Impulse (kV crest)	1040
	Low Frequency Withstand	
	1 Minute Dry)(kV, rms)	425
	10 seconds Wet (kV, rms)	350
	Minimum creep distance (mm/inches)	3720/146
	Required continuous current rating (amperes)	1200
3-G.2	<b>X Bushings</b> Nominal System Voltage (kV)	115
	BIL (kV crest)	650
	Chopped Wave Impulse (kV crest)	750
	Low Frequency Withstand	
	1 Minute Dry (kV, rms)	310
	10 Second Wet (kV, rms)	275
	Minimum creep distance (mm/inches)	2235/88

	Required continuous current rating (amperes)	2000
3-G.3	<b>Y Bushings</b> Nominal System Voltage (kV)	13.8
	BIL (kV crest)	200
	Chopped Wave Impulse (kV crest)	230
	Low Frequency Withstand	
	1 Minute Dry (kV, rms)	80
	10 Second Wet (kV, rms)	75
	Minimum creep distance (mm/inches)	560/22
	Required continuous current rating (amperes)	1200
3-G.4	<b>Neutral Bushing</b> Nominal System Voltage (kV)	Neutral
	BIL (kV crest)	200
	Chopped Wave Impulse (kV crest)	230
	Low Frequency Withstand	
	1 Minute Dry (kV, rms)	80
	10 Second Wet (kV, rms)	75
	Minimum creep distance (mm/inches)	560/22
	Required continuous current rating (amperes)	400
<b>3-H BUSHING CURRENT MULTI-RATIO TRANSFORMERS</b>		
3-H.1	BCT's per Bushing	
	H-bushing	2
	X-bushing	2
	Y- bushing	2
	Y-Winding (Inside the delta connection, one per phase winding.)	3 total
	Neutral bushing	2
3-H 2	BCT Maximum Current Rating Amperes	
	H-bushing	1200:5
	X-bushing	2000:5
	Y-bushing	2000:5

	Y-Winding (see note above)	3000:5
	Neutral bushing	1200:5
3-H.3	ANSI Relaying Accuracy	
	H-bushings	C800
	X-bushings	C800
	Y-bushings	C800
	Y-Winding (see note above)	C800
	Neutral-bushings	C800

### 3-I POTENTIAL DEVICE

3-I.1 H-Bushing- Mounting brackets for future addition of GE KA-108 or ABB PBA-2 Bushing Potential Devices. The devices shall be mounted on the tank sidewall below the H1, H2, and H3 bushings.

### 3-J GAS-IN-OIL MONITOR

3-J.1 Provisions for future addition of a Hydran Gas-In-In Oil Monitor shall be made available.

### 3-K SOUND LEVEL

Not to exceed 70 dBA at 300 MVA.

The transformer shall meet the audible sound emission requirements at rated voltage and frequency, per IEEE C57.12.00 and C57.12.90 The standard IEEE test for audible sound emission shall be performed at the factory.

The transformer shall also meet the audible sound emission requirements at rated voltage and frequency with the following superimposed DC current present in the power system as measured in the transformer neutral.

1.0 amp DC present	74 dBA maximum
--------------------	----------------

Compliance with superimposed neutral DC current shall be demonstrated by calculations. A graph of the calculated sound levels, for a range of DC currents from +3.0 amps to -3.0 amps in 0.5 amp increments, at rated voltage and frequency, shall be provided.

### 3-L TRANSPORTATION

The transformer, in its shipping configuration, shall be suitable for transport on BPA rail car BPAX900 (See specification 22-11 SPC Section 3-6). It shall not cause the combination of transformer on rail car BPAX900 to exceed the weight, length, width and height restrictions for travel within Oregon, Washington, Idaho and Montana.

Verification that proposed equipment will meet transportation requirements for road and rail shipment to destination shall be provided at the time approval drawings are submitted, or 120 days after contract award.

Transformer shipping configuration shall not exceed the following:

Height Above Base, Feet (Millimeters)	Maximum Width at Height Above Base (Symmetrical About the Centerline), Feet (Millimeters)
0 to 1.5 (0 to 457)	10 feet 0 inches (3048)
1.5 to 10.0 (457 to 3048)	12 feet 0 inches (3658)
10.5 (3200)	11 feet 4 inches (3454)
11.0 (3353)	11 feet 0 inches (3353)
12.5 (3810)	10 feet 0 inches (3048)
13.5 (4115)	9 feet 0 inches (2743)
14.0 (4267)	8 feet 5 inches (2565)
15.0 (4572)	7 feet 1 inches (2159)
16.0 (4877)	5 feet 5 inches (1651)
16.5 (5029) (Max. Height)	4 feet 4 inches (1321)

Maximum Shipping Weight: 330,000 lbs.

The above dimensions and weights are the maximum allowed for BPA's shipping requirements; however, this does not relieve the supplier of the responsibility for checking shipping limitations from its factory to the equipment destination.

### 3-M OTHER FEATURES

3-M.1 OPERATION - The transformer will be used for step-up and step-down operation.

#### 3-M.2 LOSS EVALUATION AND PAYMENT REQUIREMENTS

Calculated and actual losses shall be provided as required in Unit 1 of the Solicitation. Bids will be evaluated and payment will be adjusted as indicated below. Losses expressed in units smaller than 1/10 kW will be adjusted to the next higher 1/10 kW.

##### 3-M.2.1 Definitions

Constant Loss: The excitation loss at nominal voltage plus the power requirement of any accessories (including cooler fans and pumps) that are on whenever the transformer is energized at its lowest rating.

Variable Loss: The Total Loss at the maximum nameplate 65 degrees C rise rating at nominal voltage connection including power requirements of all cooling equipment and accessories, minus the Constant loss. (Load Loss shall be at a reference temperature of 85 degrees C.)

CCL: Vendor's calculated Constant loss in kW (to be supplied with offer)

CVL: Vendor's calculated variable loss in kW (to be supplied with offer)

ACL: Actual Constant loss in kW (from actual test on unit)

AVL: Actual variable loss in kW (from actual test on unit)

RCL: BPA's reference Constant loss in KW

RVL: BPA's reference variable loss in KW

See 3-F for RCL and RVL reference values

##### 3-M.2.2 Evaluation

When the calculated loss is different than the referenced loss, the following loss adjustment will be added to the bid price for evaluation purposes:

$$\text{Constant Loss Adjustment} = (\text{CCL} - \text{RCL}) \times \$2350/\text{kW}$$

Variable Loss Adjustment =  $(CVL - RVL) \times \$560/kw$   
Total Loss Evaluation = Constant Loss Adjustment + Variable Loss Adjustment

### 3-M.2.3 Payment

When the actual loss (measured during final factory tests) exceeds the calculated loss the following amount will be subtracted from the contract unit price:

For Constant Loss, To Subtract =  $(ACL - CCL) \times \$2350/kw$

For Variable Loss, To Subtract =  $(AVL - CVL) \times \$560/kw$

3-M.3 Preferred supplier for sudden pressure relay is Qualitrol model # 900 with seal-in relay model # 909-200-01.

### 3-M.4 SURGE ARRESTER MOUNTING

Surge arresters are not required for this contract. However, surge arrester mountings that would meet the seismic rating with the indicated surge arrester shall be provided on the transformer tank.

The (H) high side surge arrester will weigh approximately 510 pounds with a height of 96 inches. Corona ring diameter is 25 inches. The mounting flange will consist of three (3) 0.56-inch diameter holes in a 120-degree pattern on a 10-inch bolt circle. Hubbell Cat. # VN 217744.

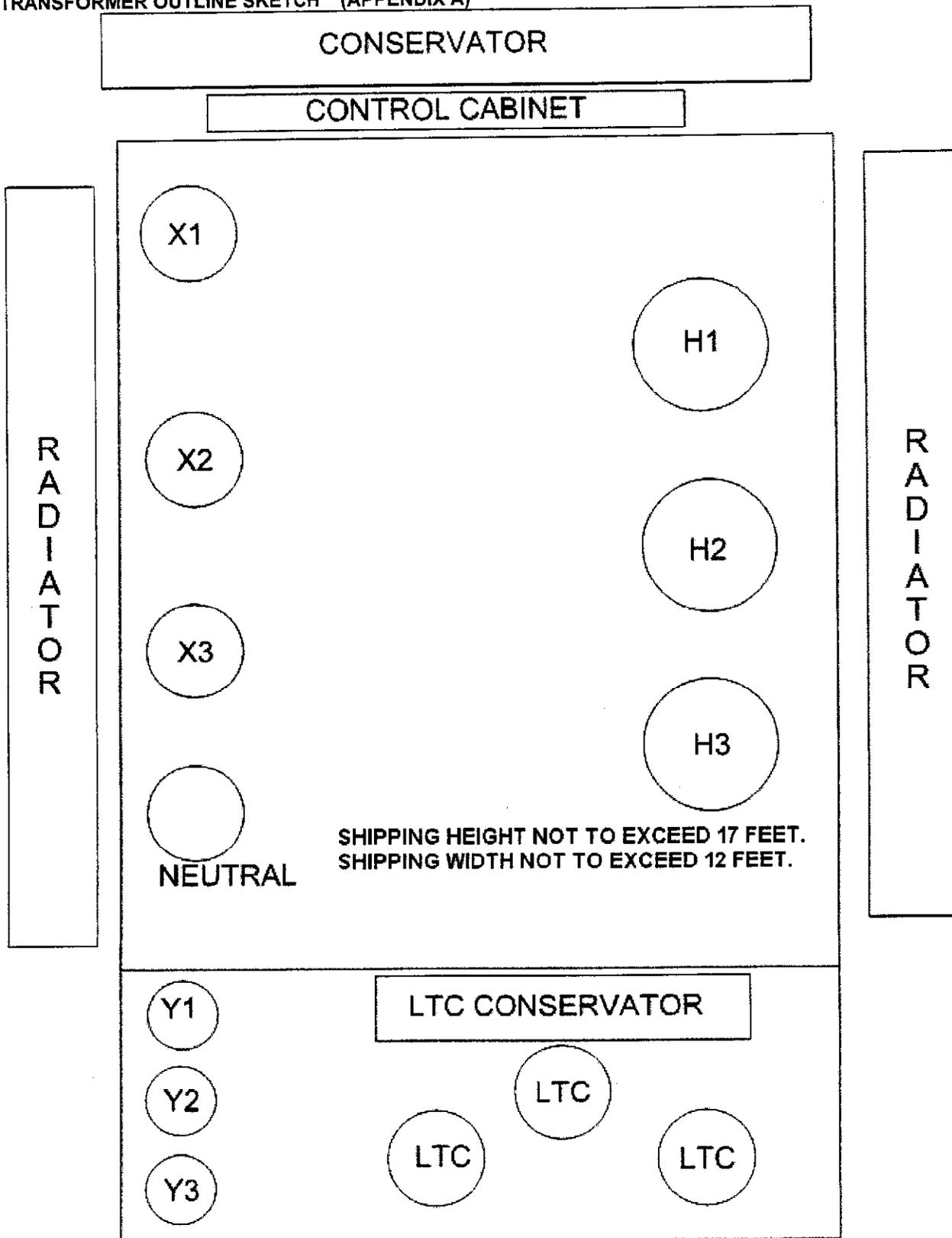
The (X) low side surge arrester will weigh approximately 265 pounds with a height of 51 inches. The mounting flange will consist of three (3) 0.56-inch diameter holes in a 120-degree pattern on a 10-inch bolt circle. Hubbell Cat. # VN 219576

The (Y) tertiary surge arresters will weigh approximately 80 pounds with a height of 25 inches. The mounting flange will consist of three (3) 0.56-inch diameter holes in a 120-degree pattern on a 10-inch bolt circle. Hubbell Cat. # VL 216015-8070

3-M.5 All bushings shall meet the high seismic requirements of IEEE 693. Prior approval of the seismic qualification by the BPA contracting officer is required before purchase order award. All information needed by BPA to evaluate the qualification claim shall be submitted with the bid proposal.

3-M.6 Appendix A, Transformer outline sketch, Appendix C, Air Bladder Measurement sketch, Appendix D, Frequency Response Analysis, and Appendix E, Test Connection Tables, all apply, except as modified in other sections of this specification.

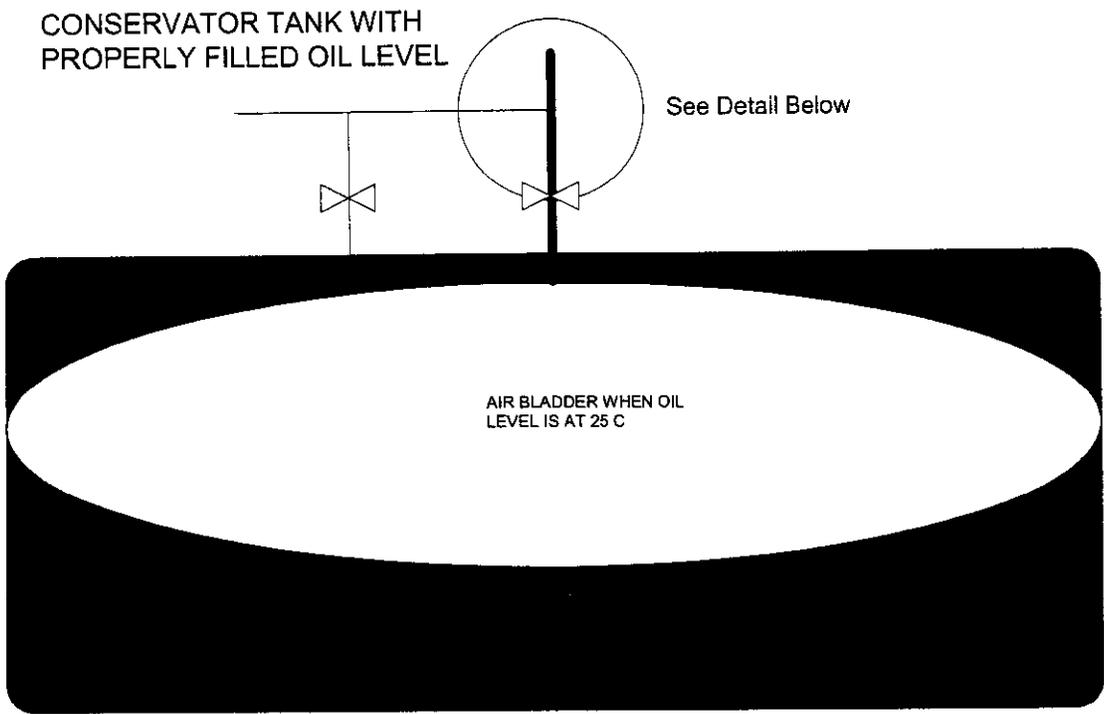
TRANSFORMER OUTLINE SKETCH (APPENDIX A)



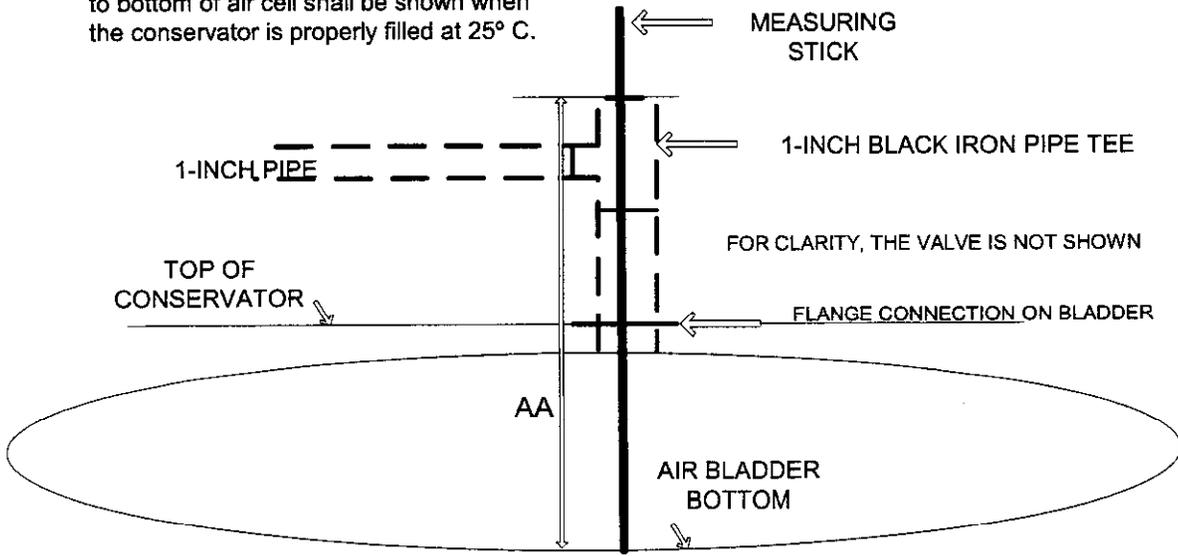
d (appendix B)

Reserve

**AIR BLADDER MEASUREMENT SKETCH (APPENDIX C)**



The distance AA from top of the 1-inch TEE in the conservator air cell connection to bottom of air cell shall be shown when the conservator is properly filled at 25° C.



## FREQUENCY RESPONSE ANALYSIS (FRA) (APPENDIX D)

### FREQUENCY RESPONSE ANALYSIS (FRA) SWEEP METHOD TEST PROTOCOL FOR POWER TRANSFORMERS

#### INTRODUCTION

Frequency Response Analysis (FRA) sweep method is performed by energizing one end of a winding and measuring the response at the other end of the same winding with respect to the transformer tank (bushing flange). The sinusoidal frequency range is essentially from DC to 10 MHz. It is very important to strictly follow the test protocol for these measurements to ensure reliable and repeatable results.

Major factors influencing the test results include transformer test lead terminations and test lead configuration/grounding.

Transformers are tested in two configurations: **fully assembled**, and **shipping** configurations. **Fully assembled** configuration FRA test is performed at the factory floor. The data will be used as the baseline for comparison to future measurements. Deviations from the baseline data could indicate winding deformation. **Shipping** configuration FRA test is designed to detect shipping damages without assembling the transformer (transformer is tested in the shipping mode). The test is performed at the factory just prior to shipping and the data will be compared to a test performed at the transformers destination prior to assembling.

#### TEST EQUIPMENT

The Bonneville Power Administration (BPA) has developed a triax/coax test lead configuration and grounding method that results in very repeatable and reliable measurements. However, since it is not feasible for BPA personnel to perform these tests abroad, the best alternative is to use a commercially available test set that is very comparable/compatible to BPA's equipment.

Currently Doble Engineering has a test set, SFRA M5100, which utilizes a similar lead configuration and grounding method as BPA. BPA is requesting that the transformer manufacturer use Doble SFRA M5100 test set and leads to perform FRA tests on BPA's transformers.

#### TRANSFORMER TEST CONFIGURATIONS

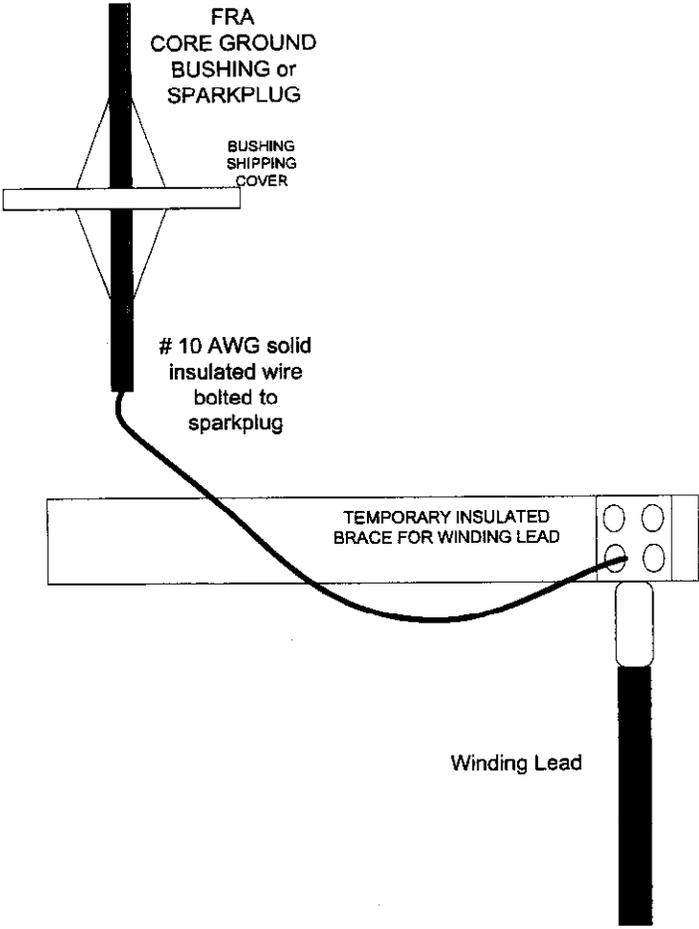
**Fully Assembled** – Transformer is completely assembled with bushings, oil, and other accessories. Measurements in this configuration on the factory test floor, and after assembly at the destination, will be used to verify appropriate assembly and as benchmarks for future measurements.

**Shipping** – The purpose of this configuration is to allow comparable FRA measurements to be made at the factory and at the destination as a tool for detection of shipping damage. The use of the shipping cover mounted core ground bushings allows these measurements to be made without opening the transformer or disturbing the lead positions.

#### **Preparing Transformer for Shipping (FRA Test Ready)**

- Secure winding leads for shipment (allow as little lead displacement as possible during transit).
- Isolate winding leads from tank walls.
- Install small electrical core ground bushings on the bushing opening shipping cover plates.
- Bushing flange must be electrically bonded to the cover plate.
- The cover plate must be electrically bonded to the transformer tank.
- Make temporary electrical connection (using a small wire such as #10 gauge) from the end of each winding lead to the small bushing on the cover plate. Be sure the connections are secure enough to stay in place and connected during shipment. See drawing below.
- Externally ground the core ground bushings for shipment.

Temporary FRA Test Connection for the Shipping Configuration



## TEST SETUP

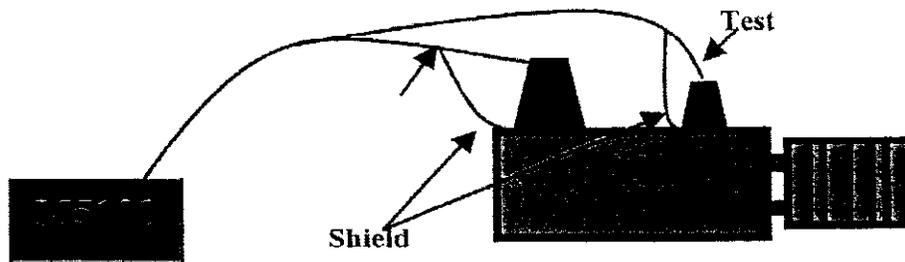
### **Leads:**

Test leads and screens should be checked for continuity before use.

Use a 3-lead setup (source, reference and test). Lead configuration must be consistent from test to test (this includes lead length, bonding/shielding, and grounding). The suggested test set lends itself to consistent test configurations and results.

### **Performing Test:**

To do an FRA measurement on a winding, connect the source and reference cable to the top of H<sub>1</sub> bushing and connect the shield of the source and the reference cable to the H<sub>1</sub> bushing flange making sure that the flange is common to the tank. Connect the test cable to the H<sub>2</sub> bushing and its shield to the H<sub>2</sub> bushing flange, again making sure the flange is common to the transformer tank. All bushings not under-test must be left floating during test. See TEST CONNECTIONS section for specific tests connections.



### **Bandwidth:**

Select the widest bandwidth sweep available on the instrument in use (10Hz - to - 10Mhz on the Doble M5100).

## DATA

Provide a copy of the test data in its native file format to the BPA COTR and the COTR will forward the data to the BPA testing personnel.

## TEST CONNECTIONS

All winding should be tested as shown in the Appendix (Test Connection Tables).

Bushings not under test shall be ungrounded, including the neutral bushing.

The tap positions shall be noted on the test report for each test. Tests on winding with tap changers shall be performed in 2 tap positions: 1) with DETC and LTC (if applicable) in the neutral position and 2) in the tap combination that places all sections of the windings in the circuit.

When testing in the neutral position, the previous tap position must be noted (previous tap position changes the capacitive coupling of the winding, but not the transformer's ratio) and thus will affect the FRA transfer function. It is recommended that the test in the neutral tap position should be performed when the neutral tap is arriving from the maximum ratio tap position.

Perform FRA tests in the **fully assembled** and **shipping** configurations. Remember to select the widest bandwidth sweep, for Doble M5100 select 10Hz - to -10MHz.

## TEST CONNECTION TABLES (APPENDIX E)

**FULLY ASSEMBLED/SHIPPING CONFIGURATION**  
**Note: Only table 3 is pertinent, other tables not included.**

**TABLE 3 - AUTOTRANSFORMER WITH TERTIARY - 33 TESTS**

Test Type	Test #	3 $\phi$	1 $\phi$
Series Winding (OC) All Other Terminals Floating	Test 1	H1-X1	H1-X1
	Test 2	H2-X2	
	Test 3	H3-X3	
Common Winding (OC) All Other Terminals Floating	Test 4	X1-H0X0	X1-H0X0
	Test 5	X2-H0X0	
	Test 6	X3-H0X0	
Tertiary Winding (OC) All Other Terminals Floating	Test 7	Y1-Y3	Y1-Y2 (Y1-Y0)
	Test 8	Y2-Y1	
	Test 9	Y3-Y2	
Short Circuit (SC) High (H) to Low (L) Short [X1-X2-X3]*	Test 10	H1-H0X0	H1-H0X0 Short [X1-H0X0]*
	Test 11	H2-H0X0	
	Test 12	H3-H0X0	
Short Circuit (SC) High (H) to Tertiary (Y) Short [Y1-Y2-Y3]*	Test 13	H1-H0X0	H1-H0X0 Short [Y1-Y2]*
	Test 14	H2-H0X0	
	Test 15	H3-H0X0	
Short Circuit (SC) Low (L) to Tertiary (Y) Short [Y1-Y2-Y3]*	Test 16	X1-H0X0	X1-H0X0 Short [Y1-Y2]*
	Test 17	X2-H0X0	
	Test 18	X3-H0X0	
Inter-Winding (IW) High (H) to Tertiary (Y) All Terminals Float	Test 19	H1-Y1	H1-Y1
	Test 20	H2-Y2	
	Test 21	H3-Y3	
Inter-Winding (IW) Low (L) to Tertiary (Y) All Terminals Float	Test 22	X1-Y1	X1-Y1
	Test 23	X2-Y2	
	Test 24	X3-Y3	
Transfer Admittance (TA) High (H) to Low (L) Ground (H0X0)	Test 25	H1-X1	H1-X1 Ground [H0X0]
	Test 26	H2-X2	
	Test 27	H3-X3	
Transfer Admittance (TA) High (H) to Tertiary (Y) Ground (H0X0 and Y-)	Test 28	H1-Y1	H1-Y1 Ground [H0X0, Y2]
	Test 29	H2-Y2	
	Test 30	H3-Y3	
Transfer Admittance (TA) Low (L) to Tertiary (Y) Ground (H0X0 and Y-)	Test 31	X1-Y1	X1-Y1 Ground [H0X0, Y2]
	Test 32	X2-Y2	
	Test 33	X3-Y3	

\* Indicates short circuit tests: terminals are shorted together. The neutral is not included for 3 $\phi$  Wye connections, but may be included for 1 $\phi$  test connections.

**COMPLIANCE SUMMARY (AS COMPLETED AND SUBMITTED WITH PROPOSAL, DATED  
APRIL 17, 2009) (APPENDIX F)**

OF OFFERED TRANSFORMER

**WITH BPA SPECIFICATION 22-11 AND  
SPECIFIC TECHNICAL SPECIFICATION 22-11STS**

M = meets requirement  
D = does not meet the requirement  
E = exceeds the requirement  
NA = is not applicable

3-1	SCOPE	
3-2	GENERAL	
3-2.1	REFERENCED DOCUMENTS	<u>M</u>
3-2.2	DEFINITIONS	<u>M</u>
3-2.3	IDENTIFICATION	<u>M</u>
3-2.4	MANUFACTURER DRAWINGS	<u>M</u>
3-2.5	INSTRUCTION BOOKS	<u>M</u>
3-2.6	ORDER OF TECHNICAL DOCUMENT PRECEDENCE	<u>M</u>
3-2.7	LOSS EVALUATION AND PAYMENT	<u>M</u>
3-3	PERFORMANCE	
3-3.1	TRANSFORMER LOADING	<u>M</u>
3-3.2	SHORT CIRCUIT CAPABILITY	<u>M</u>
3-3.3	EARTHQUAKE STRENGTH	<u>M</u>
3-3.4	WIND LOADING STRENGTH	<u>M</u>
3-3.5	AUXILIARY EQUIPMENT	<u>M</u>
3-3.6	SOUND LEVEL	<u>M</u>
3-3.7	VIBRATION	<u>M</u>
3-3.8	EXTERNAL CLEARANCES	
3-4	DESIGN AND CONSTRUCTION	
3-4.1	MATERIALS	<u>M</u>
3-4.2	WINDINGS AND WINDING CONFIGURATIONS	<u>M</u>
3-4.3	LOAD TAP CHANGER (LTC)	<u>M</u>
3-4.4	DE-ENERGIZED TAP CHANGER (DETC)	<u>M</u>
3-4.5	LEAD-LAG SWITCH	<u>NA</u>
3-4.6	FRAME AND CORE GROUNDING	<u>M</u>
3-4.7	BUSHING CURRENT TRANSFORMERS (BCT)	<u>M</u>
3-4.8	BUSHINGS AND TERMINALS	<u>M</u>
3-4.9	BUSHING POTENTIAL DEVICE (BPD)	<u>M</u>
3-4.10	GASKETS AND O-RINGS	<u>M</u>
3-4.11	TANK	<u>M</u>
3-4.12	MANHOLES	<u>M</u>
3-4.13	VAPOR TRAP FLANGE	<u>M</u>
3-4.14	VALVES	<u>M</u>
3-4.15	TRANSFORMER TANK GROUNDING	<u>M</u>
3-4.16	OIL PRESERVATION SYSTEM	<u>M</u>
3-4.17	COOLING SYSTEM	<u>M</u>
3-4.18	COMBUSTIBLE GAS PIPING SYSTEM	<u>M</u>
3-4.19	LIFTING FACILITIES	<u>M</u>
3-4.20	MOVING FACILITIES	<u>M</u>
3-4.21	JACKING FACILITIES	<u>M</u>
3-4.22	FALL PROTECTION	<u>M</u>
3-4.23	SURGE ARRESTER BRACKETS	<u>M</u>
3-4.24	CONDUIT AND WIRE	<u>M</u>

3-4.25	CONTROL CABINET POWER REQUIREMENTS	M
3-4.26	CONTROL CABINET	M
3-4.27	CLEANING AND PAINTING	M
3-4.28	PROCESSING REQUIREMENTS	M
3-4.29	INSULATION SYSTEM	M
3-4.30	LIQUID LEVEL INDICATOR	M
3-4.31	LIQUID TEMPERATURE INDICATOR (TOP OIL)	M
3-4.32	LIQUID TEMPERATURE RECORDER (7-DAY)	M
3-4.33	WINDING-TEMPERATURE INDICATORS (WTI) (HOT SPOT)	M
3-4.34	GAS ACCUMULATION RELAY	M
3-4.35	PRESSURE RELIEF DEVICE	M
3-4.36	SUDDEN PRESSURE RELAY	M
3-4.37	LTC PROTECTION	M
3-4.38	MATCH-MARKED	M
3-5	TESTS	
3-5.1	GENERAL	M
3-5.2	DESIGN TESTS	M
3-5.2.1	Temperature Rise and Tank-wall Hot-spot Tests	M
3-5.2.2	Cooling Fan Test	M
3-5.2.3	Combustible Gas-In-Oil Analyses	M
3-5.2.4	Load Tap Changer Test	M
3-5.2.5	Wind Test or Calculations	M
3-5.2.6	Seismic Test or Calculations in accordance with IEEE 693-97	M
3-5.2.7	Audible sound level test	M
3-5.2.8	Mechanical Tests	M
3-5.2.9	Short Circuit Test	M
3-5.3	ROUTINE TESTS	M
3-5.3.1	Winding Resistance Measurements	M
3-5.3.2	Polarity and Phase Relation Tests	M
3-5.3.3	Ratio Tests	M
3-5.3.4	Excitation Loss and Excitation Current	M
3-5.3.5	Impedance and Load Loss	M
3-5.3.6	Dielectric Tests	M
3-5.3.7	Cooling system losses	M
3-5.3.8	Audible sound level measurement	M
3-5.3.9	Tank and Radiator Test Insulation	M
3-5.3.10	Bushing Current Transformer Tests	M
3-5.3.11	Magnetization Curves	M
3-5.3.12	Load Tap Changer Test	M
3-5.3.13	De-energized Load Tap Changer Test	M
3-5.3.14	150 Percent Overcurrent Tests	M
3-5.4	Frequency Response Analysis	M
3-6	PREPARATION FOR DELIVERY	M
SPECIFIC TECHNICAL SPECIFICATION (STS):		
3-A	Type And Rating	M
3-B	Voltage Ratings	M
3-C	Minimum Winding Insulation Levels	M
3-D	Taps And Tap Changers	M
3-E	Impedance	M
3-F	Reference Losses	M
3-G	Minimum Bushing Electrical Requirements	M
3-H	Bushing Current Transformers	M
3-I	Potential Device	M
3-J	GIO Monitor	M

3-K Sound Level  
3-L Transportation  
3-M Other Features

M
M
M

TECHNICAL DATA (AS COMPLETED AND SUBMITTED BY OFFEROR WITH THE PROPOSAL (APPENDIX G))



TECHNICAL DATA

1 of 8

**TECHNICAL DATA (TO BE COMPLETELY BY OFFEROR)**

Provide the following information : (either on these sheets or similarly organized on another sheet). The information provided below will be used to evaluate the proposals. It will be to the Offeror's advantage to provide sufficient pertinent information in a clear, concise manner to adequately demonstrate the quality of their equipment.

1. Manufacturing location :	Ulsan, Korea	
Indicate whether transformer will be :	Core form <input checked="" type="checkbox"/> X <input type="checkbox"/>	Shell Form <input type="checkbox"/>
The manufacturer shall provide verification that proposed equipment will meet transportation requirements for road and rail shipment to destination at the time approval drawings are submitted.		

2. Rating			
Type :	Auto-transformer, Oil-immersed type		
Phase :	3		
Hertz :	60		
Temp Rise :	65 deg. C		
Winding	Nominal phase-to-phase voltage, kV	Connection	
H	230	Gnd. Wye	
X	115	Gnd. Wye	
Y	13.8	Delta	
Elevation	6000 feet		
Cooling class	Stage 1	Stage 2	Stage 3
H Winding	180 MVA	240 MVA	300 MVA
X Winding	180 MVA	240 MVA	300 MVA
Y Winding	15 MVA	20 MVA	25 MVA

3. MINIMUM WINDING INSULATION LEVELS				
Winding	H	X	Y	Neutral
Basic Lightning Impulse Insulation Level (BIL) (kV Crest)	750	450	150	150
Chopped Wave Test Level Crest Voltage, kV	825	495	165	NA
Switching Impulse Level (BSL) (kV Crest)	620	375	NA	NA
Induced Voltage Test (phase to ground)				
One Hour Test Level (kV rms)	210	105	NA	NA
Enhancement Level (kV rms)	240	120	NA	NA
Applied Voltage Test Level (kV rms)				
	NA	NA	50	50

4. LOAD TAP CHANGER : (LTC)				
Winding Location (H or X)	Tap capacity (Full or Reduced)	Mfg. Model #	Oil / Vacuum	Current Rating
H	Full	VRC 1001 or eq.	Vacuum	1000
Oil Filter(if needed)	NA			

5. DE-ENERGIZED TAP CHANGER : (DETC)		
Winding Location (H or X)	Current Rating	Mfg. Model #
X	1600	DUIII

6. PERCENT IMPEDANCE VOLTS					
% IZ	Between Windings	At MVA	% IZ	Between Windings	At MVA
8.6	H-X (max.)	300	5.94	H-Y	25
7.6	H-X (nom.)	300	5.86	H-Y	25
6.9	H-X (min.)	300	5.71	H-Y	25
% IZ	Between Windings	At MVA			
	X-Y	-			
4.68	X-Y	25			
	X-Y	-			

Note) The above mentioned impedance is based on LV tap position is at nominal.

7. LOSSES AT NOMINAL TAP		
Loss Evaluation Factors (See Clause 3-M.2.1 for definitions)		
Reference Loading (MVA)	Reference No-Load Losses (RCL in kW)	Reference Variable Losses (RVL in kW)
300	80	500

Note) Reference variable losses are based on HV & LV tap position is at nominal.

8. PERFORMANCE DATA, Based on 85°C Reference Temperature						
Losses (kW) and Exciting Current					Voltage Regulation	
Excitation	No Load Loss (kW)	Exciting Current (%)	Load Loss(Rated Tap)		Power Factor	% Regulation
			Loss (kW)	Reference Load(MVA)		
100%	62	0.03	490	300	1.0	Approx. 0.97
110%	80	0.04			0.8	Approx. 8.24

9. AUXILIARY LOSSES			
Cooling Stage	Load MVA	Cooling Class Designation	Watts Aux. Loss (kW)
First	180	ONAN	-
Second	240	ONAF	3
Third	300	ONAF	6

10. BUSHINGS FOR PROPOSED TRANSFORMER :						
	Manuf.	Cat. No.	BIL (kV)	Creep (mm)	Rated Current	Seismic Performance Capability
H-Bushing	ABB	196W1216AZ	900	≥ 3720	1200	High
X-Bushing	ABB	1ZUA138020	650	≥ 2,235	2000	High
Neutral	ABB	1ZUA034012	200	≥ 560	1200	High
Y Bushings	ABB	1ZUA034012	200	≥ 560	1200	High

Indicate the proposed seismic performance capability of the bushings in the space provided above. Indicate the qualification method used or that will be used to prove its seismic performance capabilities. Provide sufficient documentation so BPA can assess the bushing's seismic performance capability or the proposed test procedure that will be used to qualify the seismic performance of the bushings.

11. BUSHING CURRENT TRANSFORMERS (BCT)			
Bushing	BCT per Bushing	Current Rating	Accuracy
H	2	MR 1200-5A	C800
X	2	MR 2000-5A	C800
Y	3	MR 2000-5A & 3000-5A	C800
NEUTRAL	2	MR 1200-5A	C800

12. BUSHING POTENTIAL DEVICE		
Bushing Location	Mfg.	Type
H.V	GE or ABB	KA-108 or PBA-2

13. SOUND LEVEL		
Transformer Condition		Sound Level. dBA
First Cooling Stage at	180 MVA	<70
Second Cooling Stage at	240 MVA	<70
Third Cooling Stage at	300 MVA	<70
Top rated MVA/Voltage with 0.5 A DC superimposed		<78
Top rated MVA/Voltage with 1.0 A DC superimposed		<84

14. DRAWING SUBMITTAL	
Indicate schedule for preliminary drawing submittal (earlier submittal desired. Not to exceed the number of days, shown in parenthesis, after award of contract) for the following :	
Days after Award	
60	Detailed dimensioned transformer drawings including base dimensions, equipment location, material list, etc.
70	Nameplate drawings and equipment layout.
70	Wiring detail and other drawings.

15. Indicate core steel used and maximum core flux density at nameplate rating for proposed transformer :		
Manufacturer and Type	Flux Density at Maximum Name plate Rating, Tesla	Thickness
POSCO/23PH095	< 1.6	0.23mm

16. Indicate kind of windings to be used for the proposed transformer for the following :	
	ITEM 1
H (series) :	Disk
X (common) :	Disk
Y (tertiary) :	Layer
LTC Reg. Winding :	Helical
DETC Reg. Winding :	Helical

17. MECHANICAL DATA.		
Provide the following information. Provide an outline drawing or sketch of the unit with the bid. (the information provided shall be within 10% of the final)		
Dimensions (Approximate, inches)	Fully Assembled	Shipping
Height	315	179
Length	425	387
Width	270	127.6
Untanking Height	480	480
Mass (Approximate, in Lbs) (liquid in gallons)		
Core and Coils	236,220	
Tank and Fittings	111,260	
Liquid (in gallons)	19,696	
Total Mass (Installed)	495,400	
Largest Shipping Mass	315,400	

18. Provide a winding schematic diagram. Show the LTC in the diagram.  
=> Please refer to attached winding schematic diagram.

19. Indicate what winding insulation will be used (name/description & manufacturer) for the proposed transformer :

Winding insulation	Description & Manufacturer	Remarks
Dennison paper	Dennison / USA	
Kraft paper	MUNKSJO / SWEDEN	

20. Indicate what pressboard insulation will be used (name/description & Manufacturer) for the proposed transformer :

Description	Manufacturer	Remarks
Press Board	Honshu / Japan	
Press Board	Weidmann / China	

21. Indicate whether active parts will be treated by vapor phase process or not :  
 => All the active parts will be dried by vapor phase drying plant two times ; First time after winding and second time upon completion of core & coil assembly.

To what percent water content will insulation be dried :  
 => Through the vapor phase process, moisture content for insulation material is controlled not to exceed 0.5%.

22. List what the maximum water content of the insulation will be when the transformer is shipped and the method used to determine this degree of dryness. The maximum allowed water content of the insulation when received at the BPA site is 0.5%  
 => We keep the maximum water content of the insulation should be below 0.5% when the transformer is shipped. If the dew point is below -40 deg.C, it may be assumed that the transformer has not been contaminated with air or moisture in transit. And, if the dew point is kept as close as possible to the value as measured at the factory, it may be assumed that the transformer has not been contaminated with air or moisture in transit.

23. Indicate the insulation processing required at site, which includes any required drying prior to oil filling, vacuum levels and time and any required set time under oil or circulation of oil and temperature after filling.  
 => Please refer to attached "Shipment, Storage and Erection Manual"

24. Indicate how core material will be cut to length :  
 => The oriented silicon steel strip is cut by computerized machinery (cut-to-length machine), thus minimizing air gap in the joint during assembly. This enables the core to minimize core loss and sound level during operation.

Indicate what maximum burr will be allowed on edges and end cuts :  
 => Burr height limit : 0.7 mils.

25. Has or will electrostatic stress analysis been done on design? How?  
 => Yes, we perform electric field analysis. For electric field calculation, we use AXIAL97E (BEM) and HTREM(FEM)

26. Has or will impulse distribution analysis been done on design? Will it be based on capacitance and inductance?  
 => Yes, we perform impulse distribution analysis. The voltage distribution in the transformer

winding which is subject to transient over voltage depend on the capacitance at the early time (transient-state) and on the inductance to calculate voltage distribution in winding and transferred voltage as time goes on. We have our own program which uses a circuit model which include capacitive and inductive elements.

27. Indicate what is done to ensure the short circuit strength of the unit exceeds the force that may be generated under short circuit conditions :

=> By analyzing short circuit, short circuit current incoming to transformer are calculated for all possible failure modes. For the mechanical analysis, transformer is designed according to HHI standard to withstand calculated forces on the conductor through design parameter adjustments. Programmed software do all these calculations using IMAGE methods and checked using the FEM method. All design parameters which have affect on the short circuit forces and stress are considered during calculation by computer.

27. What will be the cross-section of the leads? What will be the lead material? How many layers of paper will it have? What will be the temperature rise of the leads at full load?

H : Cross-section(mm<sup>2</sup>) : approx. 300, Lead material:Cu wire, Layer:6mm one side, Temp. rise.:<20K  
 X : Cross-section(mm<sup>2</sup>) : approx. 300, Lead material:Cu rod, Layer:5mm one side, Temp. rise.:<20K  
 Y : Cross-section(mm<sup>2</sup>) :approx. 240, Lead material:Cu rod, Layer:0.4mm one side, Temp. rise.:<20K

28. Indicate what is done to ensure the short circuit strength of the unit exceeds the forces that may be generated under short circuit conditions:

29. Has any transformer, out of factory from which this transformer will be manufactured, experienced a field failure within the last 5 years? What kind? What was the cause? What corrective action has been taken to prevent future failures? Name of purchaser.

=> Please refer to attached " Field failure rate"

30. Has any transformer out of factory from which this transformer will be manufactured, has experienced a test floor failure within the last 5 years? What kind? What kind of failures? What was the cause? What corrective action has been taken to prevent future failures? Name of purchaser

=> Please refer to attached "Test floor failure rate"

31. Indicate the person(s) that will be doing the design and overseeing construction. List and describe their experience with the design and construction of similar units (including the name of the company and their position at that time, i.e. Lead Designer, training, etc.).

Section Name	Name	Educational / Professional Certifications	Experience	Remarks
Transformer Design Dept	Goo-Chel Lee	B.S. Electrical Eng	25years	General Manager
Quotation	Moo-Geun Park	B.S. Electrical Eng	25years	General Manager
Technical calculation	Ho-Young Kim	B.S. Electrical Eng	25years	General Manager
	Jae-cheol Yang	Master of Mechanical Eng.	14years	Manager

Project Managing	Jung-soo Lee	B.S. Electrical Eng.	31years	General Manager
	Ki-Hyun Park	B.S. Electrical Eng.	15years	Manager
Detail Design for Electrical Construction	Yong-si Lee	B.S. Electrical Eng.	31years	General Manager
Detail Design for Mechanical Construction	Tae-Bong Hwang	B.S. Electrical Eng.	31years	General Manager

32. Indicate whether CAD drawings will be supplied in addition to hard copies :  
=> The CAD drawings will be supplied together with hard copies.

Indicate format : AUTOCAD.DWG

33. Identify any conduit or factory installed wiring that needs to be removed for shipping?  
=> The transformer will be shipped without removing any conduit or factory installed wiring.
34. Will the control cabinet be removed or any other auxiliary equipment be removed for shipping?  
=> The control cabinet isn't removed from the transformer for shipping. For more information, please refer to packing list.

## POWER TRANSFORMER, SPEC NO. BPA 22-11, FEBRUARY 5, 2009

### 3-1 SCOPE

This specification sets forth the minimum technical requirements for single and three-phase, 60 Hz, 65°C rise, BPA main grid and industrial service power transformers.

### 3-2 GENERAL

#### 3-2.1 REFERENCED DOCUMENTS

The following standards and specifications, including revisions to the dates shown, form a part of this specification. Newer revisions of these standards require review and approval from the BPA contracting office prior to use for the equipment specified herein:

a. American National Standards Institute (ANSI) and Institute of Electrical and Electronics Engineers (IEEE) Standards:

- B16.5-2003 Steel Pipe Flanges and Flanged Fittings
- C57.12.00-2006 General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers
- C57.12.10-1997 Transformers, 230,000 Volts and below, 833/958 through 8,333/10,417 kVA, Single-Phase, and 750/862 through 60,000/80,000/100,000 kVA, without LTC; And 3750/4687 through 60,000/80,000/100,000 kVA, with LTC; including Supplement C57.12.10a-1978
- C57.12.70-2000 Terminal Markings and Connections for Distribution and Power Transformers
- C57.12.80-2002 Terminology for Power and Distribution Transformers
- C57.12.90-2006 Test Code for Liquid-Immersed Distribution, Power and Regulating Transformers, and Guide for Short-Circuit Testing of Distribution and Power Transformers
- C57.13-1993(R2003) Requirements for Instrument Transformers
- C57.91-1995 Guide for Loading Liquid-Immersed Power Transformers
- C57.93-1995 Guide for Installation of Liquid-Immersed Power Transformers
- C57.131-1995 Standard Requirements for Load Tap changers
- IEEE 100 The Authoritative Dictionary of IEEE Standards Terms (7th Edition)
- IEEE 693-2005 Recommended Practice for Seismic Design of Substations

b. American Society for Testing and Materials (ASTM) Standard:

- B432-04 Standard for Copper and Copper Alloy to Steel Plate
- D3487-00(2006) Mineral Insulating Oil used in Electrical Apparatus
- D4059-00(2005)e1 Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

c. National Electrical Manufacturers Association (NEMA) Standards:

- CC 1-2005 Electric Power Connectors for Substations
- MG 1-2006 Motors and Generators

### 3-2.2 DEFINITIONS

- a. All references to a specified voltage rating shall be understood to be the nominal voltage rating.
- b. All references to a specified MVA rating shall be understood to be the maximum MVA rating based on 65°C rise.
- c. All other definitions shall be in accordance with IEEE C57.12.80 and IEEE STD 100.

### 3-2.3 IDENTIFICATION

The transformer shall be provided with stainless steel nameplates in accordance with ANSI C57.12.00, Nameplate C of Table 10. All nameplates shall be located approximately 6 feet (2 meters) above the base on the tank wall or control cabinet door.

3-2.3.1 The following additional information shall be included on the rating nameplate:

- The BPA contract number
- The amount of vacuum (inches) and positive pressure (psi) the tank, radiators/coolers and conservator will withstand; (maximum operating pressure of liquid preservation system)
- The weights of paper, pressboard (transformer board) and solid insulation within the tank --pounds (kilograms)
- U.S. gallons and pounds of insulating oil in conservator and LTC conservator, if required
- Sound level (dbA)
- Maximum elevation design --- feet (meters)
- Indication whether the transformer meets seismic requirements of IEEE 693.
- Bushing BIL
- Induced voltages: one hour \_\_\_\_\_ enhanced \_\_\_\_\_ for each winding
- Applied voltage (kV RMS): \_\_\_\_\_ for each winding
- Maximum short-circuit current (ka) asymmetrical current: for each winding

3-2.3.2 A bushing current transformer (BCT) nameplate or the rating nameplate shall include the following information for each (BCT) furnished:

- Location
- Accuracy class
- Primary current ratings
- Ratios

3-2.3.3 An LTC nameplate shall be installed on the LTC control cabinet according to C57.131.

3-2.3.4 A Valve and Piping nameplate clearly showing all pipe and valve locations and sizes, include LTC oil filtration system if required. Do not show conduit runs.

3-2.3.5 A Lifting Diagram nameplate shall be provided showing:

- Indication whether the transformer may be moved on rollers and lifted when filled with oil;
- Requirements for lifting the completely assembled transformer, with and without oil;
- Requirements for lifting of the core and coil assembly;
  - Weight of core and coils;
  - Untanking height.

3-2.3.6 Transformer tank markings

- The transformer serial number shall be stamped into the tank adjacent to the transformer-rating nameplate with characters approximately one-half inch (12 mm) high.
- The location of the centers of gravity, (c.g.) shall be permanently marked on two adjacent sides of the transformer tank and shall be appropriately identified "c.g. complete" and "c.g. for shipment";
  - "c.g. complete" — the completely assembled transformer and filled with oil;
  - "c.g. for shipment"—transformer for shipment without oil.
- Transformer tank centerline marks shall be chiseled/marked into the tank base plate and highlighted (red or yellow paint) on all four sides of the tank for ease of orientation with the foundation centerlines.

3-2.3.7 The core and coil assembly shall be identified with the serial number of the transformer.

### 3-2.4 MANUFACTURER DRAWINGS

3-2.4.1 Provide a complete set of finally accepted contract drawings. This shall consist of the drawings listed below: Drawing size (approx.) (841 x 594mm) (A1) or (560 x 1016 mm) Minimum font size 2.54 mm (.1 inch)

- The final set of drawings shall include all test data as required.
- Provide CAD drawings, in addition to the drawings submitted in accordance with the specification requirements, if such drawings are available. The preferred formats are as follows:
  - Files from a **MicroStation .DGN** Version 5 format or higher
  - **AUTOCAD. DWG** system
  - DWF files are not acceptable

3-2.4.1.1 An outline drawing including the following:

- Dimensions, weights and dimensioned location of all parts and accessories
- Bushings
- Valves, including the 8-inch butterfly valve - - permanently installed
- Radiators/coolers
- Conservators -- main tank and LTC ( indicate approx. number of gallons in each tank)

- The electrical clearances -- distance from bushings to nearest grounded surface and bushing-to-bushing
- Details of core grounding
- Grounding pad connections
- Centers of gravity of the completely assembled transformer with oil and for shipment without oil
- All protective relays on main tank and LTC
- All thermal devices
- Oil level gauges for main tank and LTC
- Jacking pads
- Paint specifications
- Fastener Specifications

3-2.4.1.2 A bushing outline drawing for each type used shall be provided.

3-2.4.1.3 A detail of each type of bushing terminal used: This information may be supplied on the outline drawing or bushing outline drawing.

3-2.4.1.4 Parts (including o-ring/gasket material) and accessories shall be identified in a Bill of Material on the outline drawing or on separate 8-1/2 x 11 inch pages. O-ring and gasket material must be listed with o-ring size (must include inner diameter and cross-section of o-ring), quantity, time-based periodic replacement recommendation, and location on the equipment.

3-2.4.1.5 A dimensioned transformer base/welding drawing showing:

- The structural support area, including a detail of the support structure; (height, width, weight per foot, thickness etc.),
- Welding locations and required weld size, for seismic anchoring, meeting IEEE 693 requirements,
- At the option of the manufacturer, this information may be supplied on the outline drawing instead.

3-2.4.1.6 A dimensioned drawing of the safety rail system installation and mounting details shall be provided. At the option of the manufacturer, this information may be supplied on the outline drawing instead.

3-2.4.1.7 An oil piping and valve drawing clearly indicating all oil pipes and valve sizes, and flexible connections, include any in-line oil protection devices:

- Show valve position during normal operation
- The distance from top of the 1-inch TEE in the conservator air cell connection to bottom of air cell shall be shown when the conservator is properly filled at 25° C (See SKETCH in STS document).

3-2.4.1.8 Gas Collection Piping and Valve drawing showing the gas collection system, pipe sizes, all gas accumulation relays, valves and flexible connections.

3-2.4.1.9 A shipping drawing showing proper handling and including the following:

- Whether the transformer may be moved on rollers and lifted when filled with oil

- Centers of gravity
- Height
- Width
- Length
- Weight
- A detail of FRA test bushings (preferably in the bushing shipping covers) and location of the winding leads in the shipping configuration.
- Impact recorder locations
- Dry air or nitrogen devices for shipping.

3-2.4.1.10 An LTC nameplate drawing shall contain manufacturers' data.

3-2.4.1.11 Dimensioned cross-sectional drawings of all bushing pockets; showing flanges, bushing current transformer (BCT), pocket supports, mounting details and minimum clearances. These may be shown on outline.

3-2.4.1.12 Bushing current transformer (BCT) drawings: showing the height, weight, inside and outside diameters.

3-2.4.1.13 Core and coil assembly drawing shall show overall winding construction, identification and location of all leads and connections with relation to a readily identifiable reference points in the transformer.

- Drawing shall include details and location of yoke grounding.
- If multiple grounds are used, show internal and external core grounding connections.

3-2.4.1.14 Schematic and wiring diagrams shall include:

- Ratings of protective components for all controls
- LTC controls
- CT terminals
- Alarm/trip circuits
- Indicating circuits
- Bushing Potential Device connections, if supplied
- All BPA connections shall be labeled.

3-2.4.1.15 Control cabinet layout drawings shall have all equipment and terminal boards within the enclosure clearly identified.

3-2.4.1.16 An untanking drawing for core and coil removal shall indicate:

- Requirements for lifting of the core and coil assembly
- Lifting height

- Any special tools required for this shall be listed on drawing. This diagram shall include the actual heights and weights of core and coils, tank and oil volume.

3-2.4.1.17 Bushing Potential Device, if supplied, shall have a drawing showing:

- Schematic and wiring
- Layout of the device
- Value of C3 (the auxiliary capacitor used in the potential device to augment the capacitance from the bushing capacitance tap to ground).

### 3-2.5 INSTRUCTION BOOKS

See Unit 2 clauses 18-51M and 18-53 for further information.

Instruction books shall contain the following information:

- The BPA Purchase Order shall be noted on each instruction book
- All instruction books shall have a table of contents and index tabs

Two review copies of the instruction book shall be sent to BPA instruction book review unit (addresses below) at least 60 days prior to scheduled shipment of the equipment. Comments made by BPA during review shall be included in the final instruction books. A review book is required for all purchases.

Instruction books shall be provided as follows:

- One (1) preliminary instruction book shall be shipped with each transformer. The book shall be located inside the control cabinet. The book shall be marked "For Construction Only" and have the equipment serial number noted on the cover.
- Four (4) final edition paper instruction books and five (5) CD copies of the instruction book shall be sent to:

**Mailing Address:**

Bonneville Power Administration  
P.O. Box 491  
Vancouver, WA 98666-0491

Attention: Instruction Book Review Unit - TESM-AMPN-2

**Parcel Delivery:**

Bonneville Power Administration  
5411 NE Highway 99  
Vancouver, WA 98663

Attention: Instruction Book Review Unit - TESM-AMPN-2

Final approved instruction books shall include the following technical information:

- a. Instruction Books--- Four (4) final edition paper instruction books and five (5) Electronic books shall be provided on CD's and containing all the final drawings (those listed in section 3-2.4) in a black and white PDF format and the completed rating nameplate drawing. (The final rating nameplate may be mailed at a later date).

- b. Descriptions and instructions covering the installation, operation and maintenance of the transformer and all accessories.
- c. Complete parts list and drawings, brochures or cut sheets for all accessories. The parts information list shall include but not be limited to (Manufacturer's brochures are required not facsimiles):

Bushings

The tap changer

Oil filtration system

The conservator system

BCT's, Relays and cooling control

Circuit breakers

Pressure relief devices

Sudden pressure relays

Gas detection or Buchholz relay

Liquid level gauge

Hot-spot simulators

Temperature recorders

Liquid temperature

Fans

Pumps

Liquid flow gauge

The list shall include the quantities, manufacturer's and vendor's part numbers and contact information for spare parts.

- d. All auxiliary equipment with multi-model brochures in the book shall have the correct model/cat #/style number used, flagged in the brochure for ease of identification.
- e. Instructions for untanking the core and coils including precautions, required tools and a sequence of events with systematic description for each event.
- f. Colored glossy photographs (8" x 10") shall show:
- A minimum of all four sides and top view of the assembled core and coil before the unit is tanked
  - Include photos of the inside of tank if shielding is present
  - The transformer serial number shall be displayed adjacent to the core and coil. It may be written on paper, wood, etc. The serial number shall be legible in the photograph and shall not obstruct the view of the core and coil.
  - Photos of the completely assembled transformer on all sides and top

- A clear and readable photo of completed nameplate including all fill-in data
- g. A family of temperature-time curves for various currents for calibration of each winding-temperature indicator relay and each remote temperature detector.
- h. Torque requirements shall be provided for all bolts and nuts for assembly.
- i. Final test reports for the following:
  - Bushing tests
  - Transformer tests
  - BCT tests
  - Magnetization curves
  - Sound level tests
  - Frequency Response Analysis (FRA) reports (assembled and shipment configurations)

### **3-2.6 ORDER OF TECHNICAL DOCUMENT PRECEDENCE**

Technical discrepancies shall be resolved by giving precedence in the following order:

- a. SCHEDULE Item description
- b. SPECIFIC TECHNICAL SPECIFICATION (STS)
- c. GENERAL TECHNICAL SPECIFICATION, except REFERENCED DOCUMENTS portion
- d. Referenced ANSI Standards
- e. Referenced IEEE Standards
- f. Referenced NEMA Standards
- g. Referenced ASTM Standards

### **3-2.7 LOSS EVALUATION AND PAYMENT**

Transformer losses used for bid evaluation and subsequent payment adjustments will be calculated, when applicable, as shown in the SPECIFIC TECHNICAL SPECIFICATION (STS).

## **3-3 PERFORMANCE**

### **3-3.1 TRANSFORMER LOADING**

3-3.1.1 The transformer will be loaded in accordance with IEEE standard C57.91 to not more than 1.5 times maximum nameplate rating for the following loading types defined in the IEEE standard:

- Normal Life Expectancy Loading
- Planned Loading Beyond Nameplate Rating
- Long Time Emergency Loading
- Short Time Emergency Loading

- Tertiary winding loading shall be considered non-simultaneous

3-3.1.2. All transformer parts shall be sized to allow full use of the winding capability up to 150% of rated nameplate rating for all loading types listed above.

### **3-3.2 SHORT CIRCUIT CAPABILITY**

The transformer, and its current-carrying parts, including tap changers and bushings, shall have short circuit capability based on the assumed system characteristics in Table 18 of ANSI C57.12.00.

3-3.2.1 Tertiary Windings, when specified in the SPECIFIC TECHNICAL SPECIFICATION (STS), shall be self-protecting. System fault power may be supplied from either one or both unfaulted terminals. The maximum short circuit current at the tertiary bushings shall not exceed either, 25 times the rated tertiary winding capacity, or 32 kA whichever is lower.

### **3-3.3 EARTHQUAKE STRENGTH**

The completely assembled transformer shall meet the requirements of IEEE Standard 693 at the High Seismic Qualification Level. All applicable seismic identification plates, drawings, calculations and test reports shall be provided as specified in IEEE Standard 693.

### **3-3.4 WIND LOADING STRENGTH**

The transformer shall be designed to withstand wind up 120 miles/hour in its service configuration (i.e., with bushings, arresters, radiator/coolers, conservator, etc. installed). The earthquake and wind forces need not be considered as occurring simultaneously. Documentation in the form of test data or calculations shall be provided to confirm the transformer's wind and mechanical shock withstand capabilities.

### **3-3.5 AUXILIARY EQUIPMENT**

Buchholz relay or sudden pressure relay if separate from the Buchholz relay, etc. shall be able to withstand the seismic event without malfunctioning. Mercury type switches are not allowed for relays and switches.

### **3-3.6 SOUND LEVEL**

The transformer sound level shall not exceed the value listed in the SPECIFIC TECHNICAL SPECIFICATION (STS).

### **3-3.7 VIBRATION**

The transformer and accessories shall be protected from damage by vibration during operation, transportation or short circuits.

### **3-3.8 EXTERNAL CLEARANCES**

External clearances shall be such that there will be no visible corona up to 1.1 p.u. system voltage. In addition, the minimum external clearances between live parts and live parts to ground shall not be less than that specified in NEMA TR 1-1980, Table TR 1-0.06. For a 500 kV system the phase-to-phase clearance shall be not less than 144 inches and the phase-to-ground clearance shall be not less than 130 inches.

## **3-4 DESIGN AND CONSTRUCTION**

### **3-4.1 MATERIALS**

Materials shall be of recent manufacture, unused, and free of defects or irregularities. Recycled substances shall be utilized to the maximum practical extent without jeopardizing material requirements and equipment performance.

3-4.1.1 All nuts, bolts, studs and U-bolts shall be of the appropriate hardness and strength for the application.

- a) All threaded parts shall be in accordance with the latest ANSI standards
- b) All fasteners shall be ASTM Grade 5 (Metric 8.8) or above
- c) All fasteners must be registered with Industrial Fastener Institute (IFI)
- d) Spares shall be supplied with the equipment in quantities of ten percent, but not less than one, in excess of the normal amounts required for each type.

3-4.1.2 Mercury switches are not allowed on any devices.

### 3-4.2 WINDINGS AND WINDING CONFIGURATIONS

All insulation shall be of uniform quality and void free with moisture content not exceed to 0.5%. Current-carrying joints or splices shall be welded, brazed or made by compression fittings that have been proven suitable for the purpose. Use of resin-bonded insulation shall be subject to approval.

#### 3-4.2.1 Wye / Wye Configuration

Autotransformers or transformers connected wye-wye shall have no angular displacement between the high and low voltage.

#### 3-4.2.2 Wye / Delta or Delta / Wye Configuration

Transformers connected wye-delta or delta-wye shall be furnished with the low voltage lagging the high voltage by 30 electrical degrees unless otherwise specified in the SPECIFIC TECHNICAL SPECIFICATION (STS).

#### 3-4.2.3 When lead-lag or series-multiple connections are specified, the connection shall be made using a De-Energized Tap-Changer (DETC) switch (See 3-4.5 for construction).

The switch positions shall be identified by ALPHABETIC characters.

#### 3-4.2.4 Winding Test Taps

Temporary test taps are allowed for low frequency induced testing of transformers without tertiary windings. No dielectric tests are required on the test tap. The test tap shall not be grounded nor shall any surge voltage limiting device or impedance be connected to the test tap during impulse tests on the high and low voltage windings. On completion of the low-frequency induced tests, the test tap bushing shall be removed and the tap lead shall either be removed or terminated inside the tank without disturbing the winding insulation structure. Any remaining portion of the tap lead shall not be relocated from the position it occupied during the impulse tests

#### 3-4.2.5 Metal Oxide Surge Arresters

Prior approval shall be obtained from the Contracting Officer before any device such as Metal Oxide Surge Arresters (MOSA) or protective devices are placed within the main winding compartment of the transformer. Use of MOSA across the regulating section of the main transformer winding is not desired. Approval may be granted if the manufacturer is able to demonstrate that such devices will not reduce reliability, load ability or useful life of the transformer and the device can be easily removed and replaced without un tanking the core and coils.

### 3-4.3 LOAD TAP CHANGER (LTC)

When specified the LTC shall comply with C57.131.

#### 3-4.3.1 When load tap changing is specified, a three (3)- phase 240-volt motor-driven tap-changing device shall adjust the ratio. For inter-changeability reasons the load ratio control equipment shall compatible to BPA LTC Drawing (See sketches in STS section).

- a) If a Reinhausen tap changer is provided, BPA will supply the number for a schematic diagram which meets BPA' requirements and the specified control polarity.
- b) When windings are required to be suitable for more than one connection (delta or wye, series-multiple, lead or lag), the taps shall be effective on all possible connections.
- c) The use of vacuum interrupter LTC's is preferred. If one is used, an LTC oil filter is not required. If an oil interrupter LTC is used, an LTC filter system is required.

3-4.3.2 The control voltages will be 125 volt DC, the polarity is given in SPECIFIC TECHNICAL SPECIFICATION.

3-4.3.3 BPA uses the convention of having the lowest H/X ratio as tap position 1. As an example, see table below:

<u>LTC position</u>	<u>H-winding voltage</u>
9	120750
8	119313
7	117875
6	116438
5	115000
4	113536
3	112125
2	110688
1	109250

3-4.3.4 The tap changer mechanism shall be mechanically capable of performing 200,000 operations, and the tap changer contacts shall be capable of performing 50,000 operations at rated load without parts having to be replaced or rebuilt.

3-4.3.5 Local indication of the tap position shall be provided at each transformer. It shall be readable to a person standing at the base of the transformer.

3-4.3.6 Remote indication of tap position shall be provided using a binary coded signal (Dual Code) output which drives an indication module in the control house and provides a binary output signal for connection to SCADA.

3-4.3.7 An operation counter to record the number of tap changes shall be provided for each tap changer.

3-4.3.8 With prior approval of the Contracting Officer, the LTC may be installed and final connections made at the site. When approval is granted for site installation, a flange system (or equivalent) shall be installed at the factory so the LTC compartment can be welded to the main tank after the installation is completed without having to weld to a surface that is in direct contact with insulating oil. The manufacturer shall be responsible for installation of the LTC and welding of the compartment.

3-4.3.9 Diverter Switch Compartment. Elements of the load tap changer mechanism which cause arcing shall be located in a compartment separate from that of the core and coils.

All electrical connections and oil expansion provisions shall be designed to prevent interchange of oil between the separate compartments.

3-4.3.10 LTC Filtration System. The NON-VACUUM type LTC shall have a filtration system to minimize arc-produced carbon, other particles and water from the oil. The filter shall be accessible for quick and easy replacement. A spare cartridge, adequately packaged for storage, shall be provided with the transformer.

To eliminate trapping of air in the return line when changing filters the ball valve in the return line must not be located above the elevation of the bleeder (See SKETCH in STS document).

#### **3-4.4 DE-ENERGIZED TAP CHANGER (DETC)**

When a de-energized tap changer is specified in the SPECIFIC TECHNICAL SPECIFICATION, it shall be provided in accordance with ANSI C57.12.10 section 5.1.1.

- 3-4.4.1 The operating handle shall be located four and one half (4 –1/2) ft. above the tank base.
- 3-4.4.2 Positive indication of tap position shall be provided.
- 3-4.4.3 Position indication shall be identified by ARABIC NUMERALS.
- 3-4.4.4 Gears external to the transformer tank shall be in sealed, oil or grease filled gearboxes.
- 3-4.5.5 Shear pin, when used, shall be located external to the tank and on the switch shaft end that is closest to the operating handle.

#### **3-4.5 LEAD-LAG SWITCH**

When it is specified in the SPECIFIC TECHNICAL SPECIFICATION, shall be provided in accordance with ANSI C57.12.10 section 5.1.1.

- 3-4.5.1 The operating handle shall be located four and one half (4 –1/2) ft. above the tank base
- 3-4.5.2 Positive indication of switch position shall be provided.
- 3-4.5.3 Position indication shall be identified by ALPHABETICAL CHARACTERS
- 3-4.5.4 Gears external to the transformer tank shall be in sealed, oil or grease filled gearboxes
- 3-4.5.5 Shear pin, when used, shall be located external to the tank and on the switch shaft end that is closest to the operating handle.

#### **3-4.6 FRAME AND CORE GROUNDING**

Normal clamping of the core to the tank for bracing will not be considered an acceptable ground. Grounding through fuses, resistors and other devices is not allowed.

##### **3-4.6.1 Single Core Ground System**

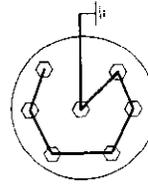
Separate core and frame grounds shall be brought out through bushings having a 1.2 kV rating. The bushings shall be jumpered together outside the transformer and grounded to the tank. All the connections shall be enclosed in a weather-tight enclosure with a removable cover. Threaded bushings are NOT ACCEPTABLE.

##### **3-4.6.2 Multiple Core Ground System**

If a multiple segment core design is used, each segment shall be grounded independently as follows.

- 3-4.6.2.1 An independent core ground lead shall be brought out from each core segment to an external access point using bushings having a 1.2 kV rating. Threaded bushings are not acceptable.
- 3-4.6.2.2 The support frame ground shall also be brought out in a similar manner.
- 3-4.6.2.3 The bushings shall be located in a weatherproof enclosure. The core and frame ground leads shall be connected together with a jumper on the bushing terminals and connected to the transformer tank at one point.

EXAMPLE



3-4.6.3 Each core ground and frame ground must be labeled indicating its location as shown on the winding drawing (3-2.4.14).

3-4.6.4 On a 3 phase transformer, neutral bushing shall be grounded with bus to tank ground pad (cable or bus bar) (3-4.15.3)

**3-4.7 BUSHING CURRENT TRANSFORMERS (BCT)**

All bushing current transformers (BCT's) shall be 5-lead, multi-ratio and conform to requirements listed in the SPECIFIC TECHNICAL SPECIFICATION and shall be in accordance with ANSI C57.13.

3-4.7.1 If the required number of BCT's exceeds that allowable with standard bushings then the design shall allow for externally mounted CT's.

3-4.7.2 The BCT polarity mark shall point toward the external bushing terminal.

**3-4.8 BUSHINGS AND TERMINAL CONNECTIONS**

All bushings shall conform to requirements listed in the SPECIFIC TECHNICAL SPECIFICATION and the BPA Specification for Apparatus Bushings.

3-4.8.1 Each bushing shall be provided with a single-tang flat-pad terminal.

3-4.8.2 All terminal pads shall be made of copper or high conductivity copper alloy and shall be tinned with commercially pure tin.

3-4.8.3 Terminal construction shall permit terminal rotation around the bushing stud to facilitate bus connections.

3-4.8.4 Bolt holes shall be drilled in accordance with NEMA STANDARD CC 1; (i.e. 9/16 inch (14.3 mm) holes, spaced 1-3/4 inches (44.4 mm) apart).

3-4.8.5 The minimum terminal requirements:

Bushing Current Rating	600 amp and below	Above 600 and below 3000 amps	3000 amp and above
Terminal size (width and height)	2" x 4" or 4" x 4"	4" x 4"	6" x 4"
Terminal thickness (minimum)	.50 inch	.50 inch	.75 inch
Number of holes	2 or 4	4	6

**3-4.9 BUSHING POTENTIAL DEVICES (BPD)**

The potential device when specified shall have two 115-V secondary windings each with an intermediate tap of 66.4-V to the non-polarity terminal. The 115 V and the 66.4 V leads shall be terminated in the control cabinet.

Potential devices on bushings rated above 230 kV shall have a 100 W minimum rated burden.

### 3-4.10 GASKETS AND O-RINGS

Nitrile rubber, flourosilcone and cork-neoprene gaskets/O-rings are acceptable, but gaskets of cork only or neoprene only are NOT allowed. Gasket surfaces shall be true with grooves or stops to prevent over-compression of gaskets. Subject to the prior approval, other gasket systems may be used.

- 3-4.10.1 The manufacturer shall furnish two sets of gaskets required for initial field assembly of each transformer.
- 3-4.10.2 Grooves for O-ring gaskets shall be located on the upward facing flange, when practical.

### 3-4.11 TANK

The tank shall be of oil and gas-tight steel plate construction. All tank seams shall be welded to insure oil and gas tightness.

- 3-4.11.1 The transformer tank, including bushing turrets and unfilled manhole covers shall be designed to channel all gases to a gas accumulation relay.
- 3-4.11.2 The completely assembled transformer shall be designed to withstand, without permanent deformation, full vacuum and an internal pressure equal to the maximum operating pressure of liquid preservation system or 15 PSI.
- 3-4.11.3 The transformer tank cover shall be welded to a welding flange on the tank.
  - 3-4.11.4.1 The weld joint shall be designed for chipping of the welds (weld removal).
  - 3-4.11.4.2 Permanently installed stop gaskets shall be provided to protect against the entrance of foreign matter during chipping and welding operations.
  - 3-4.11.4.3 The manholes, and all other openings in the tank cover employing gaskets, shall be raised 3 inches above the cover surface to prevent the accumulation of water around the gasket joints.

#### 3-4.11.4 Tank Base

3-4.11.5.1 The bottom plate may be as follows:

- a) A reinforced (raised) designed using a beam skid design that is suitable for use as a seismic tie-down structure for either a welded or anchor bolt system.

OR

- b) Flat bottom that will set on the foundation and shall be suitable as a seismic tie-down for either a welded or anchor bolt system.

3-4.11.5.2 Shall be adequate for moving the transformer on rollers or skids parallel to either centerline when completely assembled and filled with oil.

3-4.11.5.3 Be designed such that no damage will occur in the event the weight of the totally assembled transformer, with oil, is sustained on diagonally opposite corners (due to unevenness of jacking or failure of the jack at one corner).

#### 3-4.11.5 Provisions for Future Installation of an On-Line Gas-In-Oil Monitor.

3-4.11.5.1 A clear space approximately 24" (610 mm) vertical by 12" (305 mm) horizontal shall be provided on the tank wall in the vicinity of the valve for the future installation of the electronic unit. Two (2) pieces of 1-1/2 inch "Unistrut" (or 3/8" thick, 1-1/2" angle iron) 12 inches long shall be welded to tank wall with a 20 inch vertical spacing.

3-4.11.5.2 See valve table 3-14 for requirements

Tank markings shall be provided as specified in clause 3-2.3.6 "Transformer Tank Markings"

### 3-4.12 ACCESS HOLES

Flanged access holes of at least 16 inches (400 mm) minimum diameter shall be furnished to provide easy access to BCT terminal boards and lower ends of bushings.

- 3-4.12.1 The access holes, and all other openings in the tank cover employing flanges with gaskets or O-rings, shall have the flanges raised a minimum of 3 inches above the cover surface to prevent the accumulation of water around the gasket joints
- 3-4.12.2 Access holes on tank top not designed to channel generated gases shall be filled with solid dielectric.
- 3-4.12.3 Each access hole shall have a bolted gasketed cover with lifting eyes.

### 3-4.13 VAPOR TRAP FLANGE

A 150 psi (1035 kPa) rated 8-inch (200 mm) lapped flange meeting the requirements of ANSI B16.5 shall be installed on the highest point practical on the transformer tank top over the main winding.

- 3-4.13.1 The flange opening shall not be blocked by obstructions in the tank.
- 3-4.13.2 The flange face shall be horizontal and have a 32-microinch finish.
- 3-4.13.3 Eight holes equally spaced on an 11-3/4-inch bolt circle (298 +1 mm) shall be drilled and tapped for 3/4-inch NC (19 mm) bolts.
- 3-4.13.4 The flange may be located on a manhole cover but not on the LTC cover.
- 3-4.13.5 A horizontal area shall be provided on the tank top to accommodate and support a refrigerated vapor trap (RVT).
  - 3-4.13.5.1 The area shall be at least 30 inches (760 mm) in diameter and centered 35 inches (890 mm) from the vapor trap flange centerline.
  - 3-4.13.5.2 The area shall be capable of supporting 2,000 lbs (900 kg) while the transformer is under full vacuum.

### 3-4.14 VALVES

3-4.14.1 Ball Valve General Requirements:

- a. Unibody construction --- Multi-piece bolted bodies not allowed
- b. Vacuum rated
- c. 1/4 Turn Indicating
- d. Lockable in both open and closed positions
- e. API 607 or equivalent fire safety rating
- f. Welded valves shall have a carbon or stainless steel body
- g. Class 150 flanged valves may be either a carbon steel or stainless steel body
- h. Stainless Steel Ball, Stem, Backing Nut

- i. Full size port
- j. Flange connections shall be designed for gasket use only (exceptions noted in Valve Table)

3-4.14.2 Butterfly Valve General Requirements:

- a. 1/4 Turn Indicating
- b. Lockable in both open and closed positions
- c. API 607 or equivalent fire safety rating
- d. Include oil tight blanking plates

3-4.14.3 Specific Valve Requirement Table and Valve Locations

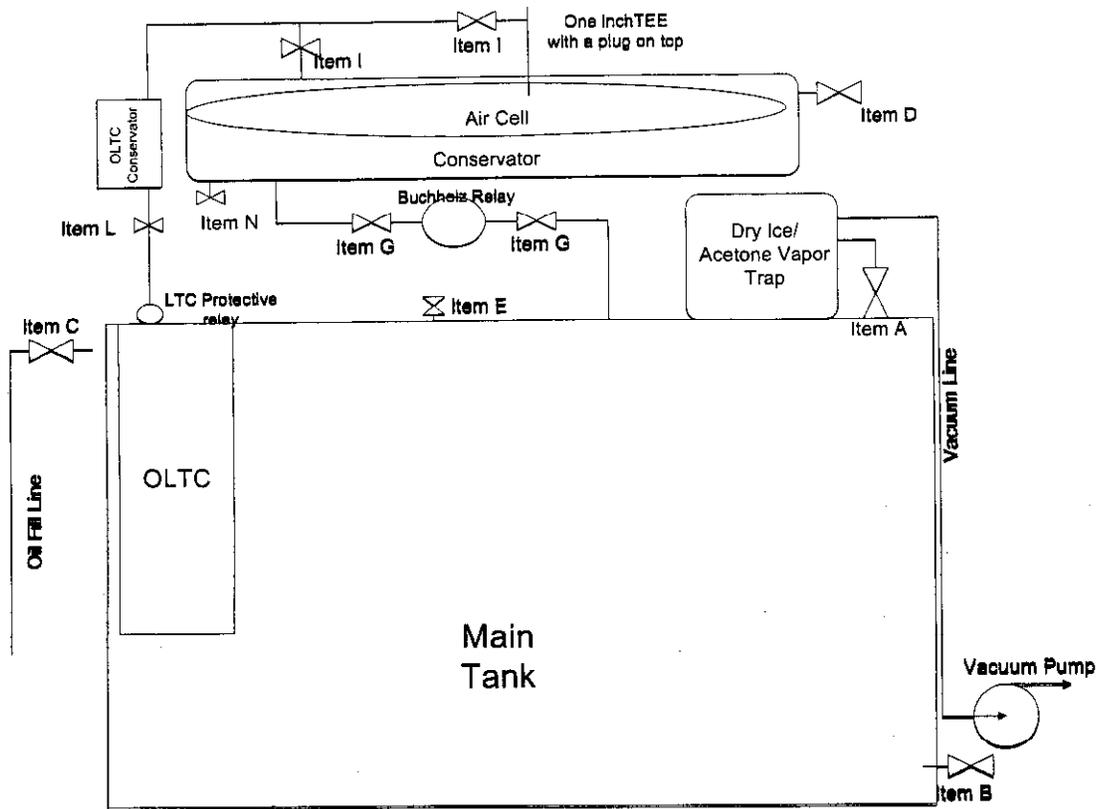
SPECIFIC VALVE REQUIREMENTS			
Valve Identification	Valve Description/Function	Construction	Location
RVT vacuum valve (Sketch Item A)	8-inch butterfly valve (for Refrigerated Vapor Trap (RVT) Mounting)	Include oil-tight blanking plate. Flanged connections. See 3-4.13	RVT flange on tank lid. Permanently installed.
Drain valve (Sketch Item B)	2-inch carbon or stainless steel body ball valve (for removing insulating oil)	Welded to tank with no threaded connections between valve and tank. NPT female discharge end fitted with threaded plug.	Bottom corner of tank. If tank oil capacity is greater than 10,000 gallons, provide two valves (spaced 18 inches apart) from each other to allow quicker oil removal.
Fill valve (Sketch Item C)	2-inch carbon or stainless steel body ball valve (for filling)	Welded to tank with no threaded connections between valve and tank; NPT female discharge end fitted with threaded plug.	Near top of tank wall. Away from tank RVT valve. Opposite side from drain valve(s) such that oil flow during filling will not damage internal parts.
Upper vacuum valve (Sketch Item D)	2-inch carbon or stainless steel body ball valve. (vacuum connection during oil filling and processing)	Welded to conservator; NPT female discharge end fitted with threaded plug.	Horizontal mounting. Highest practical point on conservator.
Tank venting valve (Sketch Item E)	½-inch ball valve (vacuum gauge connection during oil processing and filling)	Female threaded ends	Horizontal position on main tank. Near conservator shut- off valve.  Permanently installed.
Gas in Oil Monitoring Valve (Item F - not shown)	2 inch ball valve carbon or stainless (Future installation of GIO monitor)	Welded to cooler return manifold, outer end fitted with pipe plug. Output not more than 6-1/2 inches from oil flow.	Lower cooler manifold (oil return).
Buchholz Relay Isolation Valve also used as conservator shutoff valve  (Sketch Item G)	Ball valve size determined by conservator piping  Capable of holding full head of oil in conservator.		Both sides of Buchholz relay

SPECIFIC VALVE REQUIREMENTS			
Valve Identification	Valve Description/Function	Construction	Location
Gas Sampling Valve (Item H - not shown)	1/4-inch stainless steel ball valve (for taking gas samples from Buchholz relay)	Stainless steel tubing from Buchholz to gas sampling device  Female NPT thread connections both ends	Located so that samples can be taken with the equipment energized.
Pressure Equalization Valve (Item I)	1 inch ball valve  (For pressure equalization of conservator air cell during vacuum processing and oil filling)		One (1) valve between conservator air and oil spaces.  One (1) valve between air cell and LTC conservator
Oil Pump Isolation Valves (Item J - not shown)	Butterfly Valves For isolation of cooling pumps. Permits removal of oil pump without draining either the pump or the cooler.		One (1) valve between pump and tank.  One (1) valve between pump and cooler.  If one side of pump is connected to the tank, the tank side valve may also serve as the Cooler Shutoff Valve.
Radiator Isolation Valves (Item K - not shown)	Butterfly Valves For isolation of radiators/coolers Permits removal of radiator without draining oil from tank		Between radiator and tank - top and bottom open and closed positions must be clearly indicated
LTC Protective relay isolation valve (Item L)	1 inch ball valve		Located between LTC conservator and LTC protective relay
All ball valves associated with the LTC filtration, if required, shall be 1 inch	Valves required for LTC filtration system		LTC filtration system
Sudden Pressure Isolation Valve (Item M-- not shown)			Isolation for sudden pressure relay, if required. Manufacturer to determine location.
Conservator Drain Valve (Sketch Item N)	1 inch ball valve	Female NPT thread connections both ends  Open end to be plugged	For conservator tank draining
LTC Conservator Drain Valve	1 inch ball valve	Female NPT thread	For LTC conservator

SPECIFIC VALVE REQUIREMENTS			
Valve Identification	Valve Description/Function	Construction	Location
(Item O –not shown)		connections both ends Open end to be plugged	tank draining
Oil Sampling Valve	Not Required		

Preferred Valve Suppliers		
KF Industries	Milwaukee Valve	NIBCO
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# VALVE LOCATIONS



### 3-4.15 TRANSFORMER TANK GROUNDING

Grounding pads shall be in accordance with ANSI C57.12.10, with the following exceptions:

- 3-4.15.1 Grounding pads shall be copper faced meeting the requirements of ASTM B432.
- 3-4.15.2 Four (4) NEMA 4-hole ground pads shall be provided. One to be located near each bottom corner of the tank walls that are parallel to the arrester brackets.
- 3-4.15.3 The bolt holes shall be drilled on 1-3/4 inch centers and tapped for ½-13 UNC thread per ANSI B1.1
- 3-4.15.4 Neutral Bushing Grounding. For three-phase transformers an isolated copper ground bus or insulated cable having a minimum cross sectional area of 200 kcmil (100 mm<sup>2</sup>) shall be rigidly secured to the tank and connected between a grounding pad at the base of the transformer and the terminal of each neutral bushing furnished.

### 3-4.16 OIL PRESERVATION SYSTEM

The transformer shall have a conservator (expansion tank) type oil preservation system that is capable of withstanding full vacuum.

- 3-4.16.1 There shall be no contact between oil in the conservator tank and air. This shall be accomplished by the use of a nitrile air cell (diaphragm not allowed) vented to the outside air through a desiccant such as silica gel. The air cell shall be designed for flange installation (clamps not allowed).
- 3-4.16.2 All oil line pipes and rigid sections of gas collecting system used shall be black iron pipe with Class 150 welded pipe flanges (ANSI B16.5). The pipe flange connections shall be designed for gaskets. The flange connection and piping shall be adequately supported.
- 3-4.16.3 The conservator shall be of sufficient volume to operate through an ambient temperature range of minus 35°C to plus 50°C (-35°C to +50°C) without causing the low oil level alarm contacts to close at the lower limit and without exceeding the recommended full oil level at the upper limit.
- 3-4.16.5 A shut-off valve shall be provided in the oil line between the expansion tank and the Buchholz relay; a second shut-off valve shall be installed between the Buchholz relay and main transformer tank.
- 3-4.16.6 All expansion tanks shall be provided with regenerative style breathers which provide a means to automatically dry the silica gel desiccant. The breathers shall at transformer tank potential and located so they can be safely maintained while the transformer is energized.

### 3-4.17 COOLING SYSTEM

The cooling class of the transformer is specified in the STS.

- 3-4.17.1 OFAF/OFAF and ODAF/ODAF transformers shall have cooling equipment arranged in two equivalent groups. Each group shall provide sufficient cooling to permit the transformer to carry 70 percent of the rated MVA without exceeding 65°C average winding temperature rise.
- 3-4.17.2 Radiators or Coolers shall be of materials with melting points in excess of 1000 degrees C and shall be constructed such that excessive vibration will not develop from internal or external sources. The material used for welding or brazing the coolers or radiator shall also have melting points in excess of 1000 degrees C. The system shall be capable of withstanding full vacuum and 15 psig pressure.
- 3-4.17.3 Each radiator or cooler unit shall be provided with a lifting eye, vent plug and drain plug in the headers.
- 3-4.17.4 Cooling Group Power Source. When two cooling groups are provided, the two groups shall operate in parallel from the same power source with means to de-energize and isolate either group while the other remains in operation.

- 3-4.17.4.1 The cooling control shall be designed so that either group can be preferentially operated as the first or the second stage of cooling in conjunction with the winding temperature and cooling equipment starting relay so the order can be reversed to equalize wear between the two groups. The controls shall be such that they can be operated locally manual or automatic as well as remotely.
- 3-4.17.4.2 A magnetic contactor in conjunction with the winding temperature indicator relay shall control each group of fans and pumps.
- a) Each contactor shall have two auxiliary contacts that may be adjusted to be normally open or normally closed, or shall have two normally open and two normally closed contacts.
- b) If adjustable contacts are furnished, one shall be set normally open and the other normally closed.
- 3-4.17.4.3 An auxiliary relay(s) shall be installed in the Control Cabinet such that the contacts of the auxiliary relay(s) will act to shut down all cooling pumps and fans upon receiving a 130 Vdc biased BPA signal input to energize the auxiliary relay(s). The relay(s) shall have a 130 Vdc coil.
- 3-4.17.5 Motor overload protection for fans and pumps shall be totally enclosed and suitable for operation in wind-driven rain.
- 3-4.17.6 Pumps, if supplied, shall be at the lower end of cooler header installed in a way so they can be removed or maintained with complete safety while the transformer is energized.
- 3-4.17.6.1 Ball Bearing Pumps, if supplied, shall be, self-lubricating, sealed type, designed for continuous as well as intermittent duty. The bushings and bearings shall withstand end thrust, when required.
- 3-4.17.6.2 Sleeve Bearing Pumps, if supplied, shall be provided with pump bearing-wear measuring sensors. The bearing wear measurement sensors shall be capable of measuring bearing wear to within 1/1000 of an inch with the pump installed and operating and be designed to operate with the TecSonic Bearing wear monitor that is manufactured by J.W. Harley, Inc. (Note: The Vendor is not required to provide monitors. BPA has several of the J.W. Harley monitors.)
- 3-4.17.6.3 One magnetic coupled oil flow indicator shall be installed in the oil line adjacent to each oil pump. Alarm contacts shall be provided to indicate failure of the oil pump when the cooling equipment is energized. A time delay shall be provided to prevent operation of the alarm during pump starting.
- 3-4.17.6.4 The pumps shall be provided with a means to turn off when a trip signal, from a transformer protection relay occurs. The intent is to prevent the circulation of debris when a transformer fails.
- 3-4.17.7 Cooling Fans
- 3-4.17.7.1 The fans shall meet OSHA requirements.
- 3-4.17.7.2 Fan motor bearings shall be ball bearing, self-lubricating, sealed type, designed for continuous as well as intermittent duty. The bushings and bearings shall withstand end thrust, when required.
- 3-4.17.7.3 Manual-resetting overload protection shall be provided for each individual motor unless the motors can withstand full stalled-rotor current continuously without damage.
- 3-4.17.7.4 The fan housing shall be connected to the cooling supply ground by use of a three-wire cable for single-phase motors and four-wire cable for three-phase motors.
- 3-4.17.7.5 Fans mounted off the horizontal shall be provided with a rain shield. Fan blades shall be made of either fiberglass with a protective coating or corrosion-resistant metal.

### 3-4.18 COMBUSTIBLE GAS PIPING SYSTEM

3-4.18.1 All sections of the gas collecting system from turrets, unfilled access covers, etc., shall be 1-inch black iron pipe with Class 150 welded pipe flanges (ANSI B16.5). The pipe flange connections shall be designed for O-rings. The flange connection and piping shall be adequately supported.

3-4.18.2 Piping shall be installed in a manner that keeps the center of the top of tank as clear as possible without inhibiting the accessibility of servicing any equipment located on top of tank. This is to reduce tripping hazards.

### 3-4.19 LIFTING FACILITIES

Lifting attachments shall be furnished on the tank and other transformer parts. The design of such attachments shall provide a factor of safety of at least 5.

3-4.19.1 Sharp edges shall be eliminated from all points with which the lift cable makes contact during normal lifting operations.

### 3-4.20 MOVING FACILITIES

The transformer base shall be designed in accordance with ANSI C57.12.10 clause 5.3.

### 3-4.21 JACKING FACILITIES

3-4.21.1 The jacking plates (pads) shall be located on the tank walls as near to the corners as possible. They shall be attached between 14 and 18 inches (350 and 450 mm) from the transformer base and shall extend horizontally outward at least 12 inches (300 mm) beyond any protrusion (base flange, skid channels, etc.) located below them.

3-4.21.2 The jacking pads shall be at least 12 inches (300 mm) in length along the tank.

3-4.21.3 The tank walls below the level of the pads shall be free from obstructions (valves, cooler pipes, etc.) for the length of the pads plus 6 inches (150 mm) from each end of the plates.

3-4.21.4 The jacking pads, including bracing, shall be capable of supporting one-half the weight of the transformer, completely assembled and filled with oil, without buckling or bending.

### 3-4.22 FALL PROTECTION

A fall protection system consisting of the following shall be provided:

3.4.22.1 Skid resistant paint on tank top.

3.4.22.2 A system of removable safety posts and rope (See sketch below)

3.4.22.2.1 Safety posts shall be 1.5 inch round aluminum pipe (6160-T6). Each safety post shall be 50 inches long with 3 - 1 inch "D-ring" type eyelets made of 5/8 inch AL welded on 15 inch centers starting 6 inches below the top of pipe.

3.4.22.2.2 The post sockets and pipe shall be properly aligned and drilled with a 3/8 inch hole for 1/4" X 3 inch pins. The pins shall be permanently attached to the pipe by means of a stainless steel chain or wire rope (aircraft cable). The mounting supports shall be designed to not collect water (2 - 1/4" weep holes).

3.4.22.2.3 The post mounting shall be located to the side or on the edge of tank top.

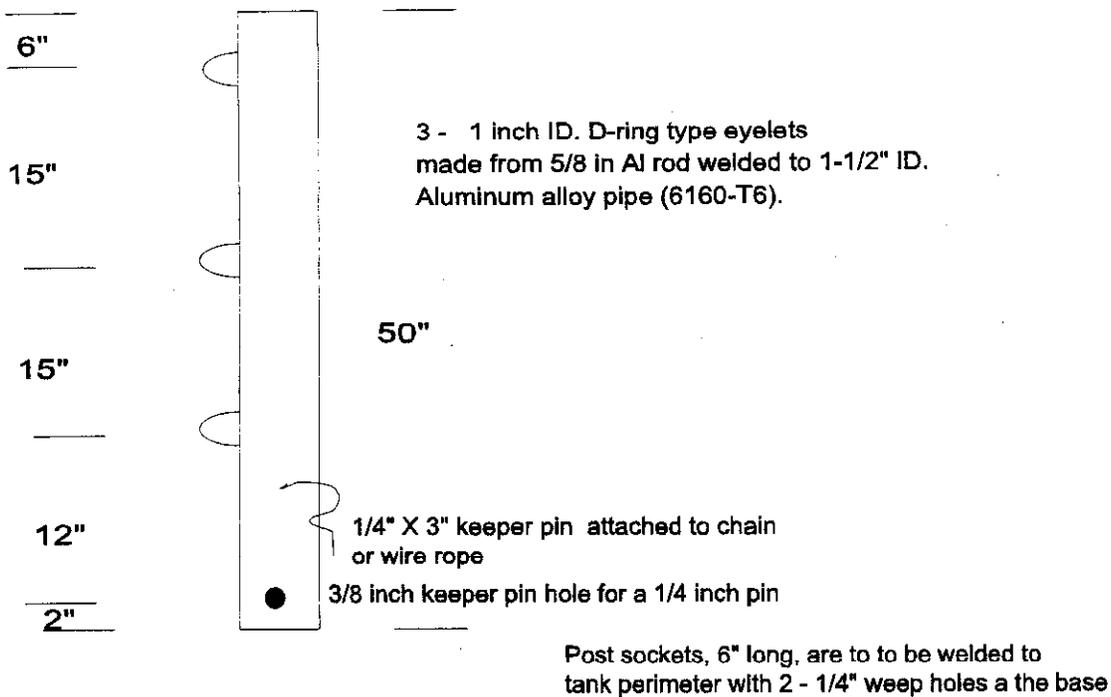
3-4.22.2.4 The poles shall be shipped in a weatherproof container (i.e. Aluminum box with a hinged cover) that will be used as a permanent storage container.

3-4.22.2.5 A Unique Concepts Limited (UCL) anchor plate, part number 85-17422 must be mounted on the top of the transformer to allow use with a standard UCL 3 man post, part number ES85-16691. The anchor

plate must be attached with a 3/8" welded fillet so that 3, 300lb workers can be supported safely by the anchor plate and post. It is the intent of BPA to use a Miller Retractable Lanyard (11 foot safety lanyard), part number 85-17422 for up to and including 3 persons for work on top of the transformer. Additional anchor plates must be added to allow workers walking on top of the transformer to reach all areas of the top of the transformer with the 11 foot retractable lanyard noted. BPA will supply the anchor post and lanyard(s) and the information for those has been included for informational purposes only.

Other fall protection systems must be approved by BPA.

### SAFETY RAIL POSTS



### 3-4.23 SURGE ARRESTER BRACKETS

When specified in the SPECIFIC TECHNICAL SPECIFICATION, surge arrester brackets shall be furnished on the transformer.

3-4.23.1 Arrester brackets shall be located on the side of the tank adjacent to their respective high and low voltage bushings. When possible, the height of the arrester terminals shall approximately match the height of associated bushings. The location of brackets shall be in accordance with the applicable customer drawings for bushings and accessories.

3-4.23.2 Mounting holes are to be oriented such that the arrester vent points away from the tank.

### 3-4.24 CONDUIT AND WIRE

- 3-4.24.1 Route all circuits through rigid, galvanized, steel conduit or other means subject to the approval of the Contracting Officer. The BCT wiring shall be stranded No. 12 AWG, all other wiring shall be stranded, minimum No. 14 AWG.
- 3-4.24.2 Common Interface. All power, alarm, control or indication circuits that BPA will interface with shall be located in the control cabinet.

### 3-4.25 CONTROL CABINET POWER REQUIREMENTS

Unless otherwise specified in the SPECIFIC TECHNICAL SPECIFICATION, BPA will furnish the following supply power to the control cabinet:

- a) 3 Phase 240 volt 60 Hz (normal supply) to Automatic Transfer Switch (ATS)
- b) 3 Phase 240 volt 60 Hz (backup supply) to Automatic Transfer Switch (ATS)
- c) Single phase 240 volt ungrounded heater supply
- d) 120 volt convenience outlet and lighting circuit
- e) 125 volt DC supply, polarity is indicated in the SPECIFIC TECHNICAL SPECIFICATION.

### 3-4.26 CONTROL CABINET

The control cabinet shall be of a weatherproof construction having a gasket-hinged door with at least two (2) latch-points operated by a single lockable handle. There shall be two (2) screened vents for ventilation; one (1) located in each back corner. An undrilled, removable, gasketed metal plate shall be located over a rectangular opening not less than 9 by 16 inches (229 x 406 mm) in the bottom for conduit entrance.

- 3-4.26.1 NEMA type circuit breakers shall be used for isolation and protection of all circuits.
- 3-4.26.2 Automatic Transfer Switch (ATS). The cooling equipment power, for fans and pumps, shall be routed through an automatic transfer switch.
- 3-4.26.2.1 ATS alarm contacts shall be provided to indicate a loss of either station power source
- 3-4.26.3 A Magnetic Contactor (starter) shall be provided for each group of fans and pumps.
- 3-4.26.4 A space heater with a thermostat adjustable from 40°F to 80°F shall be furnished for the control cabinet. The heater circuit shall be protected by a circuit breaker.
- 3-4.26.5 Terminal Blocks shall be the solder-less screw type suitable for ring tongue terminals. No more than two lugs per terminal shall be permitted. The non-conducting parts shall be fabricated from a thermosetting phenolic material which is unaffected by insulating oil.
- 3-4.26.5.1 All terminal blocks and circuit leads shall be marked for circuit identification.
- 3-4.26.5.2 One spare terminal block (or approximately 10 spare terminals) shall provided be in the control cabinet for future use.
- 3-4.26.6 All current transformer terminal blocks shall have shorting provisions of the positive-contact type. Short-circuiting the terminals of any one current transformer shall not short-circuit the terminals of any other current transformer.
- 3-4.26.7 Fan and Pump Motor leads shall be terminated on terminal blocks in weatherproof junction boxes located near the motors.

### 3-4.27 CLEANING AND PAINTING

All interiors and exteriors of tanks, enclosures, cabinets and other metal parts which are not galvanized or of corrosion-resistant material and are exposed to oil or weather shall be thoroughly cleaned and painted (interiors of radiators and coolers are excluded from painting). Cleaning shall be by degreasing and abrasive blasting or other means to remove all grease, scale, corrosion and foreign substances.

- 3-4.27.1 The interiors of all cabinets (including removable metal plates) and the tank interior shall be given at least one prime coat. The interior finish color shall be white.
- 3-4.27.2 Gray (Munsell Renotation 5.0BG 7.0/04, previously ANSI 70 Gray) silicone alkyd enamel shall be applied over a properly prepared primed surface. The dry film thickness of the primer shall be a minimum of 1-1/2 mils and that of silicone alkyd enamel a minimum of 3-1/2 mils.
  - 3-4.27.2.1 Two gallons of paint, from the same batch used on the transformer, shall be supplied with each unit for touching up.
- 3-4.27.3 Other painting procedures may be allowed subject to the approval of the BPA Contracting Officer.
- 3-4.27.4 All machine-finished or bright surfaces shall be thoroughly cleaned, coated with a suitable easily removed corrosion-resistant compound, and wrapped or otherwise protected from damage in shipment.

### 3-4.28 PROCESSING REQUIREMENTS

BPA will process the transformer in the field in accordance with Method 2 of ANSI C57.93. The following shall be provided for to facilitate processing:

- 3-4.28.1 Oil at approximately 60°C during the drying process.
- 3-4.28.2 Oil flow rate of 30 gallons per minute maximum is permissible when filling the transformer in the field.
- 3-4.28.3 During the vacuum dry out of the transformer, the complete transformer is under full vacuum. The complete transformer includes; transformer tank, conservator tank, air cell, tap changer compartment and all the gas bleed piping. The desiccant breathers are removed and the breather pipe blanked off. Vacuum is pulled on the conservator through the interconnecting pipe that contains the Buchholz relay.
- 3-4.28.4 BPA vacuum fills transformers through the top oil fill valve. This valve shall be located such that no damage is done by the hot degassed, dehydrated insulating oil entering the transformer at a flow rate of 30 gallons per minute.
- 3-4.28.5 During vacuum oil filling when the oil level is about 6-inches below the top of the tank, the valve between the trap and the transformer is closed, the trap is removed and a blanking plate is installed on the valve. The vacuum gauge sensor on top of the tank is isolated by closing the valve, the sensor is removed and a plug installed in the valve. When the conservator is close to being half full of oil, vacuum is broken on the air cell. The transformer is considered full when the oil level is above the 25°C mark on the oil level gauge and the air cell is at atmospheric pressure. A pipe "Tee" fitting shall be installed between the vertical and horizontal piping on top of the conservator with the open end plugged and sealed. This allows us to measure, with a stick, the height of the oil in the conservator as a check against the liquid level gauge on the end of the conservator.

### 3-4.29 INSULATION OIL

- 3-4.29.1 Insulating Oil, ASTM D3487 Type II, will be furnished by BPA for the transformer after it is delivered to the site.
- 3-4.29.2 The concentration of Polychlorinated Biphenyls (PCB) in the oil used during factory testing shall not exceed the limit indicated in ASTM D3487.
- 3-4.29.3 The oil used during testing shall be tested in accordance with ASTM D4059. Certified test reports containing at least the following, shall be furnished before the time of field acceptance:

- a) Concentration of PCB in the oil,
- b) Equipment used to determine PCB concentration,
- c) Accuracy and minimum detection range of the test equipment.

3-4.29.4 After testing, the manufacturer shall remove the oil used, by draining and siphoning if required, such that very little oil remains.

### 3-4.30 LIQUID LEVEL INDICATOR

A 5-1/2 inch magnetic liquid level gauge shall be in accordance with ANSI C57.12.10 clause 5.1.2, with alarm contacts in accordance with clause 7.

- 3-4.30.1 The main tank liquid level gauge shall be installed in the conservator at a downward angle such that it can easily be read from the ground.
- 3-4.30.2 The gauge indication shall be a two-level system utilizing two (2) separate sets of low oil contacts.
  - One (1) set of contacts shall close to alarm on a low-oil condition.
  - The second set of contacts shall close to trip a remote breaker at a lower oil level that corresponds to a level just before the conservator empties.
- 3-4.30.3 Alarm and trip circuit devices shall not have common wiring.
- 3-4.30.4 All alarm contacts shall be suitable for non-inductive loads of 0.20 amperes at 125 volts dc.

### 3-4.31 LIQUID TEMPERATURE INDICATOR (TOP OIL)

A dial type thermometer shall be in accordance with ANSI C57.12.10; clause 5.1.3 with alarm contacts in accordance with clause 7.

- All alarm contacts shall be suitable for non-inductive loads of 0.20 amperes at 125 volts dc.
- Indicator shall be located at a height of approximately five (5) feet above the base of the transformer to facilitate servicing and resetting the drag hand.

### 3-4.32 LIQUID TEMPERATURE RECORDER (7-DAY)

A single phase 240 volt, 60-Hz synchronous-motor-driven, seven-day recording thermometer shall be mounted on the same side of the tank as the liquid-temperature indicator.

- 3-4.32.1 The face of the chart shall be located at a height of approximately five (5) feet above the base of the transformer to facilitate servicing.
- 3-4.32.2 The recorder cover shall have a clear, weatherproof window to permit inspection without having to open the cover.
- 3-4.32.3 The recorder shall operate between 10°C and 120°C with an accuracy of plus or minus 2°C.
- 3-4.32.4 The recording thermometer shall record the oil temperature by means of a thermometer mounted in a closed well located in the path of the hottest oil.
- 3-4.32.5 The thermometer shall continue to indicate after loss of power to the unit.
- 3-4.32.6 Fifty (50) each 7-day charts shall be furnished with the recorder.

3-4.32.7 The liquid temperature recorder shall be shock mounted.

### 3-4.33 WINDING-TEMPERATURE INDICATORS (WTI) (HOT SPOT)

Each indicator shall be furnished complete with associated equipment, including bushing current transformer, closed heater well assembly, temperature detector and necessary wiring and capillary tubing.

3-4.33.1 Each WTI shall be mounted on the same side of the tank as the liquid-temperature indicator and recorder.

3-4.33.2 Each winding temperature indicator shall be shock mounted.

#### 3-4.33.3 TRANSFORMER WTI REQUIREMENTS

3-4.33.3.1 A two-winding, single-phase transformer -- One winding-temperature indicator shall be furnished to indicate the hottest-spot winding temperature -- (1 req'd).

3-4.33.3.2 A two-winding, three-phase transformer -- One winding-temperature indicator shall be furnished to indicate the hottest-spot winding temperature -- (1 req'd).

3-4.33.3.3 A three-winding, single-phase transformer -- Three winding-temperature indicators shall be furnished to indicate the hottest-spot winding temperature for each winding -- (3 req'd); H-Winding, X-Winding, Y-Winding.

3-4.33.3.4 A three-winding, three-phase transformer -- Three winding-temperature indicators shall be furnished to indicate the hottest-spot winding temperature for each winding -- (3 req'd); H-Winding, X-Winding, Y-Winding.

3-4.33.3.5 An autotransformer without tertiary -- shall be treated as a two-winding transformer --(1 req'd).

3-4.33.3.6 An autotransformer with tertiary -- shall be treated as a three-winding transformer -- (3 req'd), H-Winding, X-Winding, Y-Winding.

3-4.33.4 The dial type indicators shall be accurate to within two percent of full scale over a range of 0°C to 150°C with the upper end of the accuracy range to be not less than the temperature expected when the transformer is operated at 150 percent of rated MVA.

3-4.33.5 Each winding-temperature indicator shall have three sets of ungrounded, normally open contacts, which shall automatically close on increasing temperature and open as temperature decreases as follows:

3-4.33.5.1 The first set of contacts shall close when a winding hotspot temperature of 80°C is reached. Closure of these contacts shall actuate the next group of cooling equipment. On a dual rated transformer the second stage cooling will be activated.

3-4.33.5.2 The second set of contacts shall close when a winding hotspot temperature of 90°C is reached activating the next group of cooling. On a triple rated transformer the final stage of cooling will be activated.

3-4.33.5.3 Third set of contacts will be connected to sound alarm when a winding hotspot temperature of 105°C is reached.

3-4.33.5.4 As the temperature decreases, the contacts shall reopen at the temperature at which they were set to close with a minus 7-1/2°C or plus 0°C tolerance.

3-4.33.5.5 The winding-temperature indicator leads shall terminate in a weatherproof steel housing mounted on the transformer tank located at a height of approximately five (5) feet above the base of the transformer to facilitate servicing.

3-4.33.5.6 Each winding temperature indicator shall be provided with means for calibration.

3-4.33.5.7 Each WTI shall be located on the same side of transformer as the liquid temperature indicator (top oil).

3-4.33.5.8 Two standard 100 -ohm Platinum resistance temperature detector (RTD) elements shall be furnished with each winding-temperature-indicator required, to provide for remote indication of the winding hottest-spot temperature. The connecting leads between detection elements and control cabinet terminal blocks shall be soldered or fastened with screw type connectors. The detector elements shall be ungrounded.

### 3-4.34 GAS ACCUMULATION RELAY

A double-float Buchholz type relay shall be provided to detect fault gas accumulation, low liquid level and oil surge. Two sets of normally-open dry contacts shall be provided for the upper float system (gas accumulation function) and two sets of normally-open dry contacts shall be provided for the lower float system (oil surge and low insulating liquid level function).

3-4.34.1 Manual Test. Means shall be provided to manually actuate the sensing mechanism (i.e., lever, floats, etc.) of the relays, without exposing the transformer oil to air or gas or draining oil from the transformer or injecting any gas or liquid into the oil system.

3-4.34-2 See VALVE TABLE 3-4.14 for isolation requirements

3-4.34-3 The gas accumulation relay shall have a one (1) piece stainless steel flex tubing with female swivel fittings (one each end) connecting the relay and the gas sampling device. Alternate designs require the approval of the BPA Contracting Officer.

### 3-4.35 PRESSURE RELIEF DEVICE

A self-resetting, mechanical-type pressure relief device with visual indicator and alarm contact shall be furnished to automatically relieve internal pressures. The normal rating of the device shall be 10psi. It shall be capable of withstanding full vacuum without rupture or loss of accuracy. This device shall be constructed to minimize oil discharge when it operates.

### 3-4.36 SUDDEN PRESSURE RELAY

3-4.36.1 A fault pressure relay operating on rapid rate-of-rise pressure change. The fault pressure relay shall be a complete system including two sets of normally-open dry contacts which seal-in after pickup. Fault pressure relay shall be furnished to protect the transformer against damage due to internal faults.

3-4.36.1.1 A seal-in relay for the sudden pressure device must be capable of AC\DC operation.

3-4.36.1.2 It shall be insensitive to pressure pulses caused by electrical disturbances such as magnetizing inrush currents, or mechanical shocks such as oil pump surges.

3-4.36.1.3 It shall be highly sensitive to small arcs, which would not ordinarily cause a pressure relief device to operate.

### 3-4.37 LTC PROTECTION

3-4.37.1 A 5-1/2 inch magnetic liquid level gauge shall be in accordance with ANSI C57.12.10 clause 5.1.2, with alarm contacts in accordance with clause 7.

3-4.37.1.1 The first set of contacts (alarm) shall close on low oil levels.

3-4.37.1.2 The second set of contacts is for future use with oil filtration system.

3-4.37.1.3 Both sets of contacts shall have independent wiring.

3-4.37.1.4 All contacts shall be suitable for non-inductive loads of 0.20 amperes at 125 volts dc.

3-4.37.1.5 It shall be readable to a person standing at base level. The words, "LTC Liquid Level," shall be on the dial or on a suitable nameplate adjacent thereto.

3-4.37.2 A Rate-Of-Flow Pressure Relay shall be provided to monitor the oil flow between the load tap changer (LTC) diverter switch compartment and LTC conservator. It shall be insensitive to electrical or mechanical pressure pulses caused by normal operation of the LTC, but highly sensitive to abnormal arcing within the compartment.

3-4.37.2.1 A means shall be provided to manually test the alarm circuit without draining oil from or introducing fluids or gases into the compartment.

3-4.37.2.2 See VALVE TABLE 3-4.14 for isolation requirement.

3-4.37.3 Pressure Relief Device. A self-resetting, mechanical-type pressure relief device with visual indicator and alarm contact shall be furnished to automatically relieve internal pressures. The normal rating of the device shall be 10psi. It shall be capable of withstanding full vacuum without rupture or loss of accuracy. This device shall be constructed to minimize oil discharge when it operates.

### 3-4.38 MATCH-MARKED

Each unit shall be assembled and parts match-marked before leaving the factory. Flange, turrets, and piping, disassembled for shipping shall be match-marked for easy and correct assembly in the field. The assembly shall include all piping and associated equipment, cooling equipment, and LTC equipment.

## 3-5 TESTS

### 3-5.1 GENERAL

Equipment inspections, including submittal of test reports and data, shall be to the extent indicated in the REFERENCED DOCUMENTS, the QUALITY ASSURANCE PROVISIONS, and herein.

All tests shall be performed in accordance with IEEE C57.12.00 and C57.12.90 except as modified in the respective paragraphs below.

### 3-5.2 DESIGN TESTS

The Manufacturer shall assure the equipment being furnished meets each of the test requirements specified below by either:

- a. Furnishing certified test reports of previously performed tests on equipment of the same basic design and rating;
- b. Performing the tests on the equipment provided on this contract.

#### 3-5.2.1 Temperature Rise with Tank-wall Hot-spot Tests.

3-5.2.1.1 The temperature rise tests shall be in accordance with IEEE Standards.

3-5.2.1.2 Tank-Wall Hot-Spot Test. The tank wall surfaces shall be checked for hot spots during the heat run tests. The tank-wall hot-spot temperature rise shall not exceed 70°C for any transformer while operating at 100 percent of its rating.

3-5.2.2 Cooling Fan Test. The fan motor shall be subjected to a water spray test as described in the note in paragraph E of Part MGI-1.26 of NEMA MG 1. Any evidence of moisture within the motor housing other than that allowed shall be cause for rejection. The motor shall be internally waterproofed, if necessary, to qualify for the specified duty.

- 3-5.2.3 Dissolved Gas-In-Oil Analysis. When heat run tests are performed, a combustible gas-in-oil analysis shall be made before and after the heat run tests. Identity of samples and results of analyses shall be included in the test report.
- 3-5.2.4 On Load Tap Changer Test. Test shall be performed on the load tap changer to prove its ability to satisfy the requirements of paragraphs 3-4.3
- 3-5.2.5 Wind test or calculations.
- 3-5.2.6 Seismic test or calculations shall be in accordance with IEEE 693.
- 3-5.2.7 Audible sound level test. This test shall be a routine test. See 3-5.3.8 below.
- 3-5.2.8 Mechanical Tests
  - 3-5.2.8.1 Lifting and moving devices.
  - 3-5.2.8.2 Pressure.
- 3-5.2.9 Short Circuit Test. Calculations demonstrating the short circuit capability of the transformer. The calculation method shall be based on the results of prior short circuit testing of models and transformers.

### 3-5.3 ROUTINE TESTS

- 3-5.3.1 Winding Resistance Measurements.
- 3-5.3.2 Polarity and Phase Relation Tests.
- 3-5.3.3 Ratio Tests.
- 3-5.3.4 No-load losses and excitation current.

No-load losses and excitation current shall be measured at 90, 100 and 110 percent of rated voltage. For 525 kV transformers, an additional measurement shall be made at 120 percent of rated voltage.

Measurements shall be made before dielectric tests and repeated after dielectric tests. The measurement after dielectric tests will be used for comparison with guaranteed values.

- 3-5.3.5 Impedance voltage and load loss. Impedance measurements and load loss measurements shall be made on all combinations of rated and extreme tap positions.

All measurements shall be repeated on each unit of a multiple unit order.

- 3-5.3.5.1 Zero-phase-sequence impedance. For other than single-phase transformers, tests shall be made to provide data that can be used to determine the impedance of the zero phase sequence equivalent circuit of the transformer for all connections.

- 3-5.3.6 Dielectric Tests.

- 3-5.3.6.1 Switching impulse test.

Phase-to-ground switching impulse testing shall be performed on all high voltage terminals of transformers with a rated voltage of 230 kV and above.

Traces of all switching impulses shall be included in the test report.

- 3-5.3.6.2 Lightning impulse test

Impulse tests shall be performed in the following order:

- high voltage
- low voltage
- tertiary
- neutral

Neutral terminal lightning impulse tests shall be done using the direct test method unless otherwise specified.

Traces of all lightning impulses shall be included in the test report.

3-5.3.6.3 Low frequency applied voltage test

3-5.3.6.4 Low frequency induced voltage test for Class II power transformers

3-5.3.6.4.1 Apparent charge acceptance criteria (picocoulombs):

- a) Maximum level during one hour test (including background): 300 picocoulombs.
- b) Maximum increase from initial reading: 100 picocoulombs.
- c) Initial reading taken immediately after the voltage enhancement.
- d) If the partial discharge (including background noise) increases by more than 100 picocoulombs but is still less than 300 picocoulombs the COTR may extend the test to determine whether the partial discharge level will stabilize or decrease.

3-5.3.6.4.2 Partial Discharge levels (Radio Influence Voltage in microvolts) shall be measured during the test. These measurements are for BPA reference and will not be used as acceptance criteria.

3-5.3.6.4.3 The apparent charge (pC) and partial discharge (RIV) shall also be measured at the start and finish of the low frequency induced test at the following percentages of rated voltage:  
0% 75% 100% 125%

3-5.3.6.4.4 All apparent charge (pC), partial discharge voltage (RIV), and other data taken during the test, together with diagrams of the test and measurement circuits, shall be included in the test report.

3-5.3.6.4.5 The low frequency induced test procedure for 525 kV Transformers shall be the following:

- a) Measure apparent charge / partial discharge levels at the beginning of the test as required in 3-5.3.6.4.3
- b) Continue to raise the voltage to 475 kV (150% level) and make another apparent charge / partial discharge measurement.
- c) Raising the voltage to 550 kV (170% enhancement level), holding it for 7200 cycles.
- d) Return the voltage to the 475 kV (150% level). Immediately make the next apparent charge / partial discharge measurement. This is the initial reading.
- e) The COTR may require an additional enhancement if the initial apparent charge reading is more than 50 picocoulombs greater than the reading prior to the enhancement.
- f) Hold the voltage at 475 kV for one hour and record apparent charge / partial discharge readings at 5 minute intervals.
- g) Following completion of the one hour period, lower the voltage and measure apparent charge / partial discharge levels as required in 3-5.3.6.4.3.

- 3-5.3.6.4.6 The low frequency induced voltage test shall be the last high voltage dielectric test.
- 3-5.3.6.4.7 Insulation power-factor test  
Measure insulation power factor values in accordance with Method II of ANSI C57.12.90.
- 3-5.3.6.4.8 Insulation resistance test
- 3-5.3.6.4.9 Dielectric test for low voltage control wiring, associated auxiliary control equipment, and current transformer secondary circuits. This test shall be performed as specified in ANSI C57.12.00 clause 8.2.4.
- 3-5.3.6.4.10 Core ground resistance test. The resistance between each pair of core and frame ground leads and from each lead to the tank shall be measured. The measurement voltage shall comply with the requirements of ANSI C57.12.90 for insulation resistance measurements.
- 3-5.3.7 Cooling system (auxiliary) losses shall be measured for each forced-cooling stage.
- 3-5.3.8 Audible sound level measurement. Audible sound level shall be measured on each transformer. The measurement procedure shall comply with the requirements included in ANSI C57.12.90. The maximum acceptable sound pressure levels are listed in the Specific Technical Specification (22-11STS).
- 3-5.3.9 Tank and radiator leak test. The finished tanks and radiators shall be filled with oil and tested for leaks by the application of a pressure equal to that of the pressure relief setting of the pressure relief device, for not less than 30 minutes. The test may be conducted simultaneously with the radiators attached to the tanks or each bank of radiators may be tested individually. When separate tank compartments are furnished for parts of the load tap changer, each such compartment shall be subjected to both internal and external pressures of 10 psi (70 kPa) for 30 minutes without leaking.
- 3-5.3.10 Bushing Current Transformer Tests. Bushing current transformers shall be subjected to a 60-Hz insulation test of 2500 volts between winding and electrical ground for a period of 1 minute and shall be given sufficient ratio tests at normal rated secondary current to insure that the ratios meet the applicable accuracy requirements of ANSI C57.13.
- 3-5.3.11 Magnetization Characteristic Information shall be submitted for BPA modeling of non-linear saturation characteristics. Provide the following:
- 3-5.3.11.1 A rms. voltage -Vs- current saturation curve which is normally provided to customers. Indicate whether rms is measured with true rms meter or rectified average type meter.
- 3-5.3.11.2 A peak flux -Vs- peak current saturation curve up to 125% voltage. This curve should be produced from magnetization test measurements, but may be determined from calculation, if necessary. The term "peak" refers to the corresponding instantaneous values on the flux and current waveforms. A set of volt-second -Vs- amp points may be provided in lieu of a plotted characteristic, with most of the points defining the transition region between the unsaturated and saturated portions, or "knee" of the curve. Curves using RMS quantities do not provide adequate information for modeling because they do not show the flux conditions of the core when distorted waveforms are involved. From this characteristic provide the following values:
- a) The inductance of the unsaturated transformer
  - b) The inductance of the saturated transformer (air core inductance)
  - c) The coordinates of the intersection point where the linear unsaturated and linear saturated inductance meet, in peak flux and current.
- 3-5.3.12 On Load Tap Changer Test. The completely assembled load tap changer shall be subjected to ten complete tap changing cycles (end-tap to end-tap) to demonstrate that all linkages, contacts, and indicating mechanisms are properly assembled and aligned and free from excessive slack, deformation or fragility.

3-5.3.13 De-energized Tap Changer Test. The completely assembly de-energized tap changer shall be subjected to ten complete tap changing cycles (end-tap to end-tap) to demonstrate that all linkages, contacts, and indicating mechanisms are properly assembled and aligned and free from excessive slack, deformation or fragility.

3-5.3.14 150 Percent Overcurrent Test. The transformer shall be tested for 2 hours at 150 percent of rated current on the nominal tap position. The test may be conducted without prior loading on the transformer. The ambient temperature shall be 20°C or greater. All cooling equipment shall be in operation from the start of the test.

The following shall be performed in conjunction with the 150-percent test:

- a) The simulated hottest-spot winding temperature shall be monitored and recorded at intervals of 10 minutes or less. The test shall be terminated if the simulated hottest-spot winding temperature exceeds 140°C.
- b) The tank hot spot temperatures shall be monitored during the test and recorded.
- c) The average temperature rise of each winding shall be measured.
- d) Gas-in-oil analysis shall be performed on oil taken from the transformer before and after the test.

The gas-in-oil analysis, average winding temperature rise, tank hot spot temperatures and simulated hottest-spot-temperature data shall be submitted with the test report.

3-5.3.15 Physical dimensions and weight verification: Each transformer shall be measured and weighed as follows:

- a) Fully Assembled Configuration: The actual values of the major physical dimensions of each transformer shall be measured and reported in the test report along with the design values. The acceptance criteria for the actual dimensions shall also be listed.
- b) Shipping Configuration: The actual values of the major physical shipping dimensions of each transformer shall be measured and reported in the test report along with the design values. The acceptance criteria for the actual dimensions shall also be listed.

The shipping weight of each transformer shall be measured at the factory and reported in the test report along with the design values. The acceptance criteria for the actual weight shall also be listed.

The shipping dimensions and weight shall also be forwarded to the BPA traffic manager within 24 hours after the measurements are made. The measured dimensions and weight shall also be used in the manufacturer's final transportation planning and permitting.

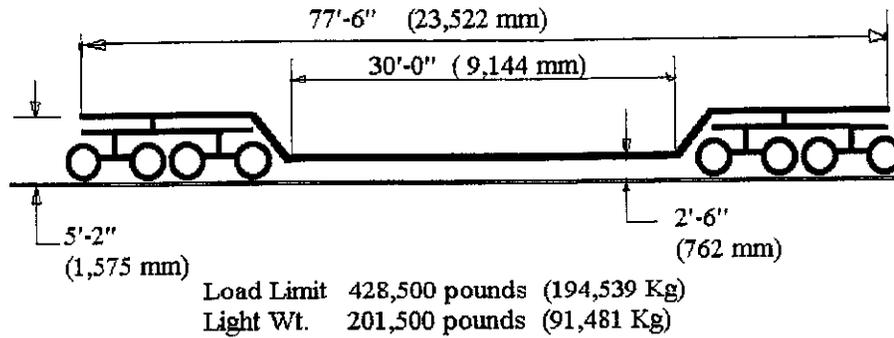
### 3-5.4 FREQUENCY RESPONSE ANALYSIS

Test Description (Refer to 22-11 STS, FRA TESTING)

### 3-6 PREPARATION FOR DELIVERY

It is the manufacturer's responsibility to supply units of shipping dimensions and weight that will allow for transport from point of manufacture to the BPA Substation. It is desired that the dimensions and weight (without oil) of the largest piece of each unit as shipped by the Contractor do not exceed that allowed for transport on BPA railcar BPAX 900 from the closest accessible railhead for the respective substation to the Ross Substation (Ampere, WA. B.N. Railroad). In the event the shipping dimensions or weight of the largest piece exceed those allowed for shipment on BPA railcar BPAX 900, the unit shall be designed such that its weight and dimension can be safely reduced in the field to that allowed for shipping.

BPAX 900 outlined below has a 9'-8" foot wide depressed steel platform and is equipped with four, 4-wheel trucks having 5 feet between axle centers. It has a load limit of 428,500 pounds provided the load is distributed not less than 10-ft. on either side of centerline.



BPAX 900

- 3-6.1 Equipment shipped by rail shall be shipped on rail cars equipped with end-of-car hydraulic cushioning devices.
- 3-6.2 Where the handling of heavy parts will be facilitated, the parts shall be securely mounted on skids.
- 3-6.3 The equipment shall be delivered without oil. Each tank shall be sealed for shipment and filled with nitrogen or dry air under pressure sufficient to insure that temperature changes encountered in transit will not result in the formation of negative pressures. A shipping marker shall be attached near the gas connection showing the type of gas used, temperature, absolute pressure and date the tank was sealed.
- 3-6.4 At time of shipment a dew point test of the shipping gas shall be performed. The dew point temperature and test method used shall be shown on the shipping marker.
- 3-6.5 Any internal blocking or bracing that is to be removed from the equipment at its destination shall be colored a bright color such as red or yellow.
- 3-6.6 The manufacturer shall prepare the equipment, accessories and spare parts in such a manner as to protect them from damage in transit, and shall be responsible for and make good any and all damages incurred in loading or in transit. This responsibility being applicable to all shipments, including those made on Government bills of lading.
- 3-6.7 Any material to be returned to the manufacturer after transformer shipment is complete shall bear identification of material ownership and shipping address. Materials not so marked will be disposed of at BPA's discretion.
- 3-6.8 All crates containing equipment that should be stored indoors shall be marked, "STORE INDOORS", in large letters.
- 3-6.9 **IMPACT RECORDERS.** Two impact recorders shall be mounted on each unit during shipping. They shall have sufficient energy, paper and ink (electronic type shall have the equivalent to paper and ink with a means to download and analyze the data on-site) to monitor the equipment movement until it arrives at the BPA site at which point the respective representatives shall examine the recorders. An impact of 3G or greater, on any axis, SHALL require a simultaneous internal inspection by BPA and the manufacturer, before unloading the transformer from the transport vehicle. The manufacturer shall provide BPA with information regarding reading and interpreting impact recorder level results. One copy of this information shall be supplied with the preliminary drawings for review. Another copy of this information shall be in a weatherproof envelope and placed in the control cabinet when the transformer is shipped and clearly marked as "Impact Recorder Information".
- 3-6.10 **IMPACT RECORDER FAILURES.** An impact recorder failure (excluding a planned interruption i.e. battery change, paper change re-inking etc.) shall be corrected at the earliest opportunity after discovery. In the event both recorders fail to monitor the entire journey from factory to site, the following step-by-step procedure will be implemented before the transformer movement proceeds with representatives from both parties present:
- a) A visual external inspection
  - b) Core ground test

- c) FRA test

NOTE: Testing may be terminated after comparison to factory FRA testing.

- d) Impedance test (optional)
- e) Leakage reactance test (optional)
- f) Internal inspection

If the above test results and inspection(s) are satisfactory to both parties, the manufacturer will write a report with a copy given to BPA. The transformer shipment may proceed.

The manufacturer shall be responsible for the above testing and demurrage charges.

## **APPARATUS BUSHINGS, BPA 50-05, JANUARY 23, 2009**

SUPERSEDES No. BPA 50-05, dated July 17,2007

### **3-1 SCOPE**

This specification covers the general technical requirements for outdoor power apparatus bushings 110 kV BIL and above. The apparatus bushings will be used as components of oil-filled transformers, oil-filled reactors and oil circuit breakers.

### **3-2 GENERAL**

#### **3-2.1 ORDER OF PRECEDENCE FOR TECHNICAL INFORMATION**

Discrepancies shall be resolved by giving precedence in the following order:

- a. Purchase Order Item Description
- b. Specific Technical Specification (STS)
- c. General Technical Specification
- d. Referenced Documents

#### **3-2.2 REFERENCED DOCUMENTS**

The following documents form a part of this specification:

- a. American National Standards Institute (ANSI):
  - B1.1-2003 Unified Inch Screw Threads
- b. Institute of Electrical and Electronic Engineers (IEEE):
  - IEEE 4-1995 Standard Techniques for High Voltage Testing
  - IEEE 693-2005 Recommended Practice for Seismic Design of Substations
  - C57.19.00-2004 General Requirements and Test Procedure for Outdoor Power Apparatus Bushings
  - C57.19.01-2000 Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
- c. National Electrical Manufacturers Association (NEMA):
  - 107-1987(R1993) Methods of Measurement of Radio Influence Voltage (RIV) of High Voltage Apparatus
- d. American Society for Testing and Materials (ASTM):

D3487-00(2006) Mineral Insulating Oil Used in Electrical Apparatus

D4059-00(2005)e1 Analysis of Polychlorinated Biphenyl in Mineral Insulated Oils by gas Chromatography

### 3-2.3 IDENTIFICATION

Each bushing shall have a nameplate with markings in accordance with C57.19.00.

### 3-2.4 MATERIALS AND WORKMANSHIP

Materials shall be of recent manufacture, unused, and free of defects and irregularities. All work shall be performed by skilled craftsmen following the best modern practices of the industry.

### 3-2.5 DRAWINGS

3-2.5.1 The following drawings shall be furnished:

- A. Bushing outline drawing showing dimensions, flange details, terminal studs, potential taps and other dimensional information that would affect interchangeability. The drawing shall also show provisions for bushing current transformers as required by this specification.
- B. Type and catalog number of USA bushing substitute for foreign bushing.

3-2.5.2 The Contractor may furnish five copies of dimension leaflets or catalog cuts as part or all of the drawing requirements above. Reproducibles of dimension leaflets are not required.

### 3-2.6 CONTRACTOR SUBMITTALS

#### 3-2.6.1 INSTRUCTION BOOKS

Instruction books shall contain the following:

- A. Complete instructions for installation and maintenance of bushings including any special instructions required for disassembly and assembly of the bushings or their parts.
- B. Complete parts list identified by item, part number, quantities used, description and cut or drawing for all bushing components. The parts list may be shown on the drawings.
- C. A complete set of final submitted drawings.

#### **Mailing Address:**

Bonneville Power Administration  
Instruction Book Review Unit – TESM – AMPN2  
P.O. Box 491  
Vancouver, WA 98666-0491

#### **Parcel Delivery:**

Bonneville Power Administration  
Instruction Book Review Unit – TESM – AMPN2  
5411 NE Highway 99  
Vancouver, WA 98663

### 3-3 PERFORMANCE

#### 3-3.1 GENERAL

The bushing shall perform in accordance with the requirements herein in addition to those specified in the SPECIFIC TECHNICAL SPECIFICATION.

#### 3-3.2 EARTHQUAKE AND WIND LOADING STRENGTH

The bushing shall be designed to withstand horizontal wind velocities up to 120 miles/hour, including height and gust factors. Documentation in the form of test data or calculations (either static or dynamic) shall be provided to confirm the bushing's wind withstand capabilities.

The bushing shall be designed to withstand seismic forces according to IEEE 693 high level unless otherwise specified in STS. Seismic qualification procedure, acceptance criteria and documentation shall be in accordance with the standard.

Wind and seismic forces need not be considered as occurring simultaneously.

#### 3-3.3 VISIBLE CORONA

The bushing shall exhibit no visible corona when energized at 115 percent of nominal operating voltage.

### 3-4 DESIGN AND CONSTRUCTION

3-4.1 The bushing shall be completely self-contained, sealed and moisture-proof. It shall be designed and manufactured in accordance with the applicable requirements of the REFERENCED DOCUMENTS. All bushings for which C57.19.01 standard dimensions and electrical characteristics are established shall conform to that standard.

3-4.2 Bushings shall be condenser type. Bushings for use on system voltages of 161 kV and above shall have either oil-impregnated or resin-impregnated paper condenser insulation. Bushings for system voltages below 161 kV shall have oil-impregnated paper condenser insulation.

3-4.3 An oil-filled bushing shall have an oil drain device and an oil level gage. Separate oil drain devices need not be provided on bushings rated 350 kV BIL and below if the oil fill plug can be used to drain the oil.

3-4.4 Transformer and reactor bushings shall be draw-lead type for all ratings allowed by C57.19.01. Draw-lead bushings exceeding the C57.19.01 ratings may be allowed, subject to the Contracting Officer's/Contracting Officer's Technical Representative (COTR) approval.

3-4.5 Bushings for use on system voltages of 161 kV and above shall have either porcelain or non-ceramic insulating envelopes. Bushings for system voltages below 161 kV shall have porcelain. Bushing porcelains shall be in compression at all times.

3-4.6 Bushings rated 350 kV BIL and below shall have bushing test taps and those rated above 350 kV BIL and above shall have bushing voltage taps.

3-4.7 The bushing potential tap shall be Type A in accordance with C57.19.01 and be designed for a coaxial cable connection to a Class A Bushing Potential Device. The power output of the potential tap shall be adequate to permit a potential device connected thereto to supply the following minimum rated burden:

<u>Rated System Voltage (kV)</u>	<u>Rated Burden (Watts)</u>
115	25
138	35
161	45

230	80
287 and up	100

3-4.8 The manufacturer shall provide the insulating oil required for the bushings and an MSDS for that oil. BPA reserves the right to replace oil when necessary with other oil meeting the minimum requirements of ASTM D3487, Type 11. Such replacement of oil shall not affect the guarantee or operation of the equipment.

3-4.9 The oil used in the bushing shall not contain a concentration of PCB (Polychlorinated Biphenyl) greater than allowed by ASTM D-3487. The oil shall be tested for compliance in accordance with ASTM D-4059. Certified test report containing the following minimum information shall be furnished before the time of field acceptance of the equipment:

- A. Concentration of PCB in the oil,
- B. the equipment used to determine PCB concentration,
- C. the accuracy and minimum detection range of the test equipment. Industry standard expectation for non-detectable content is  $\leq 1$ ppm.

3-4.10 A corrosion-resistant metal nametag inscribed with the concentration of PCB measured above shall be attached to each bushing.

3-4.11 All external insulators shall be Gray (Munsell Renotation 5.0BG 7.0/04, previously ANSI 70 Gray).

### 3-5 TESTS

#### 3-5.1 GENERAL

Equipment inspections, including submittal of test reports and data, shall be to the extent indicated herein and in the QUALITY ASSURANCE PROVISIONS.

#### 3-5.2 DESIGN TESTS

3-5.2.1 The Manufacturer shall assure that the equipment being furnished meets each of the test requirements specified below by either:

- A. Furnishing certified test reports of previously performed tests on equipment of the same basic design and rating or,
- B. Actually performing the tests on the equipment on this contract.

The tests shall be in accordance with C57.19.00, C57.19.01, and IEEE 693 except as otherwise indicated.

3-5.2.2 Low-Frequency Wet Withstand Voltage Test. The test voltage shall be as listed in the SPECIFIC TECHNICAL SPECIFICATION.

3-5.2.3 Lightning Impulse Withstand Tests. The test sequence shall be chopped-wave (tail-of-wave) voltages followed by full-wave voltages.

3-5.2.3.1 Chopped-Wave Lightning-Impulse Withstand Voltage

3-5.2.3.2 Full-Wave Lightning-Impulse Withstand Voltage

3-5.2.4 Wet Switching Impulse Withstand Test. The test voltage shall be as listed in the SPECIFIC TECHNICAL SPECIFICATION.

- 3-5.2.5 Low-Frequency Dry Withstand Test With Partial Discharge Measurements. Apparent Charge measurement is preferred. RIV measurement is acceptable if apparent charge measurement is not available.
- 3-5.2.6 Draw-Lead Bushing Cap Pressure Test.
- 3-5.2.7 Cantilever Strength Test. The bushing shall be tested in the position in which it is to be mounted.
- 3-5.2.8 Thermal Tests.
- 3-5.2.9 Wind Test or calculations.
- 3-5.2.10 Seismic Test or calculations in accordance with IEEE 693.

### **3-5.3 ROUTINE TESTS**

The tests shall be performed in accordance with C57.19.00, when applicable:

- 3-5.3.1 Capacitance ( $C_1$  and  $C_2$ ) Measurement
- 3-5.3.2 Power Factor
- 3-5.3.3 Low-Frequency Dry Withstand Test With Partial Discharge Measurements. Apparent Charge measurement is preferred. RIV measurement is acceptable if apparent charge measurement is not available.
- 3-5.3.4 Tap Withstand Voltage
- 3-5.3.5 Mechanical Tests

### **3-6 PREPARATION FOR DELIVERY**

- 3-6.1 The Contractor shall prepare the equipment, accessories, and spare parts for shipment in such a manner as to protect them from damages in transit. The shipping containers shall be usable for long-term storage.
- 3-6.2 All articles, parts, or accessories subject to loss or damage shall be boxed, crated, or similarly protected. Heavy parts or bushings supplied in quantity shall be shipped on expendable wooden pallets. The load shall be secured with a suitable banding material to prevent load shifting during transit and handling. Capping and layer separating material shall be furnished, if necessary, to secure the load and to allow the stacking of two similarly loaded pallets on top. The gross weight of the loaded pallets shall not exceed 3,000 pounds.
- 3-6.3 Oil-filled bushings shall be shipped in a position which keeps the condenser body completely immersed in the oil.

# UNIT 4 — QUALITY ASSURANCE AND SPECIAL DOCUMENTATION REQUIREMENTS

## QUALITY ASSURANCE AND SPECIAL DOCUMENTATION REQUIREMENTS,

TNS 96-01, OCTOBER 21, 2004

Supersedes TNS 96-01, March 1, 2002

\* New Changes

### 3-1 SCOPE

This specification outlines the policies and procedures to assure that purchased equipment and materials conform to the quality requirements of this contract.

### 3-2 QUALITY PROGRAM REQUIREMENTS

All contractors are required to have a quality program instituted at the site where the supplies and materials are manufactured. The contractor's quality program is to assure that purchased equipment and materials are in compliance with the requirements of referenced specifications.

If review and acceptance of the contractor's quality program was considered an evaluation factor for award, any subsequent changes in the contractor's quality program after award will be subject to BPA review. The program is subject to disapproval if the program is determined to fail to accomplish its objectives.

### 3-3 INSPECTION AND TEST PLAN REQUIREMENTS

An inspection and test plan shall be provided within 30 days after award of contract. Such plan shall encompass all areas of production including materials, components, subassemblies, end items, and preparation for delivery. The inspection and test plan shall include:

- A. Production flow and inspection stations beginning with receiving inspection.
- B. Characteristics to be inspected.
- C. Cross-reference to detailed inspection and test procedures.
- D. Sampling plan.
- E. Coordination of inspection and tests to be witnessed by BPA.
- F. Data to be submitted to BPA.
- G. Nonconformance instructions

### \*3-4 ASSURANCE INSPECTION REQUIREMENTS (AIR)

The Assurance Inspection Requirements (AIR) is a guide to critical requirements contained in specifications attached to the contract. It is attached to some substation equipment and transmission material contracts.

When an AIR is included as part of the contract, the contractor shall perform the actions specified therein to provide assurance that requirements are being met before, during, and after production.

### **\*3-5 CONTRACTOR'S DRAWINGS**

Drawings are to provide information necessary for design, construction, and maintenance activities. BPA reviews are to assure that the drawings contain the required information. BPA assumes no obligation to discover any deficiency in the contractor's documentation. BPA will comment when discrepancies are noted during review of drawings. Comments on the drawings do not constitute a contract change.

The following sections outline the procedures for drawing identification, transmittal and review.

#### **3-5.1 The drawing submittal procedures shall include,**

- A. Each drawing shall be identified by a drawing number and date, the BPA contract or purchase order (release number when applicable) number and the corresponding line item number(s). The catalogue number for the equipment shown on the drawing shall also be shown. The preferred location for this information is the lower right-hand corner of the drawing. All revisions shall be noted and dated in an obvious location and manner. All drawings and revisions shall be accurate, complete, and signed or initialed by a responsible representative of the contractor. Only drawings with the latest revisions shall be submitted.
- B. Each submittal shall be accompanied by a letter of transmittal to the Specification Group, with a copy to the Contracting Officer (CO), containing a list of the individual drawings, including their title, drawing number, and revision number. Any subsequent drawings submitted that supersede a previous drawing shall be noted with a reference to the new drawing number and the drawing it has superseded. If any drawing submitted for review deviates from previously reviewed drawings, these deviations shall be described in the letter of transmittal.
- C. The contractor shall submit all drawings within 30 calendar days from date of award unless otherwise specified. Drawings, which require changes, shall be resubmitted within 30 calendar days from the date the reviewed drawings were mailed to the contractor.

#### **3-5.2 DRAWING REVIEW**

BPA will return to the contractor one reviewed copy of each drawing submitted, within 30 calendar days after receipt.

- A. Each drawing returned will be appropriately stamped with one of the following categories:
  1. REVIEWED - NO COMMENTS. No re-submittal required. The drawing has been reviewed and no comments are made. Finals may be sent.
  2. REVIEWED with COMMENTS. This category has two sub categories. Re-submittal for review is required or re-submittal for review is not required. Whether re-submittal for review is required or not will be noted on the drawing.
- B. Once drawings have been returned to the manufacturer marked "Reviewed, No Comments" or "Reviewed with Comments/No Re-submittal Required", a "Final" or "For Record" set of drawings shall be submitted with a clear reference that these drawings are submitted for "Record" or as "Finals" in the transmittal letter. These drawings will not be returned to the vendor. However a manufacturer's drawing control log with the "Code" column marked as "E" (for records) will be returned to the contractor.
- C. If changes are made in the material or equipment after any drawing review, the contractor shall revise the appropriate drawing and resubmit for review in accordance with paragraph SUBMITTAL. When a drawing has been changed or superseded, the new drawing shall state the number of the revision or superseded drawing and note the reason for the change.

**3-5.3 As-Built Drawings:** If drawing changes are made during construction that are within the contractor's scope of supply, the contractor shall revise the appropriate drawing, for review in accordance with paragraph SUBMITTAL, and resubmit within 45 calendar days of acceptance.

### 3-6 INSPECTION AND TEST

The following sections outline the procedures for inspection and test.

3-6.1 ADVANCE NOTICE: If BPA elects to witness all inspections and tests designated in the contract, the contractor shall not proceed without the Contracting Officer's Technical Representative (COTR) being present for witnessing unless a waiver is granted by the designated COTR. The contractor shall coordinate with the COTR by direct personal contact not less than 14 calendar days before the date when supplies or equipment will be ready for inspection or tests. If inspection and test will be performed outside the continental United States, 21-calendar days advance notice shall be furnished. Dates for inspection and tests shown on the submitted events schedule do not fulfill this advance notice requirement.

3-6.2 INSPECTION AND TEST REPORTS: Copies of the inspection and test reports required by the AIR or the specification in the numbers specified in the AIR or the contract, shall be delivered to the COTR within 14 calendar days after completion of tests. Reports shall include, but not be limited to, the following:

- A. Description of supplies or equipment.
- B. BPA contract number, delivery order number (when applicable), and item number, applicable BPA technical specification, quantity, serial numbers, and reference to applicable drawings by number, revision, and date.
- C. When, where, and how each of the tests were performed, and standards used for test procedures and results, including pass/fail criteria, and non-conforming characteristics shall be identified.
- D. Test data obtained during the testing. Certifications of compliance are not acceptable.
- E. List of personnel performing and witnessing the tests and signature of a contractor's representative.

3-6.3 MEASURING AND TEST EQUIPMENT: All test and measurement equipment shall be periodically calibrated against a standard of greater accuracy and a known relationship to U.S. national standards or other basic standards.

3-6.4 PRIOR DATA: Design or qualification test reports that meet the requirements of paragraph INSPECTION AND TEST REPORTS and are based on tests performed prior to award, may be accepted, provided that the test requirements and the equipment design have not changed and that the time limitations stated in paragraph A below are met. If the design tests were performed and test reports submitted on a previous BPA contract, the contractor may reference that contract, and furnish copies of the reports as specified in paragraph INSPECTION AND TEST REPORTS. If the previous contract that the reports were submitted on is within 5 years of award of this contract, a letter referencing that contract may be submitted in lieu of design test report submittal. Partial sets of design test reports will not be acceptable. Data shall be submitted at least 15 days prior to production, or within 45 calendar days after award of the contract, whichever is earlier. If the reports are not complete, do not meet the present BPA requirements, or if the equipment being furnished includes design changes from the equipment tested, BPA may require performance of the specified tests, at no additional cost to BPA. The contract award shall not be construed as acceptance of any test report submitted prior to award.

- A. Prior data will only be accepted for design tests performed within the 12 years prior to award of this contract. Design tests that have not been performed during this 12-year period shall be repeated.
- B. Any and all exceptions to paragraph A shall be requested by the contractor at the time proposals are submitted and must be approved by the CO prior to award of the contract. Otherwise the requirements of paragraphs "PRIOR DATA" as listed in paragraph A above shall be met.

\*3-6.5 CERTIFICATIONS: Certifications of compliance, when required by the AIR or the specification and in the quantity specified, shall be delivered to the COTR and shall meet the following requirements:

- A. Certifications shall contain a statement that the supplies being offered have been found to be in compliance with the requirements of the contract.
- B. The certifying official shall sign on the basis of a personal review of the supporting documentation.

- C. Data and other documentation supporting the certification shall be on file and shall be available for review and verification by the COTR before or after release of equipment or materials.

\*3-6.6 MILL TEST REPORTS: When specified, one copy of the certified mill test reports shall be delivered to the COTR. Reports shall identify the contract number to which the material applies and quantity of each item covered. The contractor's internal records shall be available for review. Information shall be sufficient to enable the reviewer to verify the use of the mill test report material to the material and equipment being furnished.

## **SUSPECT/COUNTERFEIT FASTENERS REQUIREMENTS, NO. TNFD 96-02, DECEMBER 20, 2004**

### **3-1 SCOPE**

This specification defines actions to help prevent the introduction of suspect/counterfeit fasteners into the BPA power system and prevent their use in construction, maintenance, and support activities.

### **3-2 GENERAL**

#### **3-2.1 REFERENCED DOCUMENTS**

(Latest Revisions and Editions Apply)

- a. Department of Energy Suspect/Counterfeit Parts Headmark List (DOE List) (Attachment 5).
- b. The U.S. Patent and Trademark Office, Fastener Insignia Register, Active Insignias

#### **3-2.2 DEFINITIONS**

For purposes of this specification, the following definitions shall apply:

- a. Contractor: Any person, company, or corporation offering material or equipment for purchase to BPA.
- b. Fasteners: Bolts, screws, studs, and U-bolts.
- c. Suspect/Counterfeit (suspect) Fasteners: Fasteners with altered or without headmarks, fasteners with headmarks not registered with the U.S. Patent and Trademark Office, or fasteners with headmarks as identified by the DOE Suspect/Counterfeit Headmark List.

Exception: Infasco Grade 8 fasteners with the hollow triangle headmark are the only Infasco fasteners to be considered suspect.

### **3-3 CONTRACTOR RESPONSIBILITIES**

#### **3-3.1 CONTRACTORS SHALL**

- a. Ensure that no suspect fasteners are offered to BPA, or incorporated into equipment offered to BPA. Maintain control and visibility of fastener sources to insure manufacturer identification.
- b. Upon detection of suspect fasteners, replace without charge to BPA all suspect fasteners with acceptable fasteners, and properly discard the suspect fasteners regardless of the application, or when or by whom they are discovered.
- c. Upon detection of suspect fasteners, provide a written description of the corrective actions intended to prevent future offerings of suspect fasteners to BPA.

### **3-4 BPA SURVEILLANCE**

#### **3-4.1 CONTRACT SURVEILLANCE**

During normal contract surveillance, the BPA Contracting Officer's Technical Representative (COTR) will inspect material and equipment offered to BPA for the presence of suspect fasteners. The BPA COTR will not release material or equipment for shipment until all suspect fasteners have been replaced with acceptable fasteners.

#### **3-4.2 RECEIVING INSPECTION**

The BPA Receiving Inspector (RI) will inspect material and equipment at BPA receiving locations for the presence of suspect fasteners. The BPA RI will not accept material or equipment until all suspect fasteners have been replaced with acceptable fasteners.

### **3-5 CONTRACTOR DISPUTES OF SUSPECT STATUS**

#### **3-5.1 IDENTICAL HEADMARKS**

In the event that the contractor contends that the headmarks of identified suspect fasteners are identical to the headmarks of fasteners from acceptable sources, and that the fasteners in question are manufactured by the acceptable sources, the contractor will provide reasonable proof to support these contentions.

#### **3-5.2 UNREGISTERED HEADMARKS**

In the event that the headmarks of identified suspect fasteners are not registered with the U.S. Patent and Trademark Office, but the contractor contends that the fasteners in question are manufactured by acceptable sources, the contractor will provide reasonable proof to support these contentions.

#### **3-5.3 REASONABLE PROOF**

BPA will accept the following for reasonable proof:

- a. Invoices from manufacturers that are not on the DOE list of suppliers or BPA contractors that specifically describe the types, sizes, and grades of the fasteners in question.

If the suppliers or BPA contractors also use and stock fasteners with identical head marks from suspect sources, they must demonstrate that the acceptable fasteners are segregated in a manner that will insure that only the acceptable fasteners are used in equipment being furnished to BPA.

- b. The headmarks in question are registered by the acceptable sources on the DOE list.

(Applies to Paragraph 3-5.1 only)

- c. Written certifications from the manufacturers describing their headmarks.

(Applies to Paragraph 3-5.2 only)

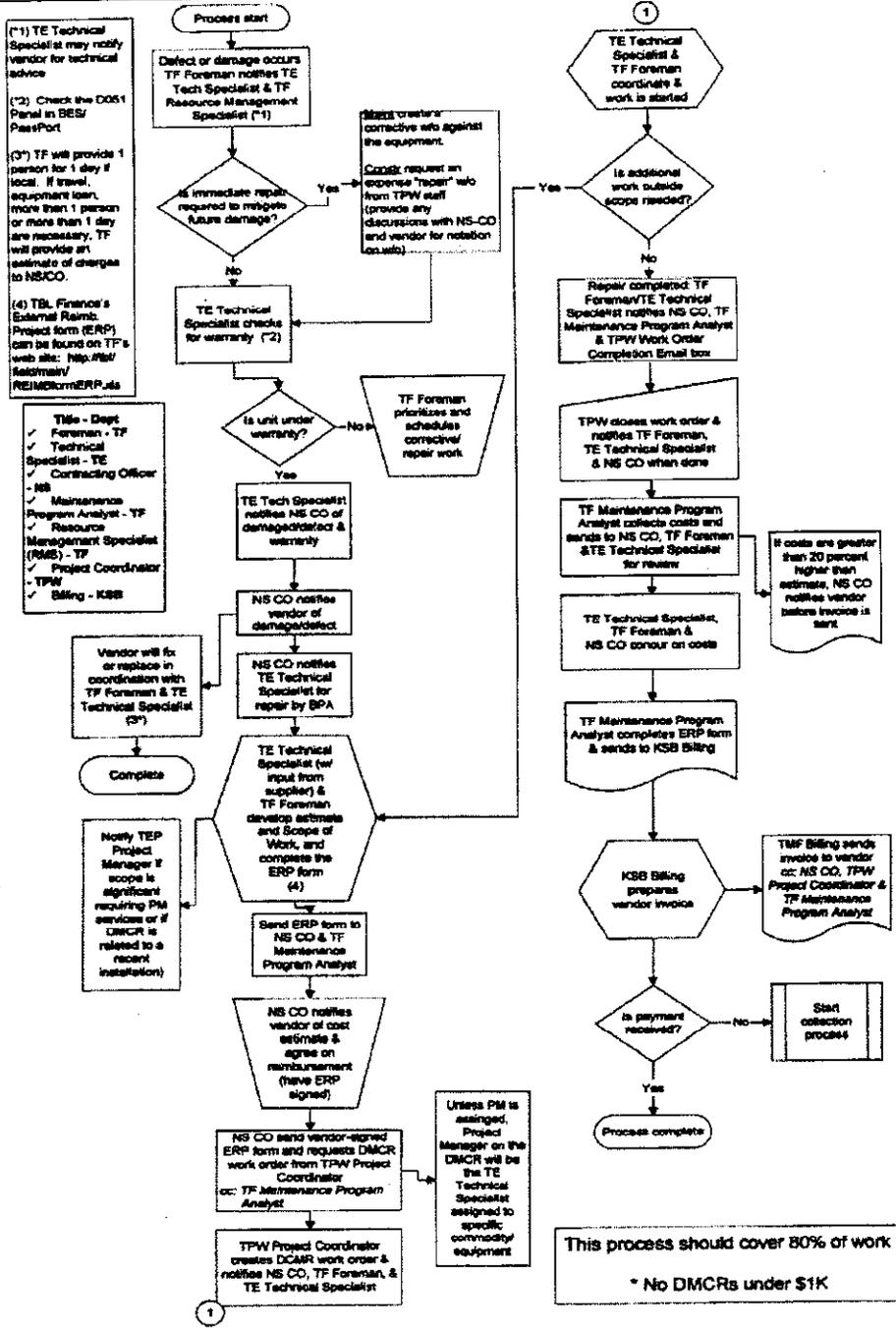
**UNIT 5 — ATTACHMENTS**

**ATTACHMENT 4**

**DEFECTIVE MATERIALS CORRECTION**

**REIMBURSEMENT PROCESS**

EXPENSE DMCR REIMBURSABLE PROCESS - REVISED 10/24/2007



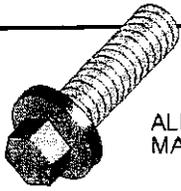
**ATTACHMENT 5**

**DEPARTMENT OF ENERGY**

**SUSPECT/COUNTERFEIT HEADMARK LIST**

# SUSPECT/COUNTERFEIT PART

## HEADMARK LIST



ALL GRADE 5 AND GRADE 8 FASTENERS OF FOREIGN ORIGIN WHICH DO NOT BEAR ANY MANUFACTURERS' HEADMARKS



Grade 5



Grade 8

GRADE 5 FASTENERS WITH THE FOLLOWING MANUFACTURERS' HEADMARKS:



MARK

MANUFACTURER

J

Jinn Her (TW)



MARK

MANUFACTURER

KS

Kosaka Kogyo (JP)

GRADE 8 FASTENERS WITH THE FOLLOWING MANUFACTURERS' HEADMARKS:



MARK

MANUFACTURER

A

Asahi Mfg. (JP)



MARK

MANUFACTURER

KS

Kosaka Kogyo (JP)



NF

Nippon Fasteners (JP)



RT

Takai Ltd (JP)



H

Hinomoto Metal (JP)



FM

Fastener Co of Japan (JP)



M

Minamida Sieybo (JP)



KY

Kyoei Mfg (JP)



MS

Minato Kogyo (JP)



J

Jinn Her (TW)



Hollow Triangle

Infasco (CA TW JP YU) (Greater than 1/2 inch dia)



E

Daiei (JP)



UNY

Unytite (JP)

GRADE 8.2 FASTENERS WITH THE FOLLOWING HEADMARKS:



MARK MANUFACTURER

KS

Kosaka Kogyo (JP)

GRADE A325 FASTENERS (BENNETT DENVER TARGET ONLY) WITH THE FOLLOWING HEADMARKS:

Type 1



MARK MANUFACTURER

A325 KS

Kosaka Kogyo (JP)

Type 2



Type 3



Headmarkings are usually raised – sometimes indented.

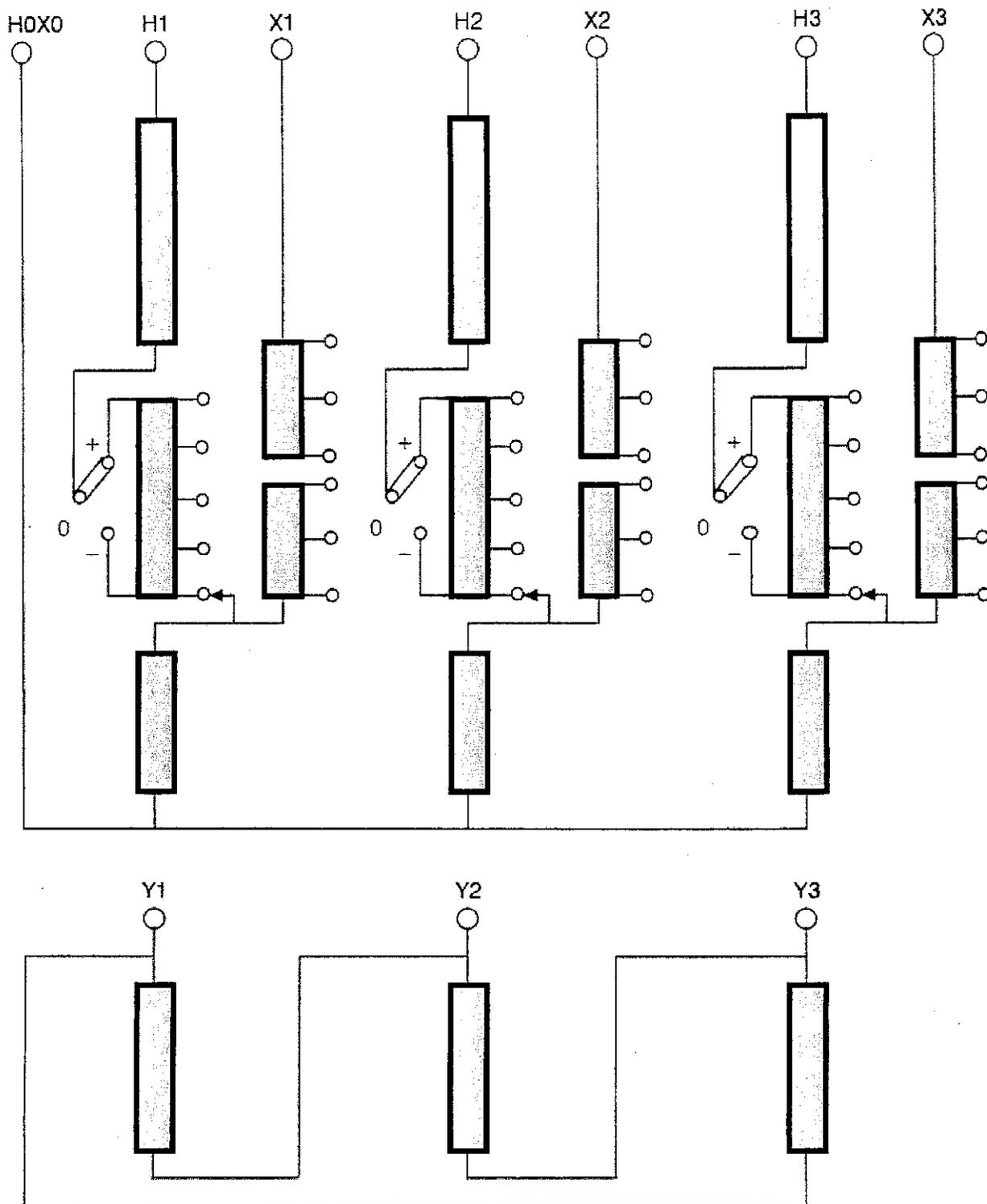
KEY: CA-Canada, JP-Japan, TW-Taiwan, YU-Yugoslavia



ANY BOLT ON THIS LIST SHOULD BE TREATED AS DEFECTIVE WITHOUT FURTHER TESTING.

OR, IF YOU SEE ANY INDICATION THAT A CIRCUIT BREAKER MAY BE USED OR REFURBISHED (SEE BULLETIN, NO. DOE/EH-0266)

**ATTACHMENT 6**  
**WINDING SCHEMATIC DIAGRAM**



WINDING SCHEMATIC DIAGRAM (III)

