AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES	
J	1	9

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO.(If applicable)
0006	13-Aug-2004	W68SBV-4033-1329	

6. ISSUED BY CODE W912EF

WALLA WALLA DISTRICT,COE-G4P
CONTRACTING DIVISION
201 N THIRD AVENUE
WALLA WALLA WA 99362-1876

7. ADMINISTERED BY (If other than item 6) CODE W912EF

WALLA WALLA DISTRICT, COE -- G4P
JANI LONG
509/527-7209
JANI.C.LONG@USACE.ARMY.MIL
WALLA WALLA WA

8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)

CODE FACILITY CODE

X	9A. AMENDMENT OF SOLICITATION NO. W912EF-04-R-0016
X	9B. DATED (SEE ITEM 11) 21-May-2004
	10A. MOD. OF CONTRACT/ORDER NO.
	10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

[X] The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer [X] is extended, [ ] is not extended.

Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS.
IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

[ ] A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.

[ ] B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).

[ ] C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:

[ ] D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor [ ] is not, [ ] is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

TITLE: Station Service Improvements, Dworshak Dam

It has been determined necessary and in the best interest of the Government to amend this solicitation to make the changes as noted in the Summary of Changes.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) TEL: EMAIL:	
15B. CONTRACTOR/OFFEROR (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA BY (Signature of Contracting Officer)	16C. DATE SIGNED 13-Aug-2004

SECTION SF 30 BLOCK 14 CONTINUATION PAGE

SUMMARY OF CHANGES

SECTION A - SOLICITATION/CONTRACT FORM

The required response date/time has changed from 20-Aug-2004 04:00 PM to 09-Sep-2004 04:00 PM.

Changes also include the following:

Drawings: Three drawings are revised without issuance of revised prints as described in the NOTE at the end of clause 252.236-7001 CONTRACT DRAWINGS, MAPS, AND SPECIFICATIONS in Section H (See below).

Specifications:

Section 01010
Paragraph 21 has been revised.

Section 16050
Paragraph 3.2.1 has been revised.

Section 16340
Paragraphs 1.1, 2.3.4 and 3.2.1 have been revised.
Photos have been added at the end of the section.

Section 16440
Paragraph 3.2.3.1 has been revised.

ENG FORM 4288, Page 1 has been revised due to an additional submittal requirement in Section 01010.

SECTION H - SPECIAL CONTRACT REQUIREMENTS

The following have been modified:

252.236-7001 CONTRACT DRAWINGS, MAPS, AND SPECIFICATIONS (AUG 2000).

(a) The Government will provide to the Contractor, without charge, one set of contract drawings and specifications, except publications incorporated into the technical specifications by references, in electronic or paper media as chosen by the Contracting Officer.

(b) The Contractor shall--

(1) Check all drawings furnished immediately upon receipt;

(2) Compare all drawings and verify the figures before laying out the work;

(3) Promptly notify the Contracting officer of any discrepancies;

(4) Be responsible for any errors which might have been avoided by complying with this paragraph (b); and

(5) Reproduce and print contract drawings and specifications as needed.

(c) In general --

(1) Large-scale drawings shall govern small scale drawings; and

(2) The Contractor shall follow figures marked on drawings in preference to scale measurements.

(d) Omissions from the drawings or specifications or the mis-description of details of work that are manifestly necessary to carry out the intent of the drawings and specifications, or that are customarily performed, shall not relieve the Contractor from performing such omitted or mis-described details of the work. The Contractor shall perform such details as if fully and correctly set forth and described in the drawings and specifications.

(e) The work shall conform to the specifications and the contract drawings identified on the following index of drawings.

FILE NUMBER	SHEET NUMBER	TITLE	REVISION NUMBER	DATE
		DWORSHAK DAM AND RESERVOIR NORTH FORK CLEARWATER RIVER-IDAHO POWERHOUSE ELECTRICAL STATION SERVICE IMPROVEMENTS		
DWP-1.8-0-0/1	1	PROJECT LOCATION AND VICINITY MAP		
DWP-1.8-6-1D7/1	2	PROJECT SITE MAP AND DRAWING INDEX		
DWP-1.8-0-0/2	3	GENERAL NOTES AND LEGEND		
DWP-1.8-6-1D7/2	4	BUS DUCT / ONE LINE		
DWP-1.8-6-1D7/3	5	GEN. EQUIPMENT ARRANGEMENT AND CABLE TRAY SYSTEM		
DWP-1.8-6-1D7/4A	6	4.16kV SP SWITCHGEAR ELEVATION BUS 1 & 2		
DWP-1.8-6-1D7/4B	7	4.16kV SP SWITCHGEAR ELEVATION BUS 1 & 2		
DWP-1.8-6-1D7/5	8	REMOTE PANEL - XPC		
DWP-1.8-6-1D11/1A	9	STATION SERVICE XFMR BUS DUCT AND CONDUIT ROUTING		
DWP-1.8-6-1D11/1B	10	STATION SERVICE XFMR BUS DUCT AND CONDUIT ROUTING		

DWP-1.8-6-1D11/2	11	PARTIAL POWERHOUSE 3RD FLOOR CONTROL & ELEC. EQUIP. LAYOUT		
DWP-1.8-6-9D21/1A	12	ONE LINE DIAGRAM STATION SERVICE		
DWP-1.8-6-9D21/1B	13	ONE LINE DIAGRAM STATION SERVICE		
DWP-1.8-6-9D22/1	14	STATION SERVICE - CT & PT CIRCUIT		
DWP-1.8-6-9D22/2	15	STA SERV TYPICAL CT & PT CKTS & RELAY CONNECTIONS		
DWP-1.8-6-9D24/1	16	STATION SERVICE CONTROL SCHEMATIC DIAGRAM		
DWP-1.8-6-9D24/2	17	SP SWITCHGEAR SCHEMATIC DIAGRAMS		
DWP-1.8-6-9D24/3	18	SP SWITCHGEAR SCHEMATIC DIAGRAMS		
DWP-1.8-6-9D31/1	19	STATION SERVICE ANNUN. SCHEMATIC DIAGRAM SHT. 1		
DWP-1.8-6-9D31/2	20	STATION SERVICE ANNUN. SCHEMATIC DIAGRAM SHT. 2		
DWP-1.8-6-9D70/1	21	CABLE AND CONDUIT SCHEDULE		
DWP-1.8-6-9D70/2	22	CABLE AND CONDUIT SCHEDULE		
	23	RESERVED		
		FOR INFORMATION ONLY		
DWP-1.8-6-9D24/17	24	STATION SERVICE BUS NUMBER 1		
DWP-1.8-6-9D24/18	25	STATION SERVICE BUS NUMBER 2		
DWP-1.8-6-9D31/1CA	26	STATION SERVICE ANNUNCIATION PANEL FRONT AND BACK LAYOUTS		
DWP-1.8-6-9D31/1CB	27	STATION SERVICE ANNUNCIATION PANEL LAYOUT AND WIRING DIAGRAM		
DWP-1.8-6-9D31/1CC	28	STATION SERVICE- SP13A WIRING DIAGRAM		
DWP-1.8-6-1D11/1C	29	STATION SERVICE XFMR BUS DUCT & CONDUIT ROUTING		

70626-1 SHT. 1A	30	CONTROL CONSOLE - SCC 6 - INTERNAL LAYOUT		
70626-1 SHT. 1B	31	CONTROL CONSOLE - SCC 7 - INTERNAL LAYOUT		
70626-1 SHT. 1C	32	CONTROL CONSOLE - SCC 8 & 9 - INTERNAL LAYOUT		
70626-1 SHT. 1D	33	CONTROL CONSOLE - SCC 11 - INTERNAL LAYOUT		
70626-1 SHT. 2	34	CONTROL CONSOLE - SCC 6 THRU 11 - PARTIAL FRONT VIEWS		
70626-4 SHT. 1	35	CONTROL CONSOLE - SCC 6 - WIRING DIAGRAM		
70626-4 SHT. 2	36	CONTROL CONSOLE - SCC 7 - WIRING DIAGRAM		
70626-4 SHT. 3	37	CONTROL CONSOLE - SCC 8 & 9 - WIRING DIAGRAM		
70626-4 SHT. 3A	38	CONTROL CONSOLE - SCC 8 & 9 - DACS LADDER DIAGRAM		
70626-4 SHT. 3B	39	CONTROL CONSOLE - SCC 8 & 9 - DACS LADDER DIAGRAM		
70628-4 SHT. 1	40	ER19 - INTERNAL LAYOUT		
70628-4 SHT. 2A	41	ER20 - INTERNAL LAYOUT		
70628-4 SHT. 5	42	ER21 - INTERNAL LAYOUT		
70628-4 SHT. 6A	43	ER22 - INTERNAL LAYOUT UPPER HALF SECTIONS		
70628-4 SHT. 6B	44	ER22 - INTERNAL LAYOUT LOWER HALF SECTIONS		
70628-4 SHT. 7A	45	ER23 - INTERNAL LAYOUT UPPER HALF SECTIONS		
70628-4 SHT. 7B	46	ER23 - INTERNAL LAYOUT LOWER HALF SECTIONS		
976D596 SHT. 1	47	CONTROL DIAGRAM LTC 72		
976D596 SHT. 2	48	CONTROL DIAGRAM LTC 72		
146C6228 SHT.1	49	CONECTION DIAGRAM		

D87001-031E-007 SHT. 1	50	DTC-2 TERMINATION DETAILS TERMINAL STRIP D-9		
D87001-031E-007 SHT. 2	51	DTC-2 TERMINATION DETAILS TERMINAL STRIP D-9		
D87001-031E-007 SHT. 3	52	DTC-2 TERMINATION DETAILS TERMINAL STRIP D-9		
D870011-031E-006 SHT. 1	53	DTC-2 TERMINATION DETAILS TERMINAL STRIP D-7		
D870011-031E-006 SHT. 2	54	DTC-2 TERMINATION DETAILS TERMINAL STRIP D-7		
D870011-031E-006 SHT. 3	55	DTC-2 TERMINATION DETAILS TERMINAL STRIP D-7		
DWP-1.7-6-9A40/1	56	CONTROL & ELECTRICAL EQUIPMENT ROOM LAYOUT		
	57-61	RESERVED		
DWP-1-6-1A6/8	62	15kV EQUIPMENT SHEET 2		
DWP-1-6-9A4/5	63	AUXILIARY CONTROL SWBD (ER)		
DWP-1-6-9A4/7	64	CONTROL CONSOLE (SCC) SHEET 2		
DWP-1-6-9A23/2	65	CONTROL SOURCES ONE LINE DIAGRAM		
DWP-1-6-9A31/2	66	GRAPHIC SWITCHBOARD AND CONSOLE ANNUNCAITOR DIAGRAM		
DWP-1-6-9A40/2	67	CONTROL & ELECT. EQUIPT. RM. LAYOUT & DETAILS		
DWP-1.2-6-9A51/4	68	AUX CONTROL SWBD ER21 EXTERNAL CONNECTION MODIFICATION		
DWP-1.2-6-9A53/2	69	CABLE ARRANGEMENT SWITCHGEAR ROOM EL 1000		
DWP-1.2-6-9A53/3	70	CABLE ARRANGEMENT SWITCHGEAR ROOM EL 1000.75		
DWP-1.2-6-9A53/4	71	CABLE ARRANGEMENT SWITCHGEAR ROOM EL 988		
DWP-1.2-6-9E42/1	72	GEN SWBD S1-1 WIRING MODIFICATION		
DWP-1.2-6-9E53/2	73	CABLE ARANGEMENT EQUIPMENT GALLERY BAY 1 EL 988.0		

DWP-1-6-9E56/2	74	STATION SERVICE BUS BREAKER & TRANSFORMER WIRING		
0108B8555	75	METALCLAD SWITCHGEAR ELEMENTARY & CONNECTION DIAGRAM		
0155F0156-SH.2	76	ELEMENTARY POWER OF RELAY CIRCUIT		
0155F0156-SH.5	77	ELEMENTARY TRANS LOCKOUT CIRC. & LOAD CHNGR CIRCUITS		
0155F0175	78	METALCLAD SWITCHGEAR CONNECTION DIAGRAM		
0155F0176	79	METALCLAD SWITCHGEAR CONNECTION DIAGRAM		
0155F0177	80	METALCLAD SWITCHGEAR CONNECTION DIAGRAM		
0155F0178	81	METALCLAD SWITCHGEAR CONNECTION DIAGRAM		
0155F0179	82	METALCLAD SWITCHGEAR CONNECTION DIAGRAM		
0155F0180	83	METALCLAD SWITCHGEAR CONNECTION DIAGRAM		
0155F0182	84	METALCLAD SWITCHGEAR CONNECTION DIAGRAM		
0155F0183	85	METALCLAD SWITCHGEAR CONNECTION DIAGRAM		
0155F0184	86	METALCLAD SWITCHGEAR CONNECTION DIAGRAM		
0155F0185-1	87	METALCLAD SWITCHGEAR INTERCONNECTION DIAGRAM		
0155F0185-2	88	METALCLAD SWITCHGEAR INTERCONNECTION DIAGRAM		
0155F0185-3	89	METALCLAD SWITCHGEAR INTERCONNECTION DIAGRAM		
0155F0185-4	90	METALCLAD SWITCHGEAR INTERCONNECTION DIAGRAM		
0155F0185-5	91	METALCLAD SWITCHGEAR INTERCONNECTION DIAGRAM		
0155F0185-6	92	METALCLAD SWITCHGEAR INTERCONNECTION DIAGRAM		
0155F0188	93	INDOOR METALCLAD SWGR INTERCONNECTION DIAGRAM		

DACW69-70-C-0114-1	94	SUMMARY OF SWITCHGEAR EQUIPMENT		
DACW69-70-C-0114-2	95	SUMMARY OF SWITCHGEAR EQUIPMENT		
DACW69-70-C-0114-3	96	SUMMARY OF SWITCHGEAR EQUIPMENT		

(End of drawing list)

Contract drawings created on CADD will be available in electronic form for use by the Contractor. No For Information Only drawings are available on CADD. CADD drawings are identified as such by the Computer Aided Design and Drafting symbol near the title block. The Contractor assumes all risks associated in using electronic CADD drawings. The contract drawings shall govern if there are any discrepancies between the electronic copy and the contract drawing. The Contractor shall promptly notify the Contracting Officer of any discrepancies. The Government will not be responsible to correct the electronic CADD drawing. If contract modifications are issued, the associated electronic CADD drawings will not be available to the Contractor. Electronic copies of CADD drawings are only available in Intergraph Microstation format. The Government will provide the files on CD ROM. If the Contractor requires different media, such as floppy disks, the Contractor shall be responsible for all conversions required for their use and associated conversion inaccuracies.

NOTE: The following drawings are hereby revised without issuance of revised prints:

1. Drawing DWP-1.8-6-1D7/4B, Sheet No. 7. Note 3 is revised to read as follows:

"CONTRACTOR SHALL MODIFY MIMIC BUS AS REQUIRED FOR DOUBLE HIGH BREAKERS. IF A DOUBLE HIGH ARRANGEMENT IS USED, MODIFY CABLE SCHEDULE AS REQUIRED TO INDICATE PROPER CUBICLE NUMBER. EXISTING SWITCHGEAR IS 32'-3" WIDE X 5' 5" DEEP. NEW SWITCHGEAR SHALL NOT EXCEED 42' '7" IN LENGTH, INCLUDING FIRE WALL AND SEPARATION BETWEEN BUS 1 AND BUS 2, OR 7' 8" (92") IN DEPTH. EXISTING SWITCHGEAR IS ON RAISED PAD. REMOVE PAD AND INSTALL NEW SILL FOR NEW SWITCHGEAR AS REQUIRED IN 16340. EXISTING CABLE TRAY SUPPORTS EXTEND DOWN TO 101" ABOVE FINISHED FLOOR. EQUIPMENT, BREAKER CARTS, ETC. MUST FIT UNDER EXISTING CABLE TRAY SUPPORTS. SEE DRAWING DWP-1.8-6-1D11/1B FOR ADDITIONAL LIMITS ON EQUIPMENT SIZE. THE LINE UP SHOWN IS ONE POSSIBLE FRONT VIEW AND INCLUDED TO SHOW METERS, CONTROLS, LIGHTS AND MIMIC BUS LOCATED ON FRONT OF NEW SWITCHGEAR."

2. Drawing DWP-1.8-6-1D11/1B, Sheet No. Note 6 is revised to read as follows:

"EXISTING SWITCHGEAR IS 32'-3" WIDE X 5' 5" DEEP. NEW SWITCHGEAR SHALL NOT EXCEED 42' '7" IN LENGTH, INCLUDING FIRE WALL AND SEPARATION BETWEEN BUS 1 AND BUS 2, OR 7' 8" (92") IN DEPTH. EXISTING SWITCHGEAR IS ON RAISED PAD. REMOVE PAD AND INSTALL NEW SILL FOR NEW SWITCHGEAR AS REQUIRED IN 16340. EXISTING CABLE TRAY SUPPORTS EXTEND DOWN TO 101" ABOVE FINISHED FLOOR. EQUIPMENT DOORS MUST BE ABLE TO FULLY OPEN. BREAKER CARTS MUST BE ABLE TO FREELY PASS UNDER EXISTING CABLE TRAY SUPPORTS. MINIMUM CLEARANCE BETWEEN REAR OF SWITCHGEAR AND FRONT OF XPC PANEL SHALL BE 5' 0". IF NEW SWITCHGEAR, INCLUDING FIRE WALL BETWEEN BUS 1 AND BUS 2 IS OVER 32'-3" WIDE ROUTING OF BUS DUCT MAY NEED TO BE MODIFIED. BUS DUCT MUST NOT BLOCK ACCESS TO ACCESS HATCH ON ISO-PHASE BUS DUCT FROM

GENERATOR THAT IS LOCATED 12' ABOVE FINISHED FLOOR, 32" BEHIND EXISTING SWITCHGEAR."

3. Drawing DWP-1.8-6-1D11/2, Sheet No. 11 is revised to read as follows:

"EXISTING SWITCHGEAR IS 32'-3" WIDE X 5' 5" DEEP AND LOCATED 8' 6" FROM WALL. a MINIMUM CLEARANCE OF 6' IS REQUIRED BETWEEN THE FRONT OF THE NEW SWITCHGEAR AND THE WALL. BUS DUCT MUST NOT BLOCK ACCESS TO ACCESS HATCH ON ISO-PHASE BUS DUCT FROM GENERATOR THAT IS LOCATED 12' ABOVE FINISHED FLOOR, 32" BEHIND EXISTING SWITCHGEAR."

(End of Clause)

(End of Summary of Changes)

TECHNICAL SPECIFICATIONS

SECTION 01010

SUPPLEMENTARY REQUIREMENTS

1. GENERAL

The work covered by this section of the specifications consists of work common to more than one section of these TECHNICAL SPECIFICATIONS.

2. PROJECT SECURITY

The project site is a secured area and access onto the project is restricted. The security measures affect all of the Contractor's vehicles and personnel. There will be delays when entering projects due to locked gates, vehicle inspections, and personnel checks. Inspections and checks may include inspection of tool boxes, brief cases, lunch boxes, and other containers.

(a) Vehicle Access

Project access roads are secured with locked gates. All vehicles that pass thru the locked gates will be subject to being searched. No privately owned vehicles (POV's) will be allowed thru locked gates except to access designated parking areas. POV's will be restricted to designated parking areas. Only Contractor's work vehicles and equipment that are essential to the conduct of the work will be allowed in the work areas. All Contractors vehicles shall display suitable permanent or temporary identification.

(b) Identification of Employees

The Contractor shall be responsible for furnishing an identification badge/card to each employee prior to the employee's work on the project site, and for requiring each employee engaged on the work to display identification at all times. Badges shall include photo identification, company name, and the individual's name and company identification number as a minimum. Badges shall be laminated plastic type. All prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon the release of the employee. If required by the Contracting Officer, employees will be photographed by the Government. Employees who fail to submit to photographing will not be allowed on the project site.

(c) Delivery of Equipment

Delivery of equipment and materials to the project site shall arrive during the normal working hours of the project maintenance crews described in paragraph WORK SCHEDULES. All deliveries of equipment shall use the access road to the powerhouse located on the North side of the river.

3. PLANT AND EQUIPMENT LIST

The Contractor shall submit a complete list of all equipment to be used on the project, in duplicate, within 15 days after date of receipt of notice to proceed. The Contractor shall submit a revised list in the event of change of equipment. Lists shall include rented equipment as well as lease-purchase or sale-leaseback equipment. The initial list and the revised lists shall

indicate dates equipment is assigned to or removed from the project and adequate identification or description of each item of equipment including manufacturer's name (abbreviated), model number, manufacturer's serial number, year of manufacture, and Contractor's assigned serial or record number.

4. TESTING OF EQUIPMENT

Before any machinery or mechanized equipment is put to use on the job, it shall be inspected and tested by a qualified person and determined to be in safe operating condition in the presence of the representative of the Contracting Officer. Cranes or derricks shall be tested by the Contractor or a qualified testing agency in accordance with EM 385-1-1. Equipment shall be large enough to safely handle proposed picks or tasks without exceeding the crane rating established by these tests.

5. LOCATION OF CONTRACTOR’S OFFICE AND PARKING OF PRIVATE VEHICLES

The Contractor's jobsite office shall be located in a designated area inside the fenced area around the powerhouse. Parking areas for privately owned vehicles will be established and designated. POV’s will not be allowed to cross the river by access over the dam. Contractor’s vehicles and POV’s may be required to park outside the fenced area.

6. UTILITIES

6.1 Water. The domestic water system at Dworshak Dam is not working properly so the Contractor shall provide its own drinking water.

6.2 Electricity. Electric power will be made available to the Contractor from the existing electrical systems within the dam and will be supplied without cost to the Contractor. Power is available from existing 120-volt, 1-phase, 15-ampere receptacles, and 480 volt, 3 phase, 30 ampere receptacles. The Government receptacles are located at various sites throughout the powerhouse. Temporary wiring may be required to facilitate the work. The location of all temporary power lines and connections will be subject to Contracting Officer approval. All temporary circuits, wire, extension cords, and devices shall be furnished, installed, connected, and maintained by the Contractor in a workmanlike manner, and shall be removed by the Contractor in like manner prior to final acceptance by the Government. All temporary electrical lines and appurtenances shall be furnished and installed at no additional cost to the Government. Government personnel will have priority use of the electrical receptacles.

6.3 Compressed Air. Compressed air at 100 psi up to 20 SCFM will be made available for Contractor use from existing outlets. Government personnel will also use the compressed air at times for routine and emergency maintenance operations. Government personnel will have priority for use of the compressed air.

7. SANITATION FACILITIES

The Government’s restrooms inside the dam will not be available for use by Contractor personnel. The Contractor shall furnish sanitation facilities in accordance with EM 385-1-1. The Contractor shall provide freeze protection during the months October through March to prevent any spillage.

8. SAFETY

8.1 Accident Prevention. In accordance with Contract Clause: ACCIDENT PREVENTION the Contractor shall provide and maintain work environments and procedures which will safeguard the public, Government personnel, Contractor personnel, property, materials, supplies, and equipment exposed to Contractor operations and activities.

8.1.1 The Contractor shall comply with the US Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, dated November 2003 and all revisions.

8.1.2 Whenever the Contracting Officer detects any noncompliance with these requirements or any condition that poses a serious or imminent danger to the health or safety of any personnel, the Contracting Officer will notify the Contractor and request immediate initiation of corrective action. Lack of notice from the Contracting Officer does not relieve the Contractor from compliance requirements and responsibility. After receipt of notice from the Contracting Officer, the Contractor shall immediately take corrective action. Such notice, when delivered to the Contractor at the site of the work, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for additional costs or damages by the Contractor.

8.2 Accident Prevention Plan. Before commencing any work on site, the Contractor shall submit an Accident Prevention Plan for the Contracting Officer’s review and acceptance. Paragraph 01.A.07 and Appendix A of EM 385-1-1 reflect requirements and guidelines for preparing accident prevention plans.

8.3 Hazard Analysis. Prior to beginning each major phase of work, an activity Hazard Analysis shall be prepared by the Contractor in accordance with paragraph 01.A.09 and Figure 1-1 of EM 385-1-1 and provided to the Government Inspector.

8.4 Subcontractors. Compliance with the accident prevention and safety requirements by subcontractors will be the responsibility of the Contractor.

9. SAFE CLEARANCE (LOCKOUT) PROCEDURES

A safe clearance procedure (hazardous energy control plan) is used by project personnel to ensure continuity of service and safety to personnel and equipment. The project requires that the Contractor shall provide the names of two individuals who shall have the authority to request clearances and release clearances. These individuals will receive training at the projects. At least three hours is required for the training and for the Contractor to review the projects procedures. Any work performed by the Contractor which requires taking project operating equipment out of service will be done only after a formal clearance is obtained through the Contracting Officer’s Representative. Only the Project Control Room as arranged by the Contracting Officer’s Representative will issue clearances. Contractor personnel shall not violate the clearance procedure. A copy of each Projects Safe Clearance Procedure will be provided to the Contractor. As required in paragraph 12.A.02 in Corps Safety manual EM 385-1-1, the Contractor shall submit its

hazardous energy control plan to the Corps for review and acceptance prior to initiation of any activities requiring the removal of any project operating equipment from service. Prior to the removal of any project operating equipment from service a meeting and preparatory inspection will be held between the Contractor and project personnel to ensure that all affected personnel understand and comply with the restrictions of each others energy control procedures.

10. FIRE CONTROL

Each piece of internal combustion engine driven equipment used at the work site shall be equipped with a fire extinguisher in accordance with recommendation NFPA as appropriate. The minimum approved rating of extinguishers shall not be less than 5-B:C.

11. WORK SCHEDULES

11.1 Contractor’s Schedule. At the prework meeting, the Contractor shall furnish a schedule of working hours and days of the week for contract work. The Contractor shall furnish notification of any change of schedule of regular work hours, overtime work hours, and shifts of work crews and personnel at the site. This notification shall be provided a minimum of 48 hours prior to any schedule change to allow suitable scheduling of Government personnel and inspection. Exception to this requirement may be allowed in case of schedule change due to emergency conditions.

11.2 Government's Schedule. The maintenance crews and administrative staff at the dam work from 6:30 a.m. to 5:00 p.m., Monday through Thursday excluding Federal holidays. A powerhouse operator is at the site 24 hours a day, 7 days a week, including Federal holidays but is not available to assist the Contractor.

12. CONTRACTOR WORK AREA

Work and storage areas within the powerhouse will be available for the Contractor. These areas will be confined to the erection bay floor and the generator floor. The Contracting Officer will designate the actual locations for work and storage areas on these two floors. All stairways, doorways, and floor drainage gutters shall remain open and accessible. Temporary storage of equipment and materials in the powerhouse shall be limited to those items required for performance of the work. The Government will not be responsible for providing security for stored equipment, supplies, and materials either inside or outside the powerhouse. The Contractor shall provide all necessary security.

13. DISPOSITION OF REMOVED EQUIPMENT

All existing equipment that is removed and not reinstalled shall become the property of the Contractor and shall be removed from the project site and disposed of in a legal manner. All of the existing breakers shall remain on site, intact, and in good working condition until all new breakers are installed and pass all operational field testing. The existing breakers shall be removed from the site after satisfactory completion of field testing of the new breakers.

14. RESERVED

15. REGULAR CLEANUP AND DEBRIS DISPOSAL

Debris resulting from the work, such as packing cases, scrap lumber, and other debris shall be collected and removed from the project site daily and disposed of in a legal manner. All costs for removing debris shall be incidental to the work, and no separate payment will be made therefore. The Government’s trash cans, dumpsters, etc. shall not be used.

16. PROTECTION AND RESTORATION OF EXISTING FACILITIES

The Contractor shall take precautions to prevent damage to existing facilities while performing work under this contract. Upon completion of the work, all the existing facilities not included as a portion of the work shall be left in a condition better than or equal to the condition existing at time of contract award. Costs for maintenance, repair and restoration of any facilities shall be considered as incidental to and included in the line item prices in The Schedule, Section B.

17. REPAIR OF EXISTING PAINTED SURFACES

All existing painted surfaces damaged by the Contractor during the course of the contract shall be cleaned and touch-up painted with paint equal in type, quality, and color to the existing paint. The Government will furnish the Contractor the name, color, and type of the existing paints upon request.

18. CARE OF DRAINS

Existing powerhouse floor drains shall not be used for disposal of any solid material or any liquids other than clear water. The Contractor shall demonstrate that the pipes and drains are unobstructed when so directed.

19. PROTECTION OF POWERHOUSE FLOORS

Care shall be taken to prevent damage to tile floors within the powerhouse. Minimum protection shall include continuous cover of three-layer, oil-impervious craft paper over traffic and work areas. Place continuous layer of 3/4-inch-thick plywood on floor areas to receive equipment or stored items. Accessible floor pipe chases shall remain accessible even if covered. All designations relating to fire protection equipment that get covered shall be remarked after covering. Provide additional blocking and timbers when required. Also suitably protect other surfaces of work. Damage to floors caused by Contractor's operations shall be repaired at no additional cost to Government. Repairs shall match surrounding area in color, texture, and surface finish and are subject to approval. Work in the powerhouse shall not start until floor protection meets the satisfaction of the GQAR.

20. CONTRACTOR’S CRANES

Contractor’s cranes and equipment furnished for this work shall conform to all applicable OSHA Requirements and EM 385-1-1. Crane wheel and outrigger loading diagram and deck protection for outriggers shall be submitted for approval at least 14 calendar days prior to using any cranes rated 50 tons or more on any of the project decks.

21. USE OF POWERHOUSE BRIDGE CRANE

21.1 General. The Government’s tw0 bridge cranes in the powerhouse will be available for the work within the working load and movement limits of the cranes. Each crane has two trolleys (350 ton main hoist and an auxiliary hoist per trolley). One auxiliary hoist is 175 tons and the other hoist is 25 tons. The bridge crane with the 25 ton auxiliary hoist will be available for use by the Contractor at such times as not required for other maintenance and repair work performed by Government personnel and other contractors. The Government will furnish electric power, lubrication, and normal maintenance including adjustments without cost to the Contractor. The Contractor shall give the Government at least 24 hours notice in advance each time he desires use of the crane on weekdays and 48 hours notice for use on weekends and Federal holidays. The Government retains the right to withdraw the availability of the crane at any time it is required for emergency use, normally scheduled project maintenance, or for coordination with other contractors.

21.2 Crane Operators. The Contractor shall furnish qualified bridge crane operators for his operations. Each operator in addition to meeting the requirements of EM 385-1-1 shall have had at least 1-year experience on a bridge crane of equivalent capacity and characteristics. Qualifications for each operator in the form of an affidavit signed by the operator and the Contractor shall be furnished in duplicate. The affidavit shall include a complete record of all related work with particular emphasis on experience directly related to operation of a bridge crane handling comparable loads. Before any operator is approved he shall spend at least 1 hour in being checked out on the cranes under the direct surveillance of a Government operator. The operators may be retested at any time. The Contractor shall insure that the crane operators have current (within the previous 12 months) physical or medical examinations with emphasis on hearing, eyesight, and cardiovascular conditions. Dates of physical exams shall be submitted with the operator qualifications to the Contracting Officer.

21.3 Use of the Crane. The crane facilities at the project must be shared with the Corps project forces and other contractors as directed by the Contracting Officer. The Contractor will be liable for all damage, due to fault or negligence, incurred while the crane is operated by the Contractor's crane operators. The Contracting Officer will make allocation of crane time between the different contractors, and his decision will be final in any dispute arising relative thereto.

21.4 Riggers. Only qualified riggers shall be used in preparing loads for lifting and in attaching such loads to the crane. A Government operator will check them for knowledge of hand signals. Hand held portable radios may be used but only on non-Government frequencies. All rigging and lifting devices shall be furnished by the Contractor.

22. AIR PURITY CONTROL IN THE POWERHOUSE

The Contractor shall take such measures as are necessary to effect maximum control, and prevent escape to the powerhouse, of all dust and fumes created by operations under this contract. To the maximum extent possible, all dust and dirt shall be removed by vacuum cleaning. Prior to commencement of work in the powerhouse, the Contractor shall submit for approval, in writing, his proposed air purity control program. Air purity control program shall include, but not necessarily be limited to, the following:

(1) Adequate isolation and ventilation of air arcing, welding, burning, and grinding operations.

(2) Provision of exhaust ducts that shall discharge outside the powerhouse structure where mechanical ventilation is used.

(3) Controlled operation of power driven tools.

(4) Furnishing and removing of oiled sawdust or other dust preventatives in areas that cannot be properly rendered free from excessive dusting by vacuum cleaning or other methods.

(5) Vacuum cleaning of spaces within the work areas where dust accumulates.

(6) Air-, electrical-, or battery-driven equipment may be used inside the powerhouse.

(7) Internal-combustion engine powered equipment will not be permitted to operate inside the powerhouse unless exhausted to the exterior except for short periods of time to unload materials and equipment.

Depending upon the Contractor's plant, equipment, and methods of operation, additional provisions for satisfactory air purity control will be required and shall be included in the proposed air purity-control program. Decisions of the Contracting Officer as to the adequacy and extent of the air purity-control program and prosecution of the work shall be final and conclusive.

23. WARRANTIES

A copy of all manufacturer’s standard warranties that are furnished with items of equipment supplied in this contract shall be given to the Contracting Officer. This requirement is in addition to any warranties or guaranties that may be specifically required in other sections of the technical specifications or in the contract clauses.

24. MAINTAIN WORKING “AS-BUILT” CONTRACT DRAWINGS

The Contractor shall maintain a current and accurate record of the work as actually constructed in the form of working “as-built” drawings by marking “as-built” conditions on the contract drawings. Blue pencil shall be used to mark information added to the drawings and red pencil shall be used to mark information deleted from the drawings. Contract drawings shall be maintained on-site during the course of the work. The completeness and accuracy of the marked “as-built” drawings must be verified by Government Quality Assurance personnel prior to submission of progress payment requests. Failure to maintain the “as-built” drawings completely and accurately may result in retention of up to 5% of the contract price. The working “as-built” drawings shall be submitted to the Contracting Officer after all “as-built” conditions have been marked on the working “as-built” contract drawings.

25. ACCESS TO THE POWERHOUSE

The powerhouse is accessed via the Powerhouse Access Road located on the right bank of the North Fork Clearwater River. Vehicles must pass through a locked gate just before the powerhouse. See paragraph PROJECT SECURITY for access through the locked gates.

26. SUMMARY OF SUBMITTALS

Submittal Register ENG Form 4288 to be furnished by the Contractor shall include the following:

Paragraph	Item	SD	AEA
01010-3	Plant and equipment list	08	C
01010-8.2	Accident prevention plan	07	CD/ECC
01010-9	Hazardous energy control plan	07	C
01010-20	Crane wheel and outrigger loading diagram	04	CD
01010-21.2	Crane operators qualifications	08	C
01010-22	Air purity control program	07	CD
01010-23	Warranties	13	C
01010-24	“As-built” contract drawings	04	CD

Code for Submittal Description (SD)

01 - Data
04 - Drawings
06 - Instructions
07 - Schedules and Plans
08 - Statements
09 - Reports
13 - Certificates
14 - Samples
18 - Records
19 - O & M Manuals

Action Element for Approval (AEA)

C - Contractor
AE - Architect Engineer
ED - Engineering Division
CD - Construction Division
EDA - Engineering Division, Architectural Design
EDC - Engineering Division, Soils - Civil Design
EDE - Engineering Division, Electrical Design
EDG - Engineering Division, Geology & Dam Safety
EDH - Engineering Division, Hydraulic Design
EDM - Engineering Division, Mechanical Design
EDS - Engineering Division, Structural Design
EDSP - Engineering Division, Specifications
HDC - Hydroelectric Design Center
ECC - Environmental Compliance Coordinator

* * * * *

SUBMITTAL REGISTER (ER 415-1-10)

Contract No:

Title and Location: Station Service Improvements, Dworshak Dam

Contractor:

Specification Section:

Activity No.	Transmittal No.	Item No.	Specification Paragraph Number	Description of Items Submitted	Type of Submittal: DATA	DRAWINGS	INSTRUCTIONS	SCHEDULES AND PLANS	STATEMENTS	REPORTS	CERTIFICATES	SAMPLES	RECORDS	O&M MANUALS	Classification: INFORMATION ONLY	GOVERNMENT APPROVED	Contractor Schedule Dates: REVIEWER	SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	Contractor Action: CODE	DATE	SUBMIT TO GOVERNMENT	Government Action: CODE	DATE	Remarks
a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.	z.	aa.
			01010-3	Plant and equipment list					X						X											
			01010-8.2	Accident prevention plan				X								X										
			01010-9	Hazardous energy control plan				X							X											
			01010-20	Crane wheel and outrigger loading diagram		X										X										
			01010-22	Air purity control program				X								X										
			01010-23	Warranties							X				X											
			01010-24	"As-built" contract drawings		X										X										
			01010-21.2	Crane operators qualifications					X						X											
			01312-1.6.3	Data diskette or CD-ROM					X							X										
			01320-3.4.1	Preliminary project schedule				X								X										
			01320-3.4.2	Initial project schedule				X								X										
			01320-3.4.3	Periodic schedule updates				X								X										
			01330-1.6	Submittal Register (ENG Form 4288)				X							X											
			01330-1.9	Final Approved Versions of Contractor		X										X										
				Prepared Drawings																						
			01330-1.10	Operation and Maintenance Manuals										X		X										
			01355-5	Environmental protection plan				X							X											
			01355-11.2	Sampling and analysis plan				X							X											
			01355-12	Hazardous materials handling plan				X							X											
			01451-3.2	Quality Control Plan				X								X										

SECTION 16050

DWSSI0416050

MISCELLANEOUS ELECTRICAL EQUIPMENT AND WORK

TABLE OF CONTENTS

PART 1 - GENERAL

1.1 PROJECT DESCRIPTION OF WORK
1.2 DWORSHAK DETAILED DESCRIPTION OF WORK
1.3 REFERENCES
1.4 SUBMITTALS
1.5 GENERAL REQUIREMENTS

PART 2 - PRODUCTS

2.1 MATERIALS
2.2 PREVENTION OF CORROSION
2.3 CONDUIT AND CABLE TRAY
2.4 FITTINGS AND BOXES
2.5 STEEL CABINETS AND BOXES
2.6 CONNECTIONS
2.7 INSULATED WIRE AND CABLE
2.8 SPECIAL WIRE AND CABLE
2.9 TERMINATIONS
2.10 NON-SEGREGATED BUS DUCT
2.11 TERMINAL BLOCKS
2.12 IDENTIFICATION

PART 3 - EXECUTION

3.1 INSTALLATION
3.2 EQUIPMENT PADS, ANCHORING OF EQUIPMENT AND WALL
3.3 CONDUIT SYSTEM
3.4 INSTALLATION OF CABINETS AND BOXES
3.5 PAINTING
3.6 WIRE AND CABLE INSTALLATION
3.7 TERMINAL BLOCKS
3.8 DEVICE MARKINGS
3.9 GROUNDING INSTALLATION
3.10 CONNECTIONS

ATTACHMENT:

TABLE 1 - WIRE TERMINATION POINTS LIST (25 Pages)

SECTION 16050

MISCELLANEOUS ELECTRICAL EQUIPMENT AND WORK

PART 1 - GENERAL

1.1 PROJECT DESCRIPTION OF WORK

1.1.1 General

This Section specifies the electrical work required to complete the station service improvements at Dworshak Dam. The electrical work includes the supply of all labor, materials, tools, transportation, temporary construction, and special or occasional services as required to provide a complete working electrical installation. The work includes the removal and disposal of miscellaneous existing electrical equipment and materials as well as the supply and installation of new electrical equipment and materials.

The station service improvements will generally consist of three major tasks:

a. The complete removal of the existing switchgear including 18" and 26" cubicles, breakers and all associated equipment located in existing switchgear. Furnish and install new vacuum breaker switchgear.

b. The replacement of existing electromechanical feeder and transformer relays located in existing switchgear. Furnish and install new remote XPC panel with microprocessor based relays and meters. The new panel will have breaker controls and indication for all breakers. Digital meters will be provided in panel XPC for transformer feeder breakers. The Contractor is responsible for design, assembly and installation of control panel XPC.

c. Reroute existing feeders to new breaker cubicles. Install new power and control cables per cable schedule. Reroute existing control and alarm cables from terminal strips in existing switchgear to new switchgear or existing annunciation panel. Most alarm cables are presently terminated in switchgear Unit 13A and then jumpered to annunciation panel. Reroute existing bus duct to new switchgear cubicles.

1.1.2 Removal

Miscellaneous items designated for removal include, but are not necessarily limited to, 5 kV switchgear and breakers, conduits, 5 kV bus duct, control cables, relays and other miscellaneous electrical devices.

1.1.3 Installation

The electrical work shall include, but not necessarily be limited to, installation of vacuum breakers, switchgear cubicles, bus duct, cables, relays and control devices as shown on drawings and as outlined in this specification. The electrical work shall also include the detailed design to accomplish the electrical work such as but not necessarily limited to selection of the new protective relays, drawings for panel wiring, interconnect, panel, 3-line, schematics, etc. for the XPC Panel and associated equipment, instrument transformers, potential transformers and switchgear. Some of the contract drawings are derived from drawings that are at least 30 years old. These drawings may not reflect all changes made to the equipment since it was installed. The Contractor is required to verify all existing controls and interlocks before proceeding with construction to insure that overall functionality

of equipment is not changed. The Contractor is responsible for all wiring changes required inside and between breaker cubicles within switchgear, in addition to cables external to switchgear to provide a functional system. Cable schedule lists only cables associated with the switchgear replacement and installation of the XPC Control Panel. Terminations for the annunciator panel cables are jumpered from the existing switchgear to the annunciator panel. Most of the cables should be long enough to be routed directly to the panel. Control cables have been added to cable schedule so that any cables that cannot be rerouted without splicing can be replaced. Existing armored 5 kV cables will be rerouted to the new switchgear and terminated. Optional cables are listed if all of the existing cables cannot be reused. The Contractor is responsible for the interconnect design within switchgear and within XPC Control Panel. The contractor is responsible for completing the interconnect design. If the detailed design associated with the relay selection and replacement requires additional cables, the Contractor is responsible for the additional cables.

1.1.4 Asbestos Removal

The arc chutes in the existing breakers at Dworshak contain non-friable asbestos. The interior of the breaker cabinets may contain dust from opening and closing of the breakers. If dust is present it shall be treated as asbestos containing material and the Contractor shall remove the dust with HEPA filtered vacuum, wet wipes, or other method allowed by law. The Contractor shall handle, contain, and dispose of all asbestos containing materials in accordance with Federal and state laws and regulations. Arc chutes that contain asbestos shall be removed from the breakers and the arc chutes and all other asbestos materials shall be disposed of in a state regulated asbestos landfill. The Contractor shall submit a copy of the documentation from the landfill to the Government after disposal. Workers shall wear appropriate safety equipment such as gloves, long sleeve shirts, half-mask respirators with HEPA filters, and goggles. After removal of each breaker from the powerhouse, they shall be removed from the project site and disposed of in a legal manner in accordance with the Circuit Breaker Disposal Plan specified in paragraph 1.4.3.1.

1.1.5 Wiring Color Code

The existing wiring color code uses the green and white colored conductors for control circuits and current transformer wiring. There may be 125 V DC, 120 V AC or other voltages and current present on these wires. The Contractor is to implement proper precautions to ensure worker safety.

For all cables installed this contract, any green conductors will be used only as grounding conductors. If the new cables include one or more green conductors, the number of conductors required in the cables per the cable schedule will be increased by one for each green conductor.

1.1.6 Control Power

Control, alarm and heater power, 125 V DC and 120 VAC, is daisy chained through the switchgear. Voltage may be present in the cubicle even after the main control power to the Bus has been isolated. Contractor will test for voltage in each cubicle.

The terminal blocks for daisy chaining are not accessible. Contractor may have to cut and tape off control cables to isolate control and annunciator power and systems. When the first switchgear bus is removed the contractor may have to install a temporary control power cable to the second switchgear bus to keep the controls operable in the energized

switchgear. The Contractor is to implement proper precautions to ensure worker safety.

1.1.7 Lead Based Paint

Existing Switchgear may have been painted with Lead Based Paint. If paint must be removed to perform contract work, the Contractor shall test existing paint for presence of lead in accordance with Section 02090. See Section 16340 for requirements on Switchgear.

1.2 DWORSHAK DETAILED DESCRIPTION OF WORK

1.2.1 Replace the existing air breakers and switchgear cubicles with new vacuum breakers and switchgear in accordance with Section 16340.

a. Install and test the new switchgear and vacuum breakers. Check breaker alignment. Test all cubicle and breaker interlocks.

b. Insulate all 5 kV connections to 5 kV including bus connections, bus duct connections and cable connections to switchgear.

c. Remove existing Nexus meter transmitter from existing switchgear and install in new switchgear.

d. Disconnect surge arrestors and Hi-Pot new switchgear bus.

e. Test new switchgear, breakers, interlocks in accordance with NETA ATS recommendations.

f. Provide operation and maintenance training for new switchgear and breakers.

1.2.2 The 4160 V bus duct the T01 connection to the switchgear is connected to SP11, SP Bus #1. The power is then bused internal to the switchgear to SP12, SP Bus #2. Before either bus can be removed the connecting bus bars in cubicle SP11A must be removed and the connections to the bus in SP11 cut back so that they do not extend past the cubicle enclosure and insulated. The opening in cubicle SP11 for the main bus extension must be covered by a metal plate the same thickness as the switchgear cubicles. If the bracing on the bus in SP11 is located so that the bus cannot be cut back so that a plate can be installed over the opening the contractor shall install a box over the opening and bus so that the end is protected while SP Bus #2 is being removed. One total SP Switchgear outage, not to exceed a total of 8 hours (2 hr. maximum to obtain clearances on the equipment and 6 hours to perform work) will be permitted to allow splitting of the switchgear bus at SP11A. Contractor shall coordinate with plant personnel for timing of this outage. Project will determine the timing of the outage and may require that this work be done on a weekend or at night so as to minimize impact to operations and other facilities that are fed from this equipment. Corp safety regulations require that this work be done when switchgear is completely de-energized.

Contractor shall isolate and remove SP Bus #2 first since after the bus split only SP Bus 1 will be fed from both T01 and T02.

1.2.3 Reroute bus duct for Transformers to new switchgear cubicles as indicated on drawings.

a. Existing bus duct #1 is routed from TJ01 to switchgear cubicle SP11. Existing bus duct #2 is routed from TJ02 to switchgear cubicles SP13 and SP14. Remove bus duct from breaker cubicles SP11, SP13 and SP14 to in front of the switchgear. Transition to new bus duct and route

to new cubicles as indicated on drawings. Contractor may change routing, with written approval if routing change is acceptable to government, from what is shown but route is to minimize the length that is routed above the switchgear. Contractor is advised that there are possible routing conflicts with existing equipment that include but are not limited to 5 kV armored cable, generator iso-phase bus duct (side and rear), HVAC equipment (side), cable tray (side and front) and existing bus duct. It is recommended that the contractor attend the pre-bid site visit and check routing.

b. When the SP switchgear is being replaced, there will be times when the transformer and bus duct is feeding one bus and the section of bus duct that was feeding the other bus, that is being removed, is energized. The end of the section of bus duct that has been disconnected from the existing switchgear will be insulated and the opening covered with a metal enclosure to prevent contact with the energized bus until contractor is ready to connect it to the new switchgear.

c. Insulate all 5 kV connections to 5 kV.

d. Inspect and test bus duct per NETA ATS recommendations.

1.2.4 Design, fabricate and install panel XPC with new relays, breaker controls, indicating lights and meters in accordance with drawings and Section 16440.

a. The Contractor shall provide the engineering services required to select new relays, generate new wiring drawings, interconnect drawings, three line drawings, panel drawings, 'AS Built' contract drawings and modify other drawings as required to complete the design for removal of existing relays and fabrication and installation of panel XPC. The transformer high side CTs are presently wye connected. New relay must be able to function with the CT configurations indicated. The Contractor is responsible for all engineering and wiring associated with equipment selection, panel fabrication and completion of final design.

b. Install cables as indicated on drawings.

c. Verify that controls and interlocks are functionally identical to the original installation.

d. Program relays.

e. Provide training on relays and meters.

1.2.5 Design and install a reinforced concrete wall to separate Bus #1 from Bus #2. The wall shall be the height and depth of the switchgear and a minimum of 6" wide. Wall shall be anchored to the floor with anchors extending through the existing switchgear foundation pedestal grout.

1.2.6 The existing switchgear foundation pedestal is raised about 2" above the normal floor level. From original drawings the grout appears to be 5" thick total. If the new switchgear is not the same size as the existing switchgear the existing pedestal shall be removed to a level even with the surrounding floor level. Floor shall be repaired as required.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318/318R	(1999) Building Code Requirements for Reinforced Concrete
ACI 503.4	(1992; R 1997) Standard Specification for Repairing Concrete with Epoxy Mortars
ACI 503.2	(1992; R 1997) Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electric Safety Code
ANSI C80.1	(1994) Rigid Steel Conduit - Zinc Coated (GRC)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A123	(1989) (Hot dip galvanized) Coatings on Iron and Steel Products
ASTM A153	(1987) Zinc Coating (hot-dip) on Iron and Steel Hardware

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(1989) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	(1983) Pipe Threads, General Purpose (Inch) Revision and Redesignation of ASME/ANSI B2.1-1968 R(1992)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.20.2	(1993)Standard for Metal-Clad and Station-Type Cubicle Switchgear(ANSI/IEEE)
IEEE C37.20.2B SUPP	(1994) Supplement to IEEE Standard for Metal-Clad and Station-Type Cubicle Switchgear: Current Transformer Accuracies
IEEE C57.13	(1993) Standard Requirements for Instrument Transformers (ANSI/IEEE)
IEEE C323	(1983)Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations (ANSI/IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATIONS (NEMA)

NEMA FB 1	(1993)Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assembly Revision No. 1 August 1993
NEMA VE 1	(1998) Metal Cable Tray Systems Third Edition; CSA C22.2 No. 126.1-98
NEMA WC 57	(1995; Rev 2 September 1998) Control Cables

NEMA WC 70	(1999) Nonshielded Power Cables rated 2000 Volts or Less for the Distribution of Electrical Energy
NEMA WC 74	(2000) 5-46 kV Shielded power cable for Use in the Transmission and Distribution of Electric Energy
NEMA 250	(1999) Enclosures for Electrical Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1999) Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

UNDERWRITERS LABORATORIES (UL)

UL 50	(1992) Enclosures For Electrical Equipment
UL 360	(1986) Liquid-Tight Flexible Steel Conduit
UL 514A	(1993) Metallic Outlet Boxes
UL 514B	(1993) Fittings for Conduit & Outlet Boxes

U.S. ARMY CORPS OF ENGINEERS

EM 385-1-1	(2003)U.S. Army Corps of Engineers Safety and Health Manual

1.4 SUBMITTALS

Government approval is required for all submittals with a “GA” designation; submittals having an “FIO” designation are for information only. The following shall be submitted in accordance with Section 01330.

1.4.1 SD-01 Data

1.4.1.1 Electrical Design Documents; GA

Submit 120 calendar days after award of contract, detailed design documents for the installation of all electrical equipment to be supplied and installed under this contract including equipment covered by 16340 and 16440.

1.4.1.2 Electrical Equipment; GA

Submit 60 calendar days after award of contract, shop drawings and catalog cuts as required to indicate complete compliance with the contract specifications. All shop drawings and catalog cuts shall include the project name and contract number. Requirements for breakers, breaker cubicles, test switches and protective relays are covered in Sections 16340 and 16440. As a minimum shop drawings and catalog information shall be submitted for the following:

a. Non-Segregated Bus Duct
b. Cable tray
c. Conduit
d. Terminal Blocks
e. Nameplates

1.4.1.3 Wire and Cable; FIO

Submit 60 calendar days after award of contract, cable manufacturers data including dimensioned sketches of 5 kV cables and multiple-conductor 600V cables showing cable construction and sufficient additional data to show that these specifications will be satisfied. Cable submittal shall indicate where the wire will be installed. Only type SIS will be used internal to the switchgear cubicles and XPC panel. Submittal shall verify that only the correct types of SIS will be used internal to equipment supplied.

1.4.1.4 Reinforced Concrete Wall; GA

Submit within 60 days of award of contract design for the wall to be installed between Bus 1 and Bus 2, paragraph 3.2.3.

1.4.1.5 Pad Removal, Concrete Repair; GA

If removal of existing grout pad under switchgear is required, submit within 60 days of award of contract design for the removal of existing pad and repair of concrete, paragraph 3.2.1.

1.4.2 SD-04 Drawings

Submit 120 calendar days after award of contract all drawings. The drawings in paragraph 1.4.2 may be submitted as one package or may be split up into subsections as numbered below.

All final drawings shall be provided both in hard copy and in Micro Station electronic format.

1.4.2.1 Equipment Arrangement/Outline Drawings - Switchgear; GA

Switchgear arrangement/outline drawings shall show mounting of the control switches, test switches, etc. showing the equipment locations elevations and indicating clearances between all equipment. Drawings shall show both front and rear of panels equipment is to be mounted on indicating wire ways and clearances between wiring and devices. Drawings shall show location in cubicles and mounting details for CTs, VTs, bus, bus supports and all other equipment. The drawings shall include sectional views of all non-identical switchgear units, drawings or catalog cuts of removable elements and all relays and other devices,

1.4.2.2 Equipment Arrangement/Outline Drawings – XPC Panel; GA

Equipment arrangement/outline drawings of the XPC panel showing mounting of the new relays, test switches, etc. showing the equipment locations elevations and indicating clearances between all equipment. Drawings shall show both front and rear of panels equipment is to be mounted on indicating wire ways and clearances between wiring and devices. Panel will be fabricated by a UL Certified Panel Shop built in accordance with UL-508.

1.4.2.3 Electrical Schematic and Control Diagrams - Switchgear; GA

Complete schematic diagrams with wire designations, complete assembly full-line connection diagrams, one-line diagrams and interconnection wiring diagrams shall be furnished for all switchgear. Electrical schematic and control diagrams showing locations and connections of components, terminal blocks, and all wire numbers and terminal block numbers for wiring internal to the equipment and all cables. The wiring diagrams shall show all terminal blocks including panel connections, panel interconnections, and conductor designations, and shall provide a space at least 3 inches below and adjacent to the terminal blocks in which external circuits, conduits, or connections shall be shown. These diagrams shall include such external cable and conductor designations as are shown on the reference drawings or added when shop drawings are approved. The wiring diagrams shall be made as seen by an observer of the wiring, and space shall be furnished for the addition of devices where mounting space exists on the structure. If any discrepancies are discovered between contract drawings and actual existing conditions, Contractor is responsible for correcting drawings so that the completed drawings reflect actual “AS BUILT” conditions at the end of this contract.

1.4.2.4 Electrical Schematic and Control Diagrams – XPC Panel; GA

Electrical schematic and control diagrams showing locations and connections of components, terminal blocks, and conductor designations. Drawings shall indicate all wire numbers and terminal block numbers for all internal wiring and all incoming cables. The XPC control panel drawings shall detail all relay, control switch, meter, test switch and instrument transformer connection and wire designations / tags. If any discrepancies are discovered between contract drawings and actual existing conditions, Contractor is responsible for correcting drawings so that the completed drawings reflect actual “AS BUILT” conditions at the end of this contract.

1.4.2.5 Electrical Schematic, Three Lines and Interconnect Drawings; GA

Contractors are responsible for as building schematics, three lines and interconnect drawings to accurately reflect all changes made this contract. These drawings shall detail how the equipment fits together to

provide a finished product. All interconnect and termination points for every cable installed or rerouted shall be indicated. Drawings shall detail each cable, the wire numbers for each conductor in that cable, wire tag designations and the termination points on each end.

1.4.2.6 As-Constructed Drawings; GA

As-constructed drawings shall be submitted within 30 calendar days of the date the installation is complete.

1.4.3 SD-07 Schedules and Plans

1.4.3.1 Circuit Breaker Disposal Plan; FIO

a. Submit a complete detailed plan describing the methods used to remove the existing breakers from the project site, transport, and dispose or recycle the breakers. All operations shall comply with all applicable Federal and state laws and regulations.

b. Names and qualifications of each contractor that will be transporting, storing, handling, and disposing/recycling the breakers. The facility locations and phone numbers shall be included.

c. Time schedule for removal, transport, storage, and disposal/recycling.

d. Submit copies of all required documentation.

1.4.3.2 Installation Plan and Schedule; GA

Submit the Installation Plan and Schedule 90 calendar days after award of contract. The procedure shall contain a step-by step activity listing and a schedule which demonstrates the dependency of one activity on another. The plan and schedule should not duplicate information in the manufacturer’s installation instructions but should refer to those instructions with specific information on the manner in which work will be prosecuted on the site. Included in the plan and schedule shall be the crew sizes since space at the site is limited and persons on each shift responsible for the supervision and safe clearance.

Activities which are hazardous, affect plant operation, or require participation by Government personnel shall be included in the plan and schedule. See Sections 16340 and 16440 for additional requirements for installation of switchgear and XPC Panel.

The contractor will not be allowed to de-energize both Station Service transformers or buses at the same time except for the shutdown required to electrically isolate switchgear Bus #1 from Bus #2. A shutdown not to exceed 8 hour – 6 hours to perform the work and 2 hours to hang clearances will be permitted at a time to be coordinated with plant personnel. This shutdown will be scheduled between March and the end of June. Removal of existing switchgear will not be allowed until the bus is split. See paragraph 1.2 and 3.1 for more requirements.

1.4.4 SD-09 Reports

1.4.4.1 Wire and Cable Field Test; FIO

Submit 30 calendar days after test has been performed, certified copies of test reports including test results. No wire or cable shall be energized until authorized. Circuit number and location of cable tested shall be indicated on the test report.

1.4.5 SD-13 Certificates

1.4.5.1 Wire Markers; FIO

Submit 30 calendar days after award of contract, a written certificate from an approved independent testing laboratory shall be furnished to indicate the markers will not stain or discolor after 20 years service when subjected to an accelerated aging test while in contact with wire insulating materials. Identification on tags and markers shall be as shown on the drawings or as directed.

1.4.6 SD-18 Records

1.4.6.1 Request for Equipment Outages; GA

The Contractor shall provide to the Government, written request for all outages 14 calendar days in advance of each outage, paragraph 3.1.1.

1.5 GENERAL REQUIREMENTS

1.5.1 Services Of Skilled Craftsman

It is anticipated that some of the equipment currently installed and operated by the Government may require an additional amount of work, mostly electrical and mechanical, which may be necessary as a result of modifications to the installations. The services of one or more competent skilled electricians or other craftsmen, shall be furnished by the Contractor, including contractor supervision, tools and equipment, for testing circuits and equipment, and for making modifications or repairs to Government equipment as directed, where such modifications are clearly not required as the result of improper installation procedures by the Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 General

New unused materials and equipment shall be supplied and installed. Any defective material or equipment damaged in the course of installation shall be replaced or repaired upon written approval of the contracting officer. Articles, materials, and equipment shall be manufacturer's standard, free from defects and imperfections, of recent manufacture, and shall have electrical and mechanical properties suitable for the intended use. Particular care shall be taken to provide materials and equipment with factors of safety that meet or exceed those in standards referenced below for the particular material or equipment. Insofar as practicable, devices and equipment used for the same or similar services shall be of the same make and type, and shall be interchangeable when of the same rating.

2.1.2 Standard Products

Material and equipment shall be the standard products of the manufacturers regularly engaged in the manufacture of these products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 PREVENTION OF CORROSION

All metallic materials shall be protected against corrosion. Exposed metallic parts of outdoor equipment or devices shall be given a rust inhibiting treatment and standard finish by the manufacturer. Aluminum shall not be used in contact with the earth, and where it is in contact with concrete or connected to dissimilar metal, it shall be protected by approved coating, fittings and treatment. All parts such as boxes, bodies, fittings, guards, and miscellaneous parts made of ferrous metals but not of corrosion resistant steel, shall be zinc coated in accordance with ASTM A 123 or A 153, except where other equivalent protective treatment is specifically approved in writing. Painting and corrosion protection of control panel, breakers and switchgear cubicles will be in accordance with Sections 16340 and 16440.

2.2.1 Fastenings And Fittings

Screws, bolts, nuts, pins, studs, springs, washers and other miscellaneous fastening and fittings shall be of corrosion-resistant material or shall be treated in an approved manner to render them resistant to corrosion. All fastenings, which are to be exposed directly to the weather, shall be of corrosion-resisting material.

2.2.2 Corrosion-Resisting Materials

Corrosion-resisting steel, copper, brass, bronze, copper-nickel-copper alloys are acceptable corrosion-resisting materials.

2.2.3 Corrosion-Resisting Treatments

Treatment shall be in accordance with ASTM A123 or ASTM A153.

2.3 CONDUIT AND CABLE TRAY

2.3.1 Rigid Steel Conduit

ANSI C80.1, zinc coated (galvanized) both inside and outside by the hot-dip method. Rigid steel conduit shall be minimum ¾ inch trade size.

2.3.2 Flexible Steel Conduit

Flexible conduit shall conform to UL360, shall have a hot-dip galvanized steel core, copper ground wire and a waterproof extruded cover.

PVC jackets will not be permitted.

2.3.3 Cable Tray

New cable tray system components (B-Line or approved equal) shall be constructed of steel and shall be hot-dip galvanized after fabrication. The cable trays shall meet or exceed Class 20B load capacity as specified in NEMA VE 1. Trays shall comply with NEC Section 392-7(B) for use as an equipment-grounding conductor. New cable tray for control cables shall be 18” wide. Rung spacing shall be 9”.

Cable support for armored cable may be narrow channel similar to existing armored cable supports.

2.4 FITTINGS AND BOXES

2.4.1 Fittings and boxes for rigid conduit shall conform to UL360, NEMA FB 1, 250, 514A and 514B as applicable. Fittings shall have a hot-dip galvanized steel core, copper ground wire and a waterproof extruded cover. Fittings for rigid and flexible conduit shall be threaded. PVC covers are not permitted.

2.4.2 Pull boxes, complete with covers, shall be provided in conduit runs in accordance with the standards set forth in these specifications. When a pull-box or special fitting is required to make a short radius bend to reach another box, such pull-box or fitting shall be furnished as part of the conduit. Sizing of boxes shall be at a minimum per the NEC.

2.4.3 Cast boxes shall be hot-dip galvanized after fabrication. All cast boxes shall be supplied with integral cast hubs or with factory-brazed hubs. All hubs shall be factory threaded.

2.4.4 Junction and pull boxes shall be furnished with covers of the same gage metal as the box. Hubs shall be provided where required by the type of enclosure. T & B "Bullet Hub" or Myers "Scru-tite" fittings are acceptable. Concentric ring knockouts will not be permitted for conduit entrances. All pull boxes installed indoors shall be NEMA 1. Pull boxes installed outdoors shall be NEMA 3R minimum.

2.5 STEEL CABINETS AND BOXES

Steel cabinets, junction, splice and pull boxes, and other steel and enclosures and their doors and trim shall conform to Underwriter's Laboratories, Inc., Standard UL 50 for Cabinets and Boxes except as noted below. Sheet steel used in cabinets, special boxes or enclosures, shall be not lighter than No. 14 U.S. Standard gage and cover fastening screws shall be placed not more than twelve inches apart along the perimeter of a box. All special steel boxes, cabinets, doors, and covers shall be made of galvanized sheet steel or shall be hot-dip galvanized after fabrication. Junction and pull boxes shall be furnished with covers of the same gage metal as the box.

2.6 CONNECTIONS

ASME B1.1. Threads for sizes 1/4 inch to 1 inch, inclusive, shall be NC or UNC series. Sizes and threads shall be in accordance with ASME B1.20.1. Manufacturer's standard threads and construction may be used on small items, which, in the opinion of the contracting Officer, are integrally replaceable except that threads for external connections to these items shall meet the requirements outlined above.

2.7 INSULATED WIRE AND CABLE

This section covers the requirements for wire routed between equipment, such as from transformer to switchgear or from switchgear to control or annunciator panel. This wire is not approved for use between components internal to equipment where all wiring is internal to equipment.

2.7.1 Power and Control Systems

a. All wire and cable used for power, control, metering, and relaying systems shall be provided by the Contractor and shall conform to the requirements specified herein. Characteristics, including conductor size, stranding, number of conductors, rated circuit voltage, cabling, and other requirements for each type of service, shall be as indicated on the drawings, or as specified under the detailed requirements of these specifications for the particular construction or use, unless otherwise stated.

b. Wire and cable shall be furnished in accordance with the requirements of the Conduit and Cable Schedules, and as indicated on the drawings. Estimated quantities listed in the Conduit and Cable Schedules are approximate for bidding purposes.

c. The rated circuit voltage of the insulation shall be 600 volts for all circuits operating below 600 volts, with 100 percent insulation

level. Wire and cable for circuits operating at 2000 volts and below shall have minimum rated circuit voltages in accordance with Section 3 of NEMA WC 70.

d. The rated circuit voltage of the insulation shall be 5,000 volts for all circuits operating above 2,000 volts, with 133 percent insulation level.

2.7.2 Governing Standards

2.7.2.1 Materials, construction and tests, unless otherwise specified, shall conform to the applicable requirements of NEMA WC 57, NEMA WC 70 and NEMA WC 74.

2.7.3 Conductors
Conductors shall conform to all the applicable requirements of Section 2 of NEMA WC 70 or Section 2 of NEMA WC 74 as applicable. Conductors shall be annealed copper, either coated or uncoated, or tin- or lead-alloy-coated, if required by the type of insulation used.

2.7.4 Size

Minimum wire size shall be No. 10 AWG for current transformer secondary circuits and No. 12 AWG for power and breaker control circuits. Provide minimum No. 14 AWG for potential transformer, relaying, and control circuits; and No. 16 AWG for twisted shielded instrument cable. Cable shall be as indicated in the conduit and cable schedules.

2.7.5 Stranding

Conductor stranding classes cited herein shall be as defined in Appendix G of NEMA WC 70 and Appendix H of NEMA WC 74, as applicable. Any conductors used between stationary and moving devices, such as hinged doors or panels, shall be Class H or K stranding. All other conductors shall have class B or C stranding, except that conductors shown on the drawings, or in the schedule, as No. 12 AWG may be 19 strands of No. 25 AWG, and conductors shown, as No. 10 AWG may be 19 strands of No. 22 AWG.

2.7.6 Conductor Shielding

Shielding shall be provided for all cables rated above 2,000 volts and shall comply with Sections 5 and 6 of NEMA WC 74.

2.7.7 Insulation

Insulation shall be cross-linked-thermosetting-polyethylene (XLPE) type, or an ethylene-propylene-rubber (EPR) type meeting the requirements of Section 3 of NEMA WC 70, or Section 4 of NEMA WC 74, as applicable. Polyvinyl chloride (PVC) insulation will not be accepted.

2.7.8 Insulation Thickness

The insulation thickness for each conductor shall be based on its rated circuit voltage.

a. The insulation thickness for single-conductor cables and single conductors of multiple-conductor control cables used for control and related purposes rated below 2,000 volts shall be as required by Section 3 of NEMA WC 70.

b. The insulation thickness for single-conductor cables rated above 2,000 volts shall be as required by Section 4 of NEMA WC 74. Medium voltage cables shall have 133% insulation levels.

2.7.9 Insulation Shielding

Insulation shielding shall be provided in accordance with the recommended practice given in Section 4, Table 4-3 of NEMA WC 74. The method of accomplishment shall be in accordance with the current practice of the industry.

2.7.10 Jackets

All cables shall have jackets meeting the requirements of Section 4.1 of NEMA WC 70, or Section 7.1 of NEMA WC 74, as applicable, and as specified herein. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including the jacket, afterward fully meets these specifications and the requirements of the applicable standards.

a. Jacket Material. The jacket shall be one of the materials listed below, in accordance with the applicable paragraphs of NEMA WC 70 and NEMA WC 74. Polyvinyl chloride compounds will not be permitted. Variations from the materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

(1) Neoprene, heavy-duty black.
(2) Chlorosulfonated polyethylene, heavy-duty.
(3) Chlorinated polyethylene, cross-linked, heavy-duty.

Polyvinyl chloride (PVC) jackets will not be accepted.

b. Jacket Thickness. The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thickness specified below:

(1) Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by Section 4.1 of NEMA WC 70, and shall be in addition to the conductor insulation thickness required by Section 3 of NEMA WC 70 for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by Section 4.1 of NEMA WC 70.

(2) Single conductor cables, if non-shielded, shall have a jacket thickness as specified in Section 4.1 of NEMA WC 70. If shielded, the jacket thickness shall be in accordance with the requirements of Section 4.1 of NEMA WC 70, or Section 7.1 of NEMA WC 74, as applicable.

2.7.11 Medium Voltage Cable

Medium voltage cables shall be Metal-Clad cable in accordance with the requirements of NEC Article 334. Cable shall have a continuous interlocked metal armor.

2.7.12 Color Coding

Individual conductors of multiple-conductor cables shall be color coded except that colored braids will not be permitted. Only one color-code method shall be used for each cable construction type. Control cable color-coding shall be in accordance with Appendix E of NEMA WC 57.

Branch circuit wires shall be black for Phase A, red for Phase B, blue for Phase C and white for 120/208 volt grounded neutral. Other individual conductors size 8 and above shall be color-coded but such color-coding may be accomplished by applying colored plastic tapes at terminations. Color-codes other than that indicated on the drawings is acceptable with prior approval except for those using green or white as one of the required conductors. Green conductors will not be used except as a grounding conductor. Green conductors will not be counted as required spare conductors.

2.7.13 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame and moisture-resistant fillers, binders, and a lay conforming to Part 5 of NEMA WC 57, or Section 5 of NEMA WC 70, as applicable, except that flat twin cables will not be permitted. Fillers shall be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers shall be of a non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the cable and shall be lapped at least 10 percent of its width.

PVC is not permitted.

2.7.14 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

2.7.15 Factory Tests

Inspection and tests of each type of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer. Testing in general shall comply with Part 6 of NEMA WC 57, Section 6 of NEMA WC 70, or Section 9 of NEMA WC 74, as applicable. Specific tests required for particular materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Manufacturer shall have test data showing that each type of cable provided have been tested per the additional requirement specified below:

Flame Tests. All types of multiple-conductor and single-conductor cable assemblies provided shall have been tested and shall have passed the IEEE Standard 383 flame tests, paragraph 2.5, using the ribbon gas burner. Single-conductor cables and individual conductors of multiple-conductor cables shall pass the flame tests of Part 3 of NEMA WC 57, Section 6 of NEMA WC 70, or Section 7.1 of NEMA WC 74, as applicable.

2.7.16 Packaging and Marking

Contractor to verify all cable length estimates provided in the cable schedule. Wire and cable shall be furnished at the work site one length to a package or reel. Each length and the outside of each package and reel shall be plainly marked or tagged to indicate the length, voltage rating and size, and manufacturer's lot number and reel number. Reels shall remain the property of the Contractor.

2.7.17 Wire Table

The table included below is included to provide guidance on acceptable types of wire and cable.

NEC/TRADE TYPE	Conductors	Maximum Operating Temperature	Application	Insulation Type	Conductor Insulation Thickness
SIS	Single Conductor	90º C	Switchboard and control panel wiring only	Thermoset 600 volt	0.76 mm
RHH	Single conductor or multiple conductor cable	90º C	Conduit (single conductor) or cable tray (multiple conductor cable) Multiple conductor cables must be tray cable rated for cable tray installation	Conductor - Thermoset 600 volt Cable insulation – non-PVC 600 volt	1.14 mm
RHW	Single conductor or multiple conductor cable	75º C	Conduit (single conductor) or cable tray (multiple conductor cable) Multiple conductor cables must be tray cable rated for cable tray installation	Conductor- Thermoset 600 volt Cable insulation – non-PVC 600 volt	1.14 mm
XHHW	Single conductor or multiple conductor cable	90º C	Conduit (single conductor) or cable tray (multiple conductor cable) Multiple conductor cables must be tray cable rated for cable tray installation	Conductor – Thermoset 600 volt Cable insulation – non-PVC 600 volt	1.14 mm for single conductor 0.76 mm for multiple conductor cable conductors
TC	Multiple Conductor Cable (general) Individual conductors shall be RHH, RHW, or XHHW	75º C	Tray cable rated for cable tray installation	Cable insulation - non-PVC 600 volt	

2.8 SPECIAL WIRE AND CABLE

2.8.1 Control Cabinet Shop Wiring

Wiring for factory assembled panels and in existing control cabinets or assemblies of electrical components for miscellaneous equipment shall be 600 volt, copper, No. 14 to 10 AWG, Type SIS. Stranding shall be Class

B or Class C except hinge wire shall be Class D or Class K. Conductor size shall be No. 14 AWG minimum for annunciation signals, 10 AWG for CT, breaker trip or breaker close circuits. The completed installation shall conform to all requirements of the National Electrical Code.

2.8.2 Switchboard Wire

Switchboard wire shall be 600 volt, copper, No. 12 AWG minimum, 10 AWG for CT, breaker trip or breaker close circuits, type SIS. Stranding shall be Class B or Class C except hinge wire shall be Class D or Class K.

2.8.3 Ground Conductors

Ground conductors shall be bare unless routed along with the phase conductors in a multi conductor cable. The ground conductors shall be soft, or medium hard drawn Class A or Class B stranded copper cables.

2.9 TERMINATIONS

2.9.1 Terminations for Wire 6 AWG and Smaller

All wire 6 AWG and smaller shall be terminated with indented ring-tongue terminals, Burndy Type YAV or YAE, T & B Sta-Kon, or approved equal.

2.9.2 Power Cable Terminations

a. All wire 4 AWG and larger but smaller than 1/0 shall be terminated with one hole compression lugs, Burndy Type YA-L, or approved equal. Cable 1/0 and larger and all cables rated over 1000 volts shall be terminated with 2 hole or 4 hole, long barrel lugs that are UL approved for the voltage, Burndy YA-2N, YA-4N, or approved equal.

b. Medium voltage cables shall be terminated with Heat shrink, Cold shrink or tape type stress cone terminating, Raychem, 3M, or equivalent.

2.10 NON-SEGREGATED BUS DUCT

The existing bus duct, from transformers T01 and T02 to the switchgear, consists of three-phase metal-enclosed copper bus structures rated 5 kV, 1,200 amp non-segregated-phase type with all phase conductors contained in a common metal enclosure. Provide a transition cabinet to connect the existing bus duct to new bus duct with the same ratings as the existing. Route new bus duct to new switchgear. The copper bus bars for the connections between the existing bus duct and the new switchgear shall comply with ASTM B187. New sections of bus duct are required to connect the new switchgear with the existing bus duct. Non-segregated bus duct sections or modifications for connecting existing bus duct to the new switchgear shall conform to IEEE C37.23. Non-segregated bus duct sections shall have the same electrical characteristics as the existing 5 kV non-segregated bus duct except any new sections and the connections between existing bus and new bus shall be rated at 1,200 amp with a short time short circuit rating of 39 kA. The three-phase bus shall be fabricated in sections to suit the spacing and arrangement shown on the drawings. Frames, gaskets, covers, and seal-off bushings and all structural supports required for mounting the transition section shall be supplied by the Contractor. All splices for field assembly shall be bolted. Where bolted connections are used, they shall be equipped with provisions for adequate clamping and contact surfaces shall be tin- or silver-plated. The torque recommended for all bolted connections shall be included in the installation instructions. Any contact surfaces between aluminum and copper shall be tin- or silver-plated. Each phase conductor shall be completely enclosed with epoxy resin insulation. Insulation of equivalent mechanical and electrical strength as that

enclosing the bus shall be provided at bus joints and as required in the transition section. The bus shall be mounted on insulating supports. Removable metal plates or bolted hinged doors shall be provided for access to the bus compartment. Substitution of cable and conduit in place of bus duct is not acceptable.

Bar type current transformers, for transformer metering, are to be installed in the bus duct. Current transformers to comply with IEEE C57.13. See Section 16340 paragraph 2.9 for current transformer requirements. These current transformers will be submitted with the current transformers for the switchgear.

2.11 TERMINAL BLOCKS

Terminal blocks, where required, shall be molded type with barriers, rated not less than 30 amp, 600 volts, similar to General Electric Company Type EB-25 or Marathon Electric Manufacturing Corps, Series 1600, or approved equal. The terminals shall be removable binding, locknuts, and not less than size No. 10, having length and space for connecting at least two indented ring terminals of No. 10 conductors to one terminal. White or other light-colored plastic marking strips, fastened by screws to the molded sections as each block, shall be provided for circuit designation. Each connection terminal of each block shall have the circuit designation or wire number neatly printed on the marking strip with durable marking fluid. One spare marking strip shall be furnished with each block.

All terminal blocks for current transformer shall be of the current shorting type. A minimum of 10% spare terminal blocks will be provided in new equipment.

2.12 IDENTIFICATION

2.12.1 Terminal Block Markings

Terminal block wire designations shall be made with white or other light-colored plastic marking strips, fastened by screws. For each connected terminal, the manufacturer's wire number and Government's wire number shall both be shown on the marking strips with permanent marking fluid. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block, to accommodate the two sets of wire numbers.

2.12.2 Multiple-Conductor Cable Identification

All multiple-conductor cables shall be clearly identified with the cable designation by either embossed one-inch diameter brass tags, similar to Floy Tag Mfg., Co. No. FT-205, or by embossed aluminum band markers similar to Floy Tag Mfg., Co. No. FT-207.

2.12.3 Control Wires And Conductor Identification

Control wires and individual conductors of control cables shall be identified with non-metallic tube-type markers at each termination. Tube-type markers shall be Kroy or approved equal. Tubing shall be sized to fit the wire being marked and shall have black marking on a light colored background. If the markers proposed are other than specified above, a written certificate from an approved independent testing laboratory shall be furnished to indicate that the markers will not stain or discolor after 20 years' service when subjected to an accelerated aging test while in contact with wire insulating materials.

2.12.4 Nameplates and Markings

Whether specifically stated or not, each item of equipment, mounted on or in the equipment, which does not have a suitable designation included

as an integral part of the device shall be provided with an engraved nameplate. Nameplates shall be made of laminated sheet plastic or of anodized aluminum, approximately 1/8 inch thick, engraved to provide white letters on a black background. Each operating unit door or panel shall be provided with an identifying nameplates a minimum of 1 inch by 3 inch in size to match existing nameplates. If the legends will not fit on a 1-inch by 3-inch nameplate the nameplate shall be increased in size as required so that the lettering will fit. All nameplates shall be the same size. Lettering size and style shall match existing switchgear nameplates but in no case shall the lettering be less than ¼" high. Nameplate designations shall be in accordance with the drawings and shall be submitted for the approval of the Contracting Officer.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 General

3.1.1.1 The work under this contract is at the existing project site located near Lewiston, Idaho. The work under this contract is subject to the safety clearances and operating procedures currently practiced by the Dworshak Dam Project Office. All the construction activities shall be coordinated with the Contracting Officer's Representative so that the construction will not adversely affect the daily operation of the powerhouse. Safety clearances shall be obtained before opening, entering or working on any existing equipment such as power centers, switchboards, and alarm cabinets. Contractor shall provide to the Government, written request for all outages 14 calendar days in advance of each outage. Operations will review the request and notify the contractor 7 calendar days in advance if the requested outage is possible. If the requested dates are not possible operations will notify the contractor when an outage will be allowed. Operational personnel will do all switching. Unless otherwise specified, execution of all installation work shall be in accordance with the National Electrical Code, NFPA 70, the National Electrical Safety Code, ANSI C2, IEEE Standards C37 and with the U.S. Army Corps of Engineers Safety and Health Manual, EM 385-1-1. If a deviation from the above standards is specifically shown or specified, the drawings and specifications shall govern. Omission of details on the drawings or in the specifications shall not be construed as permitting deviations from the Code requirements.

3.1.1.2 De-energization of the individual 4,160 V bus sections and transformers will be allowed for a limited length of time. The Contractor will not be allowed to de-energize both Station Service transformers and /or both buses at the same time except for when the buses are separated. Contractor will be required to shut down one transformer at a time and isolate the bus duct from the switchgear sections to be removed. One bus will be removed and the new switchgear for that bus will be installed and the bus duct reconnected to at least one transformer, the equipment tested and proved to be satisfactorily operating 9 days before contractor may start on the second bus. The only exception to this is when there are interlocks between the breakers where the interlocks cannot be tested until the work on the other breakers has been completed. The Contractor shall verify existing controls are prior to starting work.

3.1.1.3 The 125 V DC control power and alarm power is daisy chained throughout the switchgear. The 120 VAC power for the switchgear heaters is daisy chained throughout the switchgear. The DC control power breakers at each cell control only the breaker power – not alarm, heater or other miscellaneous power. The terminal blocks where the power is

jumpered between cubicles is not accessible. The Contractor shall test for voltage in each cell before beginning work. The Contractor shall isolate all power to cubicles and tape off or otherwise isolate conductors terminated in the cubicles before removing the cubicles. Contractor shall install temporary cables from the 125 VDC panel to the switchgear, as required, to provide control power to the operating Bus so that operating breakers have control power at all times. Control voltage will not be removed from the operating breakers.

3.1.1.4 Materials and equipment shall be suitable protected from dampness, dust, and physical damage.

3.1.1.5 All working areas shall be kept clean and orderly at all times. Tools and construction equipment shall be put away at the end of each workday. All discarded packing materials; wire ends and conduit pieces shall be placed in proper receptacles. Dust and other debris must be prevented from entering electrical cabinets when drilling holes in existing concrete. If the creation of dust cannot be avoided the work area shall be vacuum-cleaned immediately after the activity. Control wiring to be removed will be removed from terminal to terminal. No control cables shall be abandoned in place in the cable tray.

3.1.2 Coordination With Existing Work

Electrical equipment and accessories shall be installed so interference with existing piping, ducts, cable trays, conduit, and architectural and structural features will be avoided. If interference's develop, the Contracting Officer will decide which work shall be relocated. Do not cut or weaken structural portions of the powerhouse in installing equipment and accessories unless specifically approved in writing.

3.1.3 Contract Drawings

3.1.3.1 General Requirements

The contract drawings indicate the work to be accomplished in as much detail as is practical. Except for such modifications as may be required for coordination with equipment actually furnished, they constitute the working drawings for construction, installation, and for purchase of required materials.

3.1.3.2 Existing Wiring Drawings

The reference drawings indicating the current 'As Built' conditions of the equipment are per available drawings. Attached to this specification is a listing of control cables with wire numbers and termination points. Contractor to verify existing termination points in transformer and alarm panels. Contractor is responsible for verifying existing wiring prior to demolition. No functionality of the existing equipment shall be deleted.

3.1.3.3 Departure from Drawings

If departures from the working drawings are deemed necessary by the Contractor, details of proposed changes and reasons for the change shall be submitted for approval as soon as practicable before scheduled installation date. No such departures shall be made without prior approval.

3.1.3.4 As-Constructed Drawings

The Contractor shall maintain as-constructed drawings in accordance with SECTION 01307.

3.2 EQUIPMENT PADS, ANCHORING OF EQUIPMENT AND WALL

3.2.1 The existing switchgear is fastened to a grout pad that is 5″ thick. There is 3″ of grout below normal floor level and a 2″ raised platform above the normal floor elevation. If the footprint of the new switchgear, including wall, is the same size as the existing switchgear the new switchgear may be mounted on the existing grout pad. If the footprint of the new switchgear is not the same size as the existing switchgear the grout pad must be removed down to the normal floor level and the floor repaired. See Section 16340 Paragraph 2.3.4 for information on new sill foundation requirements. If the pad is to be removed contractor shall submit a plan for removal of pad. The plan shall outline the method to be used to remove the pad. Contractor shall minimize the dust generated and install protective barriers to isolate the area to prevent other equipment from being contaminated by the dust. Work will be in proximity of 4160 V AC, 125 VDC and 120 VAC energized electrical equipment. The removal plan shall include safety training for workers. The Contractor will be required to contain all water and slurry generated during concrete removal within 4 foot of the sides of the demolition area. Adjacent to the 4160 V switchgear contractor will prevent all water and slurry from contacting the energized switchgear. Concrete shall be removed in a manner that will not fracture the surrounding concrete. Care shall be taken not to damage the surrounding floor surface or reinforcing bar in the existing concrete floor. Pad removal shall result in flush, level surface at grade of the surrounding floor. Any conduits shall be plugged to prevent slurry discharge into other equipment. Saw cutting, wire cutting or any combination thereof are the recommended methods for the concrete removal to be done as part of this contract. Contractor shall dispose of any concrete removed. Plan shall include design to be used to repair damage to floor caused by removal of pad. See ACI 503.2 and ACI 503.4 for acceptable materials for repair of concrete after pad has been removed. Plan for removal of pad and repair of floor shall be submitted for government approval.

3.2.2 Each cabinet shall be anchored to the concrete foundations with a minimum of six - ½″ diameter cadmium plated grouted steel anchor bolts or as recommended by cubicle manufacturer if manufacturer’s requirements are more stringent. Grout shall be a vinylester, polyester, or epoxy resin material. The anchor bolts shall be at least 5″ longer than the minimum recommended by the anchor bolt manufacturer if the existing pad is used. The anchor bolts shall be at least 3″ longer than the minimum recommended by the anchor bolt manufacturer if the existing pad is removed to the normal floor elevation. The anchor bolts shall be accurately set. Anchors, shims, brackets, and other miscellaneous material shall be furnished that are required to place the equipment in position and hold it in proper alignment. If shims are visible they shall be full shims (not washers) providing a good workmanlike appearance. Provide mounting seals, if necessary, limit dust and dirt contamination at base to maintain the NEMA 1 Enclosure rating of the equipment. Where required to place anchors or anchor bolts for the installations, holes shall be drilled in the existing concrete and steel anchor bolts of suitable capacity shall be used per manufacturer’s recommendations.

3.2.3 Provide a reinforced concrete wall equal to the height and depth of the breaker cubicles located between SP Bus #1 and SP Bus #2. Reinforced concrete wall shall be 6″ thick minimum and shall be designed according to the requirements of ACI 318 / 318R. Concrete floor in contact with the new wall shall be roughened and cleaned of all laitance and prepared with bonding agent. Reinforcing dowels shall be drilled and grouted. Reinforcing dowels shall be 5″ longer than recommended if pad is not removed and 3″ longer than recommended if pad is removed down to normal floor level. Design shall be performed by a registered structural

engineer and shall be submitted for government approval.

3.3 CONDUIT SYSTEM

3.3.1 Material

Provide rigid steel conduit as required. Short exposed runs of flexible conduit up to 18 inches long may be used. Lengths greater than 18 inches but not to exceed 36 inches may be used when so approved.

3.3.2 Installation

The conduit system shall include all rigid and flexible steel conduit, all cast or sheet metal boxes of 170 cubic inches or less and all-necessary fittings. Prevent the entrance of grout, concrete, dirt, plaster or trash in conduit, fittings, and boxes during installation. Conduit, which has been crushed or deformed in any way, shall not be installed. Bends and offsets in rigid conduit shall be avoided where possible, but where necessary shall be made with an approved hickey or conduit bending machine for 3/4 and 1-inch conduit. Bends in conduit 1-1/4 inch or larger shall be made with a bending machine only. The use of a pipe tee or vise for bending conduit will not be permitted. Maintain electrical continuity of the conduit system to provide a safe ground path for fault currents. Conduit joints shall be made up wrench tight but with a minimum of wrench cuts. Galvanized conduit surfaces damaged during installation or by adjacent welding shall be repaired by cleaning and galvanizing in accordance with ASTM A 123 or by applying two coats of an approved zinc rich paint.

3.3.3 Exposed Conduit

Exposed conduit shall be installed with a minimum of bending and cutting. Conduits not dimensioned as to location shall be installed approximately where shown on the drawings with limited adjustment to avoid interference with other work. Structural steel shall not be cut, drilled, or bent to avoid interference except when approved in writing. Exposed conduit shall be installed to conform to the shape of the surface over which it is run. Conduit shall be straight and true with runs horizontal, vertical or parallel to structural lines. Diagonal runs shall be avoided insofar as possible. Where run in groups of two or more, conduits shall be secured by means of a common support with the individual conduits at least 1/2 inch clear of the surface and attached to the support by means of pipe clamps or approved equal. Individual conduits shall be mounted with clamps and clamp backs clear of the surface over which they are run, except that for runs not over 10 feet, they may be mounted directly on the surface. The maximum spacing of supports for conduit, unless otherwise indicated on the drawings, shall not be greater than 7 feet for 3/4-inch conduit and 10 feet for one inch and larger conduit. Supports shall be used at entrance or exit from all conduits, boxes, cabinets, and changes of direction of conduit. Threaded items of supporting hardware for conduit shall be electro-galvanized, cadmium-plated or hot-dip galvanized. All other supporting hardware shall be hot-dip galvanized after fabrication. Supports on concrete surfaces shall be fastened securely to the concrete with concrete anchors. Wooden, fibrous, or similar plugs inserted into the concrete will not be accepted. Powder driven guns shall not be used for embedded anchors. Conduits or similar fittings shall be used wherever necessary to make a neat appearance. Where it is necessary to use flexible conduit because suitable connections cannot be made with rigid conduit or where flexible conduit is shown on the drawings, "Sealtite" ground bushings, or approved equal, shall be provided to insure positive ground continuity as required by NEC 350.60. Conduit terminating with a

flush coupling under equipment, shall be extended far enough beyond the grout surface to permit capping with a metal disc and bushing.

3.3.4 Cutting and Threading

All cuts shall be made with a hacksaw or an approved cutter-type tool. Roller-type pipe cutters shall not be used on conduits. All cuts shall be square and the conduit opening shall not be constricted. After cutting and threading, conduit ends shall be reamed to remove burrs, and the conduit shall be thoroughly cleaned to remove all cuttings, dirt and oil from its interior. Threads shall be clean-cut. No running threads will be permitted.

3.3.5 Thread Compound

Conduit joints and connections shall be made watertight, rust-proof and electrically conductive by the application of a thread compound composed of colloidal copper and rust inhibitors. The thread compound shall be equal to Thomas and Betts Co. "Kopr-Shield". Each threaded joint shall be thoroughly cleaned to remove all cutting oil before the compound is applied.

3.3.6 Bends

Wherever possible, bends in conduit runs shall have a radius (measured to the conduit inner edge) of not less than ten diameters nominal size. Shorter radius bends shall be in accordance with NEC Table 344-24. Exceptions may be used at the surface of a wall or floor slab if the space available is insufficient to permit a larger radius. Minimum bend radius for conduits containing 5 kV cables shall be 36 inches unless contractor provides calculations showing maximum side wall pressure during installation will be less than the cable manufacturer’s maximum allowable side wall pressure. All bends shall be free from cracks and indentations. Where two or more exposed conduit are run in a parallel configuration, all bends shall have a radius as determined by the largest conduit and shall be concentric, presenting a neat and uniform appearance. All conduit runs shall be made with the minimum total degrees of curvature compatible with the requirements of the drawings and these specifications and the NEC. Contractor shall install pull boxes as required to comply with the NEC and to limit pull tensions to acceptable levels.

3.3.7 Drains

All conduits shall be installed to avoid moisture traps. When it is not possible to avoid such moisture traps, drains shall be installed at low points of conduit runs. Drains shall terminate so as to prevent water backup into the conduit system. Seal conduit where it passes through firewalls. Seal conduit where it passes from inside to outside to prevent air circulation and condensation inside conduit.

3.3.8 Expansion Joints and Erickson Couplings

Expansion fittings shall be provided where conduits cross expansion or contraction joints. Where water stops are provided, conduit runs shall be placed on the dry side of the water stops. Exposed expansion fittings shall be O. Z. GEDNEY Co. Type EX, AX, PBW, or approved equal. Erickson-type couplings will be permitted only where indicated or where specifically approved.

3.3.9 Coordination

The conduit shall be installed in the most direct manner. Interference with piping, ducts, cable trays, conduit, mechanical, electrical, and

structural features shall be avoided. Conduit shall not obstruct any access hatches or openings. In case interference does develop, the Contracting Officer will decide which work shall be relocated. Previously installed work shall be examined prior to developing layout and installation plans for conduit and accessories to determine that installation can be made without interference with other work.

3.3.10 Termination of Conduit

All conduits shall be corked, plugged, capped or otherwise protected during construction to prevent material from entering the conduit.

3.3.11 Termination at Sheet Metal Boxes or Enclosures

Unless conduit hubs are provided, each conduit shall be securely fastened to sheet metal boxes and enclosures with Myers "Scru-tite" connector. All bushings shall be of the insulated type grounded or ungrounded as indicated or required. The locknuts shall be tightened against the enclosure without deforming the sheet metal. Conduits terminated in sheet metal boxes with hubs shall be corked or plugged.

3.3.12 Termination at Cast Boxes

Conduits terminating in cast boxes shall be made up in approved threaded hubs unless otherwise indicated. Cast boxes and enclosures with threaded hubs shall be provided with proper size hubs to fit conduit being installed. Threaded reducers will not be permitted.

3.3.13 Grounding of Conduit System

Unless as otherwise indicated, the entire metallic conduit system shall be grounded. Except as otherwise indicated on the drawings each conduit run, including connections through boxes with locknuts or threaded hubs, shall be electrically continuous and bonding jumpers shall be used across expansion fittings. Grounding bushings connected to the ground system with No. 6 AWG minimum wire shall ground each conduit at the source end of the run. Grounding type bushings shall be used at all source ends of conduits requiring bushings. Ground cable taps and inserts are located for ground system connections, generally at the power or control source end of the run.

3.3.14 Conduit Identification

Lighting branch circuit conduits containing wire will not require identification. All other conduits shall be durably and legibly identified with approved non-ferrous metal tags or by other approved means. Identification shall be permanently attached at each conduit termination and at each sheet metal pull or junction box. Conduits for future use, terminated with couplings shall have their identifications die stamped on the brass pipe plugs. Conduit designations shall be as indicated on the drawings.

3.3.15 Cable Tray Installation

Cable tray shall be supported at 10 ft. intervals. Cantilever bracket type supports shall provide sufficient strength to withstand the design moment loading indicated on the drawings and shall have provisions for hold-down clamps or fasteners. Connectors and splice plates shall be of the rigid type with rivet or bolt and lock washer fasteners and shall provide electrical continuity between adjacent tray sections except where hinged fittings or expansion fittings are required. Provide expansion fittings per manufacturer’s recommendation. Provide bonding jumper with the same rating as tray around hinged or expansion type fittings so that the completed installation shall comply with the

provisions of the NEC for using the cable tray as an equipment grounding conductor. Use grounding type fitting to bond conduit to cable tray. Ground cable tray to ground grid or structural I beam every 100 ft maximum. All hold-down bolts, fasteners and other hardware shall have an approved corrosion resistant finish. Rigid conduit shall be used to route all non-armored cables from cable trays to switchgear, XPC Panel and all other devices. The conduit shall be attached to the cable tray with UL Listed grounding connectors so that the completed system provides a continuous ground path.

Existing cable trays shall be cleaned of all dirt and trash generated by removal of cables for this project and any trash that would damage or interfere with the installation of the new cables before pulling new cable.

3.4 INSTALLATION OF CABINETS AND BOXES

All boxes and cabinets shall be straight and true with horizontal or vertical structural lines. The final installation shall not be out of plumb more than 1/4-inch over the full length nor be deformed more than 1/16-inch per linear foot nor more than a total of 1/4-inch in any surface. Exposed cabinets on concrete surfaces shall be fastened with anchors near each corner. All boxes and cabinets shall be cleaned of concrete and grout after the installation, and boxes with gasketed covers shall be closed immediately. The gaskets shall be treated with graphite or other approved paste at the time the cover is fastened to the box.

Exposed boxes shall be provided with mounting feet to attach the boxes rigidly to their mounting surface. Boxes not over 100 cubic inches, connected to the conduit system by threaded hubs are considered so fastened. Blank covers shall be installed on sheet metal boxes and gasketed covers shall be installed on exposed cast outlet boxes where devices are not indicated.

Hubs shall be installed where required by the type of enclosure. T & B "Bullet Hub" or Myers "Scru-tite" fittings are acceptable. Concentric ring knockouts will not be permitted for conduit entrances.

Galvanizing damaged during fabrication or field installation or drilling shall be repaired as follows: Clean and galvanize in accordance with ASTM A 123 or other applicable specification. Touch up cut edges and damaged areas of galvanizing in the field with two coats of an approved zinc-rich paint, except when the zinc coating is 2 ounces or heavier the damaged area shall be regalvanized with suitable low-melting zinc base alloy similar to the recommendations of the American Hot-Dip Galvanizers Association to the thickness and quality specified for the original zinc coating. Control cabinets shall be manufactured in accordance with UL standards for Control Cabinets by a UL approved fabrication shop or Labeled by a third party testing laboratory as defined by the NEC Article 100 and required in Article 110-2.

3.5 PAINTING

Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then, if not stainless steel, shall receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Interior surfaces shall receive not less than one coat of paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats of quick air-drying lacquer or synthetic enamel with semi-gloss finish, ANSI Indoor Light Gray No. 61 in color or for existing equipment as required to match existing equipment. Spare paint shall be furnished

to repair any damage in the exterior finish after the equipment installation has been completed.

3.6 WIRE AND CABLE INSTALLATION

3.6.1 General

All wire and cable shall be provided in accordance with these specifications, the National Electrical Code requirements and with the details and notes as shown on the drawings and cable schedules. The Government will finalize conduit and cable schedules after approval of all shop drawings for equipment requiring electrical connections (including equipment to be furnished under this contract). Because these schedules cannot be completed until after shop drawing approval, the schedules included are made available to the Contractor for initial use in ordering wire and cable. The conduit and cable schedules included contain information on conduit and cable numbers, sizes and estimated lengths, number and insulation ratings of conductors, the function and operating voltage of circuits and the terminations of conduits and cables. The Contractor shall be responsible for determining the actual conduit and cable lengths required to make an installation without splices. All necessary materials, tools and equipment required for proper handling and installation of wire and cable in conduits, cable trays, and elsewhere as indicated in the conduit and cable schedules and shown on the drawings shall be furnished. Except spares, as indicated, each wire and cable shall be connected to the associated equipment at both ends and shall be continuous and without splices between the equipment termination points. Where control and signal cables cannot be immediately terminated at both ends, the end of each cable not terminated shall be capped or taped so that conductors are insulated from each other, the equipment, and ground until connections to the associated equipment can be made. Wire and cable shall be pulled in a manner, which will preclude damage to the conductor insulation or jacket. Excessive pulling stresses on cable or conductor will not be permitted. Strain gages or equal shall be furnished and used, whenever a tugger is used, on wire or cable pulled in long runs.

When pulling 5 kV cable the pulling device shall be connected to the conductors, not to the outer jacket. Strain gages shall be used when pulling 5 kV cable if any type of mechanical pulling device is required for installation. Pulling tension shall not exceed the manufacturer’s recommendation for the cable. Any cable or conductor damaged during installation shall be removed and replaced with equivalent cable or conductor. Installation of wire and cable shall include installation of all supporting devices and all terminations and identifications required to complete the circuits as shown on the drawings and as required. Crouse Hinds type CG series or equal watertight connectors shall be provided for cables entering junction boxes, cabinets, switchgear and conduit where shown on the drawings or required. Bushings shall be provided where indicated or required for cable passage and shall be of the insulating type.

3.6.2 Control Wiring

These wiring provisions shall apply to control wiring installed during installation of equipment and during manufacture of Contractor-furnished equipment. Wiring, where not installed in channels or ducts, shall be formed into compact wire bundles suitably bound together and properly supported. Thomas and Betts Ty-Rap ties or approved equal will be acceptable for binding. Bindings and supports shall not cause damage or cold flow to the insulation, nor shall they contain sharp edges due to cutting off excess tie material. Groups of exposed wires shall be run straight horizontally or vertically with short-radius right-angle bends.

Wiring supports shall be cadmium plated. There shall be no splices in the wiring and all connections shall be made at terminal studs or terminal blocks with ring-tongue indented terminals. All screw terminals shall have toothed lock washers and all stud terminals shall have contact nuts and either locking nuts or lock washers. Terminal blocks shall be added for wiring to devices having leads instead of terminals. Any control wiring within high-voltage compartments shall be completely shielded in a protective metal enclosure. Terminal blocks shall be used for interconnecting the wiring between adjacent panels. Hinge wire shall be used between stationary panels and swinging panels or swinging doors, and shall be formed in vertical wire loops which shall provide rotation around the longitudinal axis of the conductors. Terminal or clamping blocks as shown or required shall be provided on both sides of the hinge with hinge wire of ample length connected between the blocks. Suitable provisions shall be made for training and supporting incoming cables from the point of entrance to their termination on terminal blocks. Special attention shall be given to wiring and terminal arrangement to permit the individual conductors of an external cable to be conveniently grouped for connection to adjacent terminal points. Suitable entrance locations for cables shall be indicated on the shop drawings for top entrance of all external control cables. Wire termination shall be in accordance with paragraph 2.9 and 3.6.10. The wire termination designations shown on the existing reference wiring diagrams shall be printed on terminal block marking strips. The wire termination designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice, except where they differ from Government markings shown on the contract drawings. In this case both designations shall be shown as specified. Drawings prepared in accordance with the Government terminal connection schedules may require revision of external circuit connections, designations, and wire grouping when submitted for approval. When additional wire and cable designations for identification of external circuits are required, drawings submitted for approval will be so marked and returned to the Contractor for incorporation into equipment for delivery.

3.6.3 Power Cables

Power cables will enter the switchgear as shown on the drawings. Long barrel, NEMA 2 or 4-hole compression-type terminals shall be furnished for terminating the 5 kV cables and sufficient space shall be provided for installation of termination kits. After cables have been terminated and the connection torqued, insulate all exposed parts to 5 kV. Provide bracing rated for switchgear short circuit rating for cables.
There are 8 existing armored cables that must be reinstalled / terminated in the existing switchgear.

3.6.4 Conduit

Wire and cable shall not be pulled into conduit runs until the conduit has been checked and determined to be clean and dry by pulling a clean, dry, tight-fitting rag through each run. Only approved lubricants may be used to facilitate pulling of conductors.

3.6.5 Cable Trays

Cable pulling sheaves of adequate size shall be used where necessary to prevent damage to the cable. Cables shall be placed straight and parallel in the trays. There shall be minimum crossing of cables in trays. Cables shall be fastened in the cable tray at intervals not to exceed 6 ft. If two or more single conductors comprising a circuit to and from electrical equipment are routed in a cable tray, they shall be bundled together at intervals not to exceed six feet with approved cable

ties. Identification markers shall be installed on each tied bundle at intervals not to exceed 18 feet.

After all work in the area containing new cables is complete, the trays shall be thoroughly cleaned of all dirt and trash generated by the new cable installation. Cable moved in the cleaning process shall be repositioned and final cable positions in the trays checked and corrected if necessary.

3.6.5 Equipment Wiring

Conductors for external circuits entering switchboards, switchgear, control centers, cabinets and similar equipment will require routing within the equipment to the applicable terminal blocks. All terminations to terminal blocks shall done with ring type terminals. In addition to wiring installed by the equipment manufacturers, internal wiring will also be required. The wiring shall be installed in existing wiring channels and ducts and shall match existing wiring whenever possible. Internal wiring shall be switchboard wire as specified in paragraph 2.8 and shall be supplied for connections between terminal blocks in the switchboard cabinets and for other modifications or additions to internal wiring of equipment as directed.

3.6.6 Bends

The minimum radius to which an insulated conductor larger than No. 8 AWG, or a multiple-conductor cable may be bent, without specific approval, whether permanently or temporarily during installation, shall be 12 times the overall diameter of the completed cable for tape shielded cables and 10 times the overall diameter for other cables. In these instances where this radius is not possible, approval will be required for minimum radii as specified in the NEC. For multiple-conductor cable, follow manufacturer's recommendation for type of cable involved.

3.6.7 Cable Clamps

Clamps for protecting and supporting the weight of cables installed in vertical wireways shall be as required per NEC for adequate support. The size of each clamp shall be in accordance with the manufacturer's recommendations for each diameter and weight of cable to be supported or protected.

3.6.8 Splices

Splices will be permitted only with written approval. All splices shall be made in accessible cabinets, boxes or outlets. No splices will be allowed inside conduits. Splices for power cables rated above 2,000 volts shall be made with solderless compression connectors Burndy or approved equal, and either a Raychem Heat Shrink or a 3-M Cold Shrink Splice Kit rated at 133% insulation installed per manufacturer’s instructions.

3.6.9 Identification

3.6.9.1 Multiple-conductor cables

All multiple-conductor cables shall be clearly identified with the cable designation by either embossed one-inch diameter brass tags or by embossed aluminum band markers. Tags or band markers shall be securely fastened to the cables at each termination, junction or pull box, where cables enter or leave cable trays, and as required at other points of access.

3.6.9.2 Control Wires and Conductors

Control wires and individual conductors of control cables shall be identified with non-metallic tube-type markers at each termination. Tubing shall be sized to fit the wire being marked and shall have black marking on a light colored background. Installed markers shall be uniform in position on the wire and legends shall be visible when wires are terminated on blocks or at equipment. Identification on tags and markers shall be as shown on the drawings or as directed by the Contracting Officer. Wire markers shall use a reverse addressing system - each termination indicating the location where the other end of the conductor is terminated. Existing cables and conductors reutilized shall have any inappropriate existing identifications removed and shall be re-identified as indicated on the drawings and schedules.

Attached to this specification is Table 1. This table provides wire tag numbers and termination points for all cables except for termination points in contractor provided equipment. Wire tags use reverse addressing. Contractor to add termination points to wire tags for Contractor supplied equipment. There are 11 alarm cables and 1 control cable to be rerouted and terminated to new or existing equipment.

3.6.10 Terminations

3.6.10.1 Control Wire Terminations

Indented ring-tongue terminals shall be used on all conductors No. 18 and larger. Except for motor leads, conductors shall be either terminated on screw or stud terminals or a separate adjacent terminal block shall be provided as indicated on the drawings. Where motors or lighting transformers are provided without screw or stud terminals, two indented ring-tongue terminals may be bolted together. Such connections shall be taped in accordance with the requirements for splices and housed in an enclosure that will accept the proper size of conduit. Shielding of control and instrument cables shall be in accordance with paragraph 3.6.10.3. Either locking nuts or lock washers shall be used on all stud terminals.

3.6.10.2 5 KV Power Conductor Terminations

Shielded power conductors shall be terminated with stress cones. Power cable shielding shall be grounded at all stress cones. Heat shrink, Cold shrink or tape type stress cone terminating and splice kits shall be in accordance with the cable manufacturer's recommendations and as approved. Installation of the stress cone terminations and splices shall be as described in the kit instructions, except the taping of conductor terminals shall be extended over the terminal fitting and the terminal of the device to which the conductor is attached. All terminal connections shall be made in such manner that the phasing will be as marked on the equipment, or indicated on the approved shop drawings. Contractor shall verify phasing on existing equipment before disconnecting. Contractor is responsible for verifying that the phasing on the replacement wiring is the same rotation as presently existing wiring. Normal phasing for existing equipment is A-B-C from left to right, from top to bottom and from front to back when facing the front of the equipment but contractor to verify. After cables have been terminated and the connection torqued, insulate all exposed parts to 5 kV.

3.6.10.3 Shielded Instrumentation Cable Terminations

Shielded instrumentation cables shall be installed to prevent accidental contact of the metal shield with any metallic surface. The shield and jacket of the shielded cables shall be maintained to a point as close to the terminating blocks or studs as possible. The shield jacket shall not be stripped from the shield except where necessary to terminate the shield or make a connection. Cable shields shall be grounded only at a common point to the switchboard or equipment ground as shown on the

drawings or as directed. Connection of shields shall be made in an approved manner to prevent damage to the insulation and maintain the effectiveness of the shield.

3.6.10.4 Miscellaneous Terminations

Equipment or devices having external terminal facilities not adequate for minimum standard wire and conduit sizes shall be modified to include an enclosed terminal block as approved. When conditions permit, the terminal box shall be mounted on the equipment, otherwise it shall be adjacent with the reduced size leads as short as possible. The box, terminal block, reduced size wire and flexible conduit with necessary fittings shall be furnished and installed. All leads from each individual instrument transformers shall be brought out to terminal blocks. Current transformer secondary leads shall not be smaller than No. 10 AWG.

3.6.11 Tests

After installation, but just prior to terminal connection, each conductor shall be tested as follows:

a. A 1000 volt "Megger" test shall be performed on each conductor with all other conductors in each conduit or cable grounded. The test results will be recorded for each conductor. All conductors will then be meggered together to ground. The test result will be recorded for the cable. The final insulation resistance of each conductor shall not be less than one megohm.

b. New 5 kV bus duct shall be tested with a 5000 volt "Megger" in addition to any testing recommended in NETA ATS.

c. A continuity test of each conductor from terminal to terminal shall be performed, and a phase identification check of power conductors shall be made. Test results will be recorded for each conductor.

d. Suitable records shall be kept of all tests, indicating the "Megger" readings, values of leakage current versus applied voltage during the direct-current voltage test, continuity test, and conductor identification markings. A duplicate record of all tests shall be furnished to the Contracting Officer. Prior to testing, the test record form shall be submitted for approval.

e. Any length of wire or cable failing under the above tests shall be replaced.

f. Existing cables to be reused shall be tested as specified.

g. All instruments and personnel shall be furnished that are required for these tests.

h. Tests shall be witnessed by a GQAR and the test form shall provide room for the GQAR's signature.

3.6.12 Storage and Handling

Cables on reels and wire in coils shall be stored in an area reserved for that purpose and shall be protected from damage by construction activities or handling. Reels shall be rolled only in the direction indicated by the manufacturer. Conductors shall be unreeled or uncoiled slowly to prevent damage by sudden bending. Unreeling or uncoiling shall be stopped immediately if kinks appear and shall not proceed until kinks have been satisfactorily removed. In pulling conductors into conduits, reels and coils shall be set up in such a way that the conductor may be trained into the conduit as directly as possible. Any wire or cable improperly handled will be rejected.

3.7 TERMINAL BLOCKS

Each connection terminal of each block shall have the circuit designation or wire number neatly printed on the marking strip with durable marking fluid. One reversible or one spare marking strip shall be furnished with each block.

3.8 DEVICE MARKINGS

Each device mounted on or inside the equipment shall be identified by a device designation marked on the device or on the panel adjacent to the device. These designations are in addition to the device identification nameplates located on the front panels. Where the manufacturer's standard device designations are different from the device designations shown on the Government schematic diagrams and device legends, the Government device designation shall also be marked on or adjacent to each device. Each terminal of each device to which a connection is made shall also be marked with a distinct terminal marking which corresponds with the terminal marking shown on the Contractor's schematic and connection diagrams. The device and terminal markings shall be of permanent legible printed form in a color, which contrasts with the color of the device or panel and shall not be obscured by wires or other devices.

3.9 GROUNDING INSTALLATION

Ground connections shall be made complete to all equipment installed under this contract whether or not specifically shown or detailed on the drawings. The main items to be grounded consist of switchgear, bus duct, XPC Panel, conduit and cable tray and surrounding electrical equipment. Where required to make conduits and other metallic runs electrically continuous, approved copper jumpers or bonding shall be provided. Each bus of the new 5 kV switchgear will be grounded at both ends with a minimum of a 4/0 copper ground wire. Connect to existing ground wires for existing switchgear if possible. Connect to steel I beam if adequate ground grid connections not available. Connect ground buses from Bus #1 to Bus #2 together with a minimum 4/0 ground wire. Solidly ground bus ducts to switchgear ground buses.

Ground conductors shall be installed as continuous pieces of copper cable whenever possible. Exposed ground cable runs shall be supported to follow conduit, equipment or concrete wall contours. Support clamps or clips shall be of corrosion resistant metal and existing equipment bolts or screws shall be used where possible for fastening. Drilling of equipment housings or frames will be permitted only when approved. Concrete anchors shall be used for wall fastening.

3.10 CONNECTIONS

Connections to the equipment shall be made according to details shown on the drawings. All exposed connections and taps shall be made with approved bolted or compression connectors unless otherwise shown on the drawings. Solder-type connectors will not be permitted.

4 SUMMARY OF SUBMITTALS.

Submittal register ENG Form 4288 to be furnished by the Contractor shall include the following:

Paragraph	Item	SD	AEA
16050-1.1.4	Asbestos disposal documentation	08	C
16050-1.4.1.1	Electrical design documents	01	HDC
16050-1.4.1.2	Electrical equipment	01	HDC
16050-1.4.1.3	Wire and cable	01	C
16050-1.4.1.4	Reinforced concrete wall	01	HDC
16050-1.4.1.5	Pad removal, concrete repair	01	HDC
16050-1.4.2.1	Outline drawings – switchgear	04	HDC
16050-1.4.2.2	Outline drawings – XPC panel	04	HDC
16050-1.4.2.3	Schematics/diagrams – switchgear	04	HDC
16050-1.4.2.4	Schematics/diagrams – XPC panel	04	HDC
16050-1.4.2.5	Three line drawing	04	HDC
16050-1.4.3.1	Circuit breaker disposal plan	07	ECC
16050-1.4.3.2	Installation plan and schedule	07	HDC
16050-1.4.4.1	Wire and cable field test	09	C
16050-1.4.5.1	Wire markers	13	C

Code for Submittal Description (SD)

01	-	Data
04	-	Drawings
06	-	Instructions
07	-	Schedules and Plans
08	-	Statements
09	-	Reports
13	-	Certificates
14	-	Samples
18	-	Records
19	-	Operation and Maintenance Manuals

Action Element for Approval (AEA)

C	-	Contractor
AE	-	Architect Engineer
ED	-	Engineering Division
CD	-	Construction Division
EDA	-	Engineering Division, Architectural Design
EDC	-	Engineering Division, Soils - Civil Design
EDE	-	Engineering Division, Electrical Design
EDG	-	Engineering Division, Geotechnical Branch
EDH	-	Engineering Division, Hydraulic Design
EDLA	-	Engineering Division, Landscape Architect
EDM	-	Engineering Division, Mechanical Design
EDS	-	Engineering Division, Structural Design
HDC	-	Hydroelectric Design Center
ECC	-	Environmental Compliance Coordinator

TABLE 1 – Wire Termination Points List (25 Pages) follows

* * * * *

SECTION 16340

DWSSI0416340

TABLE OF CONTENTS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK
1.2 REFERENCES
1.3 SUBMITTALS

PART 2 PRODUCTS

2.1 MATERIAL
2.2 SWITCHGEAR AND CIRCUIT BREAKER RATINGS
2.3 SWITCHGEAR
2.4 VACUUM BREAKERS
2.5 BUSES
2.6 CONNECTIONS
2.7 MOTORS
2.8 AIR CIRCUIT BREAKERS (MOLDED-CASE TYPE)
2.9 INSTRUMENT TRANSFORMERS
2.10 CONTROL SWITCHES
2.11 INDICATING LAMP ASSEMBLIES
2.12 TERMINAL BLOCKS
2.13 DOOR MOUNTED EQUIPMENT
2.14 METERS FOR SWITCHGEAR CUBICLES
2.15 TAP CHANGER CONTROLS FOR SWITCHGEAR CUBICLES
2.16 ESCUTCHEONS AND NAMEPLATES
2.17 NAMEPLATES
2.18 HEATERS
2.19 WIRE MARKERS
2.20 SURGE ARRESTORS
2.21 THREADED FASTENERS AND JOINTS
2.22 PAINTING
2.23 TOOLS AND ACCESSORIES
2.24 SPARE PARTS

PART 3 EXECUTION

3.1 TESTING
3.2 INSTALLATION
3.3 CONTRACTOR - FURNISHED TRAINING OF GOVERNMENT PERSONNEL
3.4 QUALIFICATIONS OF FIELD ENGINEERING SERVICES PERSONNEL

SECTION 16340

4.16 kV NEW VACUUM REPLACEMENT CIRCUIT BREAKERS AND ADDITIONAL SWITCHGEAR CUBICLES

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This section specifies the detailed requirements for the design, manufacturing installation and testing of new medium voltage vacuum circuit breakers and Switchgear. The Station Service Switchgear at Dworshak Dam was manufactured by General Electric, Magne- Blast type "AM-4.16-75" breakers. This switchgear is to be completely replaced. New switchgear must fit in the existing Station Service Switchgear footprint. The new switchgear cubicles must be 26" single high or 26" or 36" double high. Maximum total switchgear length including fire wall shall not exceed 42 ft. 7 in. in length or 7 ft. 8 in. (92") in depth. The new cubicles must be at least 26" wide to allow for the incoming bus duct. The vacuum circuit breakers shall be interchangeable between all cells. Application of the specified equipment will be in a hydroelectric powerhouse at an altitude below 3,300 feet, within ambient temperature extremes of 0°C to 40°C. The Contractor shall provide all project management, factory and field engineering, supervision, labor, material, tools, rental, test equipment and transportation for installation of new switchgear and removal of existing medium voltage switchgear at Dworshak Dam.

1.2 REFERENCES

The publications form a part of this specification as applicable to the equipment being specified. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C37.06	(2002) Standard for Switchgear-AC High-Voltage Circuit Breakers on a Symmetrical Current Basis-Preferred Ratings and Related Required Capabilities
ANSI C2	(1997) National Electrical Safety Code

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(2001) Unified Inch Screw Threads (UN and UNR Thread Form)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A123	(1997) Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products E1-1998
ASTM A153	(1998) Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE STD 4	(1995) Standard Techniques for High Voltage Testing (ANSI)
IEEE C37.04	(2003) Rating Structure for AC High Voltage Circuit Breakers rated on a Symmetrical Current Basis. (Reapproved 1989, with Supplements through C37.04i-1991)
IEEE C37.09	(1999) Test Procedure for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.20.2	(1993) Metal-Clad and Station-Type Cubicle Switchgear
IEEE C37.55	(1989) Standard for Switchgear - Metal-Clad Switchgear Assemblies – Conformance Test Procedures
IEEE C37.100	(2001) Standard Definitions for Power Switchgear (ANSI)
IEEE C57.13	(1997) Standard Requirements for Instrument Transformers(ANSI/IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION PUBLICATIONS (NEMA)

NEMA AB 1	(2002) Molded Case Circuit Breakers
NEMA CC 1	(2002) Electric Power Connectors for Substations
NEMA FB 1	(2003) Fittings, Cast metal Boxes, and Conduit Bodies for Conduit Cable Assemblies
NEMA ICS 1	(2000) General Standards for Industrial Control and Systems
NEMA ICS 2	(2002) Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	(2001) Enclosures for Industrial Control and Systems
NEMA SG 4	(2000) Alternating-Current High-Voltage Circuit Breakers

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA AT	(1999) Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

UNERWRITERS LABORATORIES INC. (UL)

UL 1581 (2003) Reference Standard for Electrical Wires, Cables, and Flexible Cords

UL 44 (2002) Rubber-Insulated Wires and Cables

U.S. ARMY CORPS OF ENGINEERS

EM 385-1-1 (2003) U.S. Army Corps of Engineers Safety and Health Manual

1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following submittals shall be submitted in accordance with SECTION 01330.

1.3.1 SD-01 Data

1.3.1.1 Descriptive Specifications for the following within 60 days of award of contract; GA

a. 4.16 kV Circuit Breaker
b. Switchgear
c. Relays
d. Control Switches
e. Instrument Transformers Cut sheets for instrument transformer shall include accuracy class and burden ratings.
f. surge arresters and Accessories.

1.3.1.2 Accessories and Spare Parts List; GA

Within 30 days prior to delivery of new circuit breakers and switchgear, submit catalog data sheet for the spare parts and a spare parts listing, paragraph 2.23 and 2.24.

1.3.2 SD-04 Drawings

Drawings for the following within 90 days of award of contract unless otherwise noted.

1.3.2.1 Shop Drawings and Catalog Data; GA

Shop drawings and catalog data including all detailed information necessary to indicate material and equipment compliance with specification requirements. Shop drawings for switchgear, shall be submitted within 90 days after Notice to Proceed. Shop drawings shall consist of outline drawings, construction features, types of materials used, bill of material, connections necessary to utilize the switchgear and special features required. Information furnished shall be supported by design calculations and tests or complete descriptive catalog data covering manufactured equipment as necessary to establish the adequacy of the design. Catalog data for all equipment in metal enclosures

(switchgear) shall be submitted for approval at the same time the shop drawings for the enclosures are submitted.

1.3.2.2 Outline Drawings; GA

Provide drawings showing the overall equipment dimensions, space requirements, details of floor supports and anchorages, equipment mounting details, terminal block locations, size of raceway entrance area, and details of bus transition structure(s) and enclosure(s). The outline drawings shall indicate the footprint dimensions, the center of gravity of the switchgear and calculations to confirm adequate anchor bolt strength to prevent tipping during seismic events.

1.3.3 SD-06 Instructions

1.3.3.1 Circuit Breaker and Switchgear Installation and Commissioning Instructions; GA

Within 60 days after date of award, provide instructions detailing the installation of the new breakers, including breaker/cell alignment procedures, control circuit tests, and other field commissioning tests, paragraph 3.2.

1.3.4 SD-07 Schedules and Plans

1.3.4.1 Provide schedule and plan for replacement of switchgear, paragraph 3.2.2; GA

1.3.4.2 Training Schedule and Notification; GA

The Contractor shall coordinate with the Government 60 calendar days prior to training to schedule training dates that are acceptable to the Project’s personnel, paragraph 3.3.1.

1.3.5 SD-08 Statements

1.3.5.1 Outline of Contractor-Furnished Training; GA

A minimum of 60 calendar days prior to onsite training, a training outline detailing course topics, material, subjects, and qualifications of training personnel, paragraph 3.3.

1.3.6 SD-09 Reports

1.3.6.1 Circuit Breaker Factory Design Tests; FIO

Within 30 days after date of award, Contractor shall provide ANSI summary breaker Certification form for the complete new vacuum breakers. Vacuum element certification alone is not sufficient, paragraph 3.1.2.

1.3.6.2 Circuit Breaker Factory Production Tests; FIO

Within 30 days following completion of testing, the Contractor shall furnish five certified copies of all test reports, including complete test data on all tests.

1.3.6.3 Circuit Breaker and Switchgear Routine and Operational Field Test Procedures; GA

A minimum of 60 calendar days prior to onsite testing, the Contractor shall submit for approval an outline of the Circuit Breaker and switchgear Routine and Operational Field Test Procedures describing all testing to be performed. Testing of switchgear and breakers shall be per NETA ATS recommended procedures. It shall at a minimum include operation of the breaker in both the test and the operate positions both local and remote, Hi-pot testing of the breaker and bus, breaker contact resistance, accuracy and polarity of the instrument transformers and accuracy of the meters. Field testing shall include testing of instrument transformers and calibration of the meters transformers per NETA ATS recommended procedures.

Contractor shall check all controls, interlocks and alarms at each cell to ensure that all controls, interlocks and alarms operate in accordance with the schematics.

1.3.6.4 Circuit Breaker / Switchgear Routine and Operational Field Tests; FIO

Within 30 days following completion of testing, five certified copies of all test reports, including complete test data on all tests, paragraph 3.1.

1.3.7 SD-13 Certificates

1.3.7.1 Switchgear/Breaker Rating Certification; FIO

Within 30 days of award the Contractor shall provide certification from the Switchgear / Breaker manufacturer that the Switchgear / Breakers comply with ANSI C37.06 and this specification.

1.3.7.2 Field Service Engineer; GA

Within 90 days of award the Contractor shall provide qualifications of the Field Service Engineer that proves his ability to perform the functions of the Field Service Engineer for installation of the switchgear, paragraph 3.4.

1.3.7.3 Training Engineer; GA

At least 90 days prior to the scheduled training the Contractor shall provide qualifications of the Training Engineer that proves his ability to provide the training for the switchgear and breakers, paragraph 3.3.2.

1.3.8 SD-18 Records

1.3.8.1 Equipment Delivery Notification; FIO

Contractor shall provide written notification to the Government 14 calendar days prior to shipment of equipment, paragraph 3.1.1 and 3.2.1.

1.3.8.2 Factory Production Testing Notification; FIO

The Contractor shall notify the Government 14 calendar days in advance of the date of the tests so that arrangements can be made for the GQAR to be present at the tests, paragraph 3.1.1.

1.3.8.3 Request for Equipment Outages; GA

The Contractor shall provide to the Government, written request for all outages 14 calendar days in advance of each outage, paragraph 3.2.1.

1.3.8.4 Training Schedule and Notification; FIO

The Contractor shall coordinate with the Government 60 calendar days prior to training to schedule training dates that are acceptable to the Project's personnel, paragraph 3.3.

1.3.9 SD-19 Operation and Maintenance Manuals

1.3.9.1 4.16 kV Circuit Breaker/Switchgear Operations and Maintenance Manuals; GA

The manual shall provide complete operation, maintenance and service instructions for the switchgear, circuit breaker interrupters, operating mechanism, protection devices, meters, spare parts, relays and other accessories. Manual shall also provide recommendations on how often maintenance / testing of equipment should be performed. A CD is not an acceptable substitution for the manuals. If the information is also available on a CD the contractor shall also provide the CD.

PART 2 PRODUCTS

2.1 MATERIAL

2.1.1 General

All articles, materials and equipment shall conform to the requirements of these specifications and to the additional requirements specified herein. Unless otherwise approved, the materials, components, and equipment shall be new, high quality, free from defects and imperfections, of recent manufacture, and shall have electrical and mechanical properties suitable for the intended use. Particular care shall be taken to provide materials and equipment with long life, liberal factors of safety, and suitable operating characteristics for moderately moist conditions. All materials, components, and equipment not manufactured by the Switchgear manufacturer shall be products of other recognized reputable manufacturers. The products of manufacturers other than those specified herein will be accepted upon approval of the Government. Samples of materials and equipment shall be submitted for approval when so directed. Insofar as practicable, devices and equipment used for the same or similar services shall be of the same make and type, and shall be interchangeable when of the same rating.
In case the Contractor desires to use stock material not manufactured specifically for the work covered by these specifications, evidence satisfactory to the Government that such material conforms to the requirements of these specifications shall be submitted, in which case detailed tests of these materials may be waived.

2.1.2 Copper Bars and Rods
Copper bars and shapes for bus conductors and copper rods for current-carrying breaker parts and switchgear bus shall conform to the requirements of ASTM B187.

2.1.3 Connections
All bolts, studs, machine screws, nuts and tapped holes shall be in accordance with ANSI B1.1. Threads for sizes 1/4-inch to one-inch,

inclusive, shall be NC or UNC series. The sizes and threads of all conduit and fittings, tubing and fittings, and connecting equipment shall be in accordance with ASME B1.20.1. Manufacturer's standard threads and construction may be used on small items which, in the opinion of the Government, are integrally replaceable except that threads for external connections to these items shall meet the requirements outlined above.

2.2 SWITCHGEAR/CIRCUIT BREAKER RATINGS

2.2.1 General

The circuit breakers shall be rated on a symmetrical current basis. Ratings shall be as defined in IEEE C37.04, and as supplemented below.

2.2.2 Basic Ratings 5 KV Switchgear and Breakers

Each circuit breaker shall be of the electrically-operated, metal-clad type, with vacuum interrupters and suitable for indoor 60-Hz service. The circuit breakers shall be rated on a symmetrical current basis and have characteristics in accordance with Table 1 of ANSI C37.06 and as follows:

a. Rated maximum voltage, kV, rms 4.76

b. Rated frequency, Hz 60

c. Rated continuous current, amperes, rms 1,200

d. Rated short circuit and short time current kA.....31.5

e. Rated closing and latching Current, kA peak 82

f. Impulse withstand voltage, full-wave, kV, (BIL) crest.. 60

The contacts and the insulating structures shall remain undamaged when rated impulse voltages are applied across open contacts.

2.2.3 Standards

Except as otherwise specified, the switchgear and circuit breakers provided by Contractor shall conform to the applicable requirements of the following IEEE and ANSI Standards: C37.04, C37.06, C37.09, C37.20.2, C37.55 and C37.100. Switchgears and circuit breakers equipment shall comply with IEEE C57.13, NEMA AB 1, CC 1, FB 1 and ICS 1, ICS 2, ICS 6 and SG4 as applicable.

2.2.4 Rated Transient Recovery Voltage

Each circuit breaker shall meet the related required transient voltage withstand capabilities as described by paragraph 5.11 of IEEE C37.04.

Existing transformers being fed by the new switchgear / breakers include older dry type transformers that have a BIL level of 25 kV. See paragraph 2.20.2 for optional surge equipment requirements.

2.2.5 Rated Control Voltage

Rated control voltage ranges shall 70-140 volts DC for the trip and 100-140 volts DC for close control circuits as required by C37.06 Table 8. Further, operation of the closing and tripping control circuits shall not produce transient overvoltages exceeding 1500 volts crest.

2.3 SWITCHGEAR

2.3.1 Housing

a. Each switchgear unit shall be enclosed in a self-supporting dead-front fabricated housing constructed of sheet metal on a rigid steel frame and provided with metal partitions or barriers as required. Enclosures shall be rated NEMA 1 at a minimum. The sheet metal forming the enclosure for the removable element and the barriers between major primary sections shall not be less than No. 11 MSG. Exterior panel surfaces shall be free from holes, seams, dents, weld marks, loose scale, or other imperfections, and shall not be drilled or welded for attachment of wiring, resistors, or other devices where such holes or fastenings will be visible from the exterior. All ferrous fasteners shall have a rust-resistant finish, and all bolts and screws shall be provided with lock washers or other approved locking devices. The hinges for all doors shall be of the fully concealed type. Stops shall be provided where required to limit door swing and prevent damage to hinges or adjacent equipment. The clearance between any edge of a hinged door, when closed, and the adjacent panel shall be uniform and shall not exceed 1/8-inch. Each door shall be supplied with a two-point vault type latch with handles of the key-locking type with identical keying and ten keys furnished.

b. Ventilating openings shall be provided as required for proper ventilation
The openings shall preferably be of the grille type, and shall be provided with corrosion-resistant insect-proof screens on the inside.

c. The housing for each removable circuit breaker element shall include a hinged front, separate three-phase bus, bus duct terminating compartments, a self-contained mechanism for removing the circuit breaker, primary and secondary disconnecting devices, automatic shutters, and mechanical interlocks. The housing structure and the removable element shall be self-aligning and shall be designed in such a manner as to ensure a good mechanical fit between the two and to permit the circuit breaker removable elements to be interchanged. The mechanism for removing the breaker shall provide for moving the circuit breaker from the operating to the disconnected or test position. All contacts shall be silver-plated and shall have ample area and spring pressure. Contact parts, which carry current, shall not be used to supply contact-spring pressures. When the circuit breakers are withdrawn to the disconnect position, the circuit breaker bushing shall be withdrawn completely from the fixed contact enclosure and automatic shutters shall close the openings to prevent accidental contact with live terminals. All stationary secondary contacts shall be readily accessible and shall be adequately identified to facilitate connection with the control cables. When the circuit breaker is in the disconnect or test position, it shall be operable from normal control sources by use of the set of control jumpers to be furnished with the "Accessories", or by other approved means, but shall not be operable from remote control stations. Provisions shall be made for mechanical interlocks so that:

(1) The removable element cannot be removed from or placed in the operating position while the circuit breaker is in the closed position.

(2) The circuit breaker cannot be closed while the removable element is at any point between test and operating position.

(3) The circuit breaker cannot be closed unless the primary Disconnecting devices are in full contact or separated by a safe distance.

(4) The removable element cannot be removed from the housing with the stored-energy operator in the charged position.

d. The control switches on the front of the switchgear shall be protected from accidental operation by guards similar to the existing guards on existing switchgear as shown in the photo.

2.3.2 Device Arrangement and Terminal Marking

The design of the switchgear and arrangement of devices shall be such that adequate space is allowed for inspection and maintenance of wiring, terminals and devices. Equipment on the rear of the panels shall be so mounted that the studs of the equipment mounted on the front of the panels will be accessible without removing any device. Each device mounted on or inside the switchgear shall be identified by a device designation marked on the device or on the panel adjacent to the device. These designations are in addition to the device identification nameplates located on the front panels. Where the manufacturer's standard device designations are different from the device designations shown on the Government schematic diagrams and device legends, the Government device designation shall also be marked on or adjacent to each device. Each terminal of each device to which a connection is made shall also be marked with a distinct terminal marking which corresponds with the terminal marking shown on the Contractor's schematic and connection diagrams. The device and terminal markings shall be of permanent legible printed form in a color, which contrasts with the color of the device or panel and shall not be obscured by wires or other devices.

2.3.3 Wiring

a. All control wire, including wire for removable elements, shall be stranded copper switchboard wire with 600 volt insulation. The wire shall be type SIS as listed in ANSI/NFPA 70. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. Minimum wire size for all other control wiring shall be No. 14 AWG.

b. A suitable wiring duct system shall be installed for all interpanel wiring and shall provide easy access for inspection and replacement of wiring. All wiring shall be installed in wiring channels and ducts as far as possible. Each wire shall be properly protected where it leaves a channel or duct.

c. Wiring, where not installed in channels or ducts, shall be formed into compact wire bundles suitably bound together and properly supported. Bindings and supports shall not cause damage or cold flow of the insulation. Groups of exposed wires shall be run straight horizontally or vertically with short-radius right-angle bends. Wiring supports shall be of heavy-gage rustproof material or steel with rust resisting finish equivalent to sherardizing or cadmium-zinc plating. There shall be no splices in the wiring and all connections shall be made at terminal studs or terminal blocks with ring-tongue indented terminals, Burndy (Norwalk, CT 06856, Tel. No. (203) 838-4444) Type YAV or YAE, Thomas & Betts Corp. (1001 Frontier Road, Bridgewater, NJ 08807, Tel. No. (201) 685-1600) STA-KON, or approved equal. All screw terminals shall have toothed lock washers and all stud terminals shall have contact nuts and either locking nuts or lock washers. Each conductor shall be identified at each end with a permanently machine-embossed black identification on white plastic tubular shrink-on marker and as shown on the connection diagram terminal blocks.

c. Any control wiring within high-voltage compartments shall be completely shielded in a protective metal enclosure. Interpanel terminal blocks shall be used for interconnecting the wiring between adjacent panels at shipping splits. Hinge wire shall be used between stationary panels and swinging panels or swinging doors and shall be formed in vertical wire loops, which shall provide rotation around the longitudinal axis of the conductors. Instrument transformer secondary circuits where required shall be grounded at the switchgear. All leads from each individual instrument transformer shall be brought out to terminal blocks.

d. Terminal blocks and internal wiring shall be provided to all breaker spare auxiliary contacts and control device spare contacts for the connection of remote circuits. Terminal blocks shall be provided to terminate all external cables and shall contain at least 10 percent spare terminals. Suitable provisions shall be made for training and supporting incoming cables from the point of entrance to their termination on terminal blocks. All terminal blocks shall be accessible from the front of the switchgear unit with the front door open and the circuit breaker in the operate position. Drawings showing the proposed arrangement of terminal blocks and supports for incoming cables shall be submitted for approval. TB for CT’s shall be of the shorting type.

e. Special attention shall be given to wiring and terminal arrangement to permit the individual conductors of an external cable to be conveniently grouped for connection to adjacent terminal points. Suitable entrance locations shall be indicated on the Contractor's shop drawings for entrance of all external control cables. Terminal blocks for incoming cables shall be rated for 600V, 30A.

f. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however,

additional wire and cable designations for identification of remote (external) circuits shall be required, and drawings submitted for approval will be so marked and returned to the Contractor for additional designations. Drawings may require revision of external circuit connections, terminal and wire designations and wire grouping when submitted for approval. The Contractor shall 'as build' the drawings and correct the terminal block marking strips. Each conductor termination shall be identified with the wire designation on a non-metallic tube-type marker on the conductor. Installed markers shall be uniform in position on the wires, and legends shall be visible when wires are terminated on terminal blocks or equipment. Table 1 in Specification 16050 provides wire tag numbers for external connections

2.3.4 Channel Sill Foundations

Continuous channel sill foundations shall be furnished and installed by the Contractor for the switchgear assembly. The channels shall be designed for flat mounting floors and shall be furnished with hardware and drilling as required for mounting the equipment. The sill foundation shall be grouted into the floor in the location required by the switchgear manufacturer for his equipment.

2.3.5 Grounding

Each switchgear assembly shall include a continuous interior copper bar ground bus to which the housing, framework, cable and bus supports, and noncurrent-carrying metallic parts of all equipment and conduits shall be grounded insofar as practicable. Grounding shall conform to IEEE C37.20.2, paragraph 6.1.2, except that the ground bus bar shall be not less than 1/4 by 1 inch in size. Ground connections to the new switchgear shall be made by welds or by approved clamp-type fittings to the existing breaker cubicle ground cables. No soldered connections shall be used in the leads. If the operating mechanism of removable units is not permanently grounded, ground contacts shall be provided to connect the movable element automatically to the ground buses. These connections shall make before the main disconnecting devices upon insertion, and break after the main disconnecting devices upon withdrawal. Splice plates and hardware shall be provided for bolted connections at shipping splits (if shipping splits are required) for the ground bus. All contact surfaces shall be tinned or silver-plated.

2.4 VACUUM BREAKERS

2.4.1 General

Except as otherwise specified, the circuit breakers shall conform to the applicable requirements of the following ANSI/IEEE Standards: C37.04, C37.06, C37.11, and C37.90.
The three poles and auxiliary devices of each circuit breaker shall be operated simultaneously by a single operating mechanism from a common shaft. The operating system capacity shall be sufficient to perform repeated operating cycles, using a combination of initial stored energy and recharged stored energy, as required below, without mis-operation or thermal or mechanical damage. The circuit breaker, operating mechanism and control design shall permit any close or trip switches to remain closed for any length of time without causing damage.

The operating mechanism shall be designed to provide continuous operating force through the entire range of motion, in either breaker close or open direction. The mechanism shall be designed and manufactured to withstand all operating stresses, and bearings, pins,

bolts, nuts and other connections shall be locked and pinned in a manner to prevent loosening or change of adjustment. The operating mechanism shall not require critical adjustments, and failure of any spring (other than the operating energy storage spring) shall not prevent tripping nor cause tripping or closing of the circuit breaker. The mechanism shall contain a shock absorber system to dampen the opening force of the circuit breaker. The shock absorber shall have sufficient resilience to prevent contact bounce that could cause a re-strike of the main contacts during the opening of the circuit breaker or during a spring discharge. The shock absorber shall have a design life of 10,000 breaker opening and closing cycles without the need for repair, replacement or adjustment. All bearings that require periodic applications of grease shall be equipped with pressure-type grease fittings unless otherwise approved by the Government. A common mechanism drive shaft shall be connected to each moving contact via an insulated drive link made of glass-reinforced polyester. The insulated link material shall be non-hydroscopic and meet the flame-retardant requirements as set forth in IEEE C37.20 Paragraph 2.5.2.7. The drive links shall be easily removable with single clevis pins at each end and spring retaining clips.

All control equipment immediately associated with the circuit breaker operation shall be mounted directly on the circuit breaker assembly (or on the stationary structure) in a readily accessible location for testing and maintenance. The control equipment arrangement shall be such as to cut off the closing or tripping current as soon as the operation is completed and prevent pumping of the circuit breaker in case of automatic tripping or mechanical failure of any kind. Each circuit breaker shall be provided with a local test control switch which shall be located within the housing and shall be effective only when the breaker is in the test or disconnected position.

a. Removable Element. The removable element of each switchgear unit shall consist of a 3-pole vacuum interrupter type circuit breaker, with an operating mechanism, primary and secondary disconnecting devices, auxiliary switches, operation counter, position indicator, and control wiring, all mounted on a rugged frame suitable for moving the element. Each of the 3 poles shall be an independently sealed vacuum type interrupter as described below.

b. Interrupters. The vacuum interrupters shall be factory assembled and sealed, needing no interior maintenance or repairs to be performed after installation. The interrupters shall provide a minimum of 10,000 full-load breaking operations before replacement is needed. The interrupter shall have ready means of measuring contact wear.

c. Operating Mechanism.

(1) The circuit breakers shall be designed for normal operation by means of a motor-spring type, stored-energy closing operator with trip coil and shall also be provided manual maintenance closing and emergency tripping devices. Manual maintenance closing shall include a slow closing feature. The operating mechanism shall be electrically and mechanically trip-free. The mechanism shall be removable without disturbing the alignment or adjustment of current-carrying parts of the circuit breakers. Each mechanism shall operate a position indicator, which shall give positive indication of the contact position, whether closed or open. Each circuit breaker shall be equipped with an operation counter and an auxiliary switch assembly providing.

(2) In addition to the contacts required for breaker control or the counter, electrically-independent or Operated cell (MOC) switches shall be provided with a minimum of quantity 5 - 52a and quantity 4 - 52b contacts. Additionally, a truck operated cell (TOC) switch that operates when the breaker is racked in or out of the operating position shall also be furnished with a minimum of 5a and 4b contacts. Housing switches, for inter-locking purposes, shall be provided. Vendor shall show the TOC interlock switches on the breaker schematic provided. Contacts for internal circuit breaker controls shall be rated for greater than the most severe duty they will experience. Contacts for connection to remote circuits shall be rated for service on a 250-volt dc ungrounded system, and on a 120-volt single phase ac grounded or ungrounded system. Continuous current rating shall be 20 amperes minimum. Minimum inductive interrupting ratings shall be 10 ampere for 250 V dc duty, and 10 amperes for 120 or 240 V ac duty. All specified contacts, including spare contacts, shall be terminated on separate points on terminal blocks located together in a common accessible area within the control cabinet.

(3) Breaker closing time, when the breaker is operated from a control switch at rated control voltage, shall not exceed 5 cycles. The circuit breaker closing mechanism shall be so arranged that the closing speed of the contacts is independent of the control voltage.

(4) Load switching capacity and Life. Required load switching capability and life shall be in accordance with IEEE C37.04, paragraph 5.12, and with the following:

(a) Each breaker shall be capable of performing without maintenance or adjustment, 2000 no-load operations as prescribed in Column 4 of Table 7 per ANSI/IEEE C37.06.

(b) Each breaker shall be capable of interrupting at least 1000 close-open (CO) operations under full load conditions with maintenance and adjustments as prescribed in Column 6 of Table 7 per ANSI C37.06.

(c) Each breaker shall be capable of performing without maintenance, three close-open (CO) operations at full rated interrupting currents. Procedures shall be in accordance with IEEE C37.09, section 4.6.3.1 (Table 1 test supply).

(d) Each breaker shall be capable of performing 10,000 no-load operations with maintenance or adjustments as prescribed in Column 5 of Table 7 per ANSI C37.06.

d. Operating Sequences

The operating mechanism shall be capable of performing the following operating sequences without thermal or mechanical damage, while the circuit breaker is operating at rated short circuit current and related required capabilities:

(1) The standard ANSI duty cycle of Close-Open, 15 seconds, Close-open.

(2) Each motor-charged spring operated mechanism shall meet the duty cycle of Open-Close-Open, 30 seconds, Close-Open. At least 5 successive Close-Open operations shall be possible without overloading the spring charging motor. The mechanism shall have provisions for manually charging the springs.

e. Energy Supply and Storage Means

The spring charging system, including motor shall be in a cabinet with the operating mechanism. The replacement breaker shall incorporate an automatic operated system to completely discharge all stored energy before the circuit breaker is fully withdrawn from or inserted into the switchgear housing.

f. Special Requirements for Electric Motor Driven Spring Mechanisms

The state of charge shall be clearly visible by spring position indicators. The indicator shall show when the spring is fully charged or discharged. Spring charge shall occur only after a close operation, or, an adjustable delay (0 to 2s) may be provided to allow staggered recharge between multiple breakers at a given site.

g. Rackout Mechanism

Circuit breaker cubicles shall have breaker rackout mechanisms for racking the breaker into position. The rackout mechanism will properly align the breaker for insertion into position. It will hold the breaker rigidly in the operating position. In the disconnected position, breaker shall be easily removable from compartment. Breaker racking shall be accomplished with door closed and latched. Insert handle through a hole in front door to operate rackout device.

h. The control scheme shall be as shown on the drawings and as described herein, and shall be complete with all features necessary to perform local and remote closing, tripping, and testing, as well as to automatically provide for safety, and remote indication and alarms, except where indicated otherwise below.

2.5 BUSES

The primary buses for each switchgear assembly shall have a continuous current-carrying capacity of not less than 1,200 amperes, and shall have mechanical and thermal capacities coordinated with the highest momentary rating of the individual circuit breakers. Bus bars shall be of hard-drawn copper. Copper bars and shapes for bus conductors and copper rods for current-carrying breaker parts shall conform to the requirements of ASTM B187. Shop splices and tap connections shall be brazed, pressure-welded or bolted. All splices for field assembly shall be bolted. Where bolted connections are used, they shall be equipped with provisions for adequate clamping and contact surfaces shall be silver-plated. Each phase conductor shall be completely enclosed with molded insulation that will withstand the low-frequency dielectric test specified in paragraph 3.1. Molded neoprene boots with nylon fasteners of equivalent mechanical and electrical strength as that enclosing the bus shall be provided at bus joints. Taped insulation shall not be used at bus joints. The buses with molded insulation shall be mounted on insulating supports, and shall pass through barriers between individual unit housings. Removable metal plates or bolted hinged doors at each unit housing shall be provided for access to the bus compartment.

2.6 CONNECTIONS

2.6.1 Primary Connections

The Primary finger cluster connections shall be designed to carry the full nameplate rating of the breaker without exceeding the allowable temperature rise as stated in IEEE C37.04. In addition, the primary connections shall be capable of withstanding the full momentary/close and latch rating as well as the K*I current rating for the three (3) seconds without melting, arcing or pitting the contact surface.

2.7 MOTORS

The motors for spring charging shall be nominal 125-volt dc types designed for across-the-line starting and suitable for operation through a range of 100 to 140 volts dc. Each motor shall either be capable of continually withstanding locked-rotor current without damage, or shall be provided with manually reset thermal overload protection in each ungrounded line. The motors shall conform to the applicable provisions of NEMA Pub. No. MG 1 and the motor controls shall comply with the applicable provisions of NEMA Pubs. Nos. ICS 1 and ICS 2.

2.8 AIR CIRCUIT BREAKER (MOLDED-CASE TYPE)

The air circuit breaker shall conform to the applicable requirements of UL 489 and shall be Type I-T-E ET, Westinghouse Type AB De-ion or approved equal. Breaker shall be UL Listed for 250 VDC. The circuit breaker shall be manually operated and shall have trip free operating mechanisms of the quick-make, quick-break type. Commercial type circuit breakers similar to Westinghouse Quicklag or Siemens Energy & Automation Type I-T-E EQ will not be acceptable. All poles of each breaker shall be operated simultaneously by means of a common handle, and shall be enclosed in a common molded plastic case. The contacts of multipole breakers shall open simultaneously when the breaker is opened. The operating handles shall clearly indicate whether the breakers are in "ON", or "OFF", or "Tripped" position. The circuit breakers shall be of the individually-mounted, stationary type, shall be products of only one manufacturer, and shall be interchangeable when of the same frame size. Each circuit breaker shall be provided with mechanical pressure type terminal lugs as required.

The circuit breaker shall be of the automatic type provided with combination thermal inverse-time overload and instantaneous magnetic trip units. The instantaneous magnetic trip unit shall be set at approximately ten times the continuous current rating of the circuit breaker. Air circuit breakers for 125 volt dc circuits shall be two-pole type rated 125/250 or 250 volts d.c., and shall have a minimum NEMA interrupting capacity of 5,000 amperes d.c. The minimum frame size shall be 100 amperes.

Circuit breaker shall have an auxiliary contact for alarm circuit monitoring.

2.9 INSTRUMENT TRANSFORMERS

2.9.1 Current Transformers

a. Current transformers, except as otherwise specified, shall conform to the applicable requirements of ANSI C37.20.2 and C57.13. They shall be of the dry or compound-insulated, window or bushing type except

for the current transformers to be installed in the bus duct for metering, and shall be provided with a suitable means of mounting and for grounding the frame. The current transformers installed in the non segregated bus duct for metering shall be 5 kV rated bar type. Each current transformer secondary lead shall be connected to a terminal block of the short-circuiting type and shall be conveniently located to permit short-circuiting the secondary windings without requiring access to the primary bus compartments. The polarity of the current transformers shall be plainly marked.

b. All current transformers shall be suitable for continuous operation at the full-rated voltage and current at a frequency of 60-Hz. All current transformers shall be designed to withstand, without damage, the thermal and mechanical stresses resulting from short-circuit currents corresponding to ratings of the breakers in the circuits to which they are connected. The quantity, ratios and functions of the current transformers shall be as shown on contract drawings. Current transformers for feeder relaying shall have a combination metering / relaying rating of 0.6 B-0.2 / C50. The 1200:5 current transformers for metering and the transformer breakers shall have a combination metering / relaying rating of 0.3 B-1.8 / C200 or better. The 600:5 current transformers for metering shall have a combination metering / relaying rating of 0.3 B-1.8 / C100 or better. CT’s shall have a continuous thermal current rating factor based on 30 deg C average ambient air temperature of a minimum of 1.33

c. An analysis shall be performed by the contractor comparing the existing CT characteristics on the XJ01 / XJ02 breakers with the new CT characteristics. The results shall be submitted demonstrating that there is no increased probability of false operation on the transformer differential as a result of a mismatch in characteristics between the current transformers being supplied and the existing CTs. Contractor shall calculate the burden of the new relays, conductors and associated equipment to demonstrate that the burden does not exceed the transformer CT rating. Notify the GQAR if there is a problem with a mismatch. Submit analysis as part of the Field Test Report

2.9.2 Voltage Transformers

a. Voltage (Potential) Transformers, except as otherwise specified, shall conform to the applicable requirements of ANSI C37.20.2 and C57.13. Each voltage transformer shall be mounted in a fused rollout tray with stabs that disconnect the voltage transformer when the tray is pulled out. Transformer shall be provided with current limiting fuses on the primary side. Transformer secondary side will be fused in the switchgear low voltage compartment. Each voltage transformer low voltage connection shall be connected to a terminal block in the switchgear low voltage compartment.

b. Voltage Transformer shall be a minimum of 1500 VA. Voltage transformers shall have a relay and metering accuracy of 0.3W, 0.3X, 0.3Y, 0.6Z. Voltage transformer shall be “wye-wye” 4200-120 V.

c. Existing Voltage Transformers shall be removed from the existing switchgear and turned over to project personnel.

2.10 CONTROL SWITCHES

All control switches shall be of the rotary switchboard type with handles on the front and the operating contact mechanisms on the rear of

the panels, Each switch shall be provided with ample contact stages including spare contacts. Switches shall be rated 30 amp, 600 V continuous, 60 amp short time. Connection points to accept ring type terminal. Switches should have silver-plated contacts. Switch to have multiple contacts on each deck with separate replaceable decks. The normal life span shall be 40 year with a minimum of 10,000 operations. GE Type SBM, SB-1 or SB-10, or Electroswitch Type W or W-2, or approved equal.

Breaker control switches shall have a pistol grip. Ammeter and voltmeter selector switches shall have a Knurled grip.

The 86T control switch shall have a pistol grip. It shall be hand reset with an operating coil rated 125 VDC as indicated on drawing DWP-1.8-6-9D24/2.

The Meter selector switches shall be of the same type and manufacturer as the breaker control switches except for the grip.

2.11 INDICATING LAMP ASSEMBLIES

Indicating lamp assemblies shall be of the switchboard type, insulated for 125-volt dc service, with appropriate colored caps and integrally mounted resistors for 125-volt service. Lamps to be T2 slide base, 24-volt, 32-38 milliamperes. Color caps shall be made of material, which will not be softened by the heat from the lamps. Lamps shall be long-life light emitting diode type with a minimum normal life span of 50,000 hours. Indicating lights shall be visible from at least 20 ft. away. Lamps shall be replaceable from the front of the panels, and any special tools required for lamp replacement shall be furnished. Insofar as practicable, all color caps shall be similar and interchangeable, and all lamps shall be of the same type and rating.

2.12 TERMINAL BLOCKS

2.12.1 General

Terminal blocks for control wiring shall be molded or fabricated type with barriers, rated not less than 30 amp, 600 volts, Westinghouse Moldarta Type, General Electrical Company Type EB-5, Marathon Special Products Corporation (13300 Van Camp Road, Bowling Green, OH 43402, Tel. No. (419) 352-0875) Series 6000, or approved equal. Each terminal shall be not less than No. 10 in size with length and space for connecting at least two indented ring terminal connectors for No. 10 AWG conductors to each terminal. Not less than 10%, but in no case less than two spare terminals shall be provided on each block or group of blocks.

2.12.2 Short-Circuiting Type Terminal Blocks

Short-circuiting type terminal blocks shall be furnished for all current transformer secondary leads and shall have provision for shorting together all leads from each current transformer without first opening any circuit. These terminal blocks shall be Marathon Special Products Corporation Series 1600SC, GE Type EB-27, or approved equal.

2.12.3 White or Other Light-Colored Plastic Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The manufacturer's wire number and the Government's wire number shall both

be shown for each connected terminal on the marking strips with permanent marking fluid. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block, to accommodate the two sets of wire numbers.

2.13 DOOR MOUNTED EQUIPMENT

The following equipment shall be mounted and wired on or in the switchgear cubicle doors to duplicate the functionality of the existing controls, as shown on the contract drawing of the new front elevation:

(1) 1 each per breaker- breaker control switch (1CS), momentary contact type, spring return to neutral, contacts as shown, escutcheon and name plate markings shall be subject to approval.
(2) 1 each per breaker - indicating lamp. Green.
(3) 1 each per breaker- indicating lamp, red.

The transformer feeder breakers XP11 and XP23 shall have the following equipment mounted on or in the switchgear cubicle door:

1) 1 each per breaker- breaker control switch (1CS), momentary contact type, spring return to neutral, contacts as shown, escutcheon and name plate markings shall be subject to approval.
2) 1 each per breaker - indicating lamp, Green.
3) 1 each per breaker- indicating lamp, red.
4) 1 each per breaker- breaker control switch (1CS) for XFMR 13.8 kV breaker, momentary contact type, spring return to neutral, contacts as shown, escutcheon and name plate markings shall be subject to approval.
5) 1 each per breaker - indicating lamp for XFMR 13.8 kV breaker, Green.
6) 1 each per breaker- indicating lamp for XFMR 13.8 kV breaker, red.
7) 1 each per breaker 86 Hand reset lockout relay.
8) 1 each per breaker - switch, Manual / Auto (43MA) for tap changer, maintained contact, contacts as shown, escutcheon and nameplate markings shall be subject to approval.
9) 1 each per breaker- control switch (1CS) for tap changer raise / lower manual control, momentary contact type, spring return to neutral, contacts as shown, escutcheon and name plate markings shall be subject to approval.
10) 1 each per breaker- Tap changer indicator – same as existing, existing may be reused.
11) 1 each per breaker- indicating lamp, white.
12) 1 each per breaker- Analog ammeter - 4″ Wide
13) 1 each per breaker – ammeter selector switch.
14) 1 each per breaker- Analog voltmeter - 4″ Wide
15) 1 each per breaker – voltmeter selector switch.

2.14 METERS FOR SWITCHGEAR CUBICLES

The meters shall be analog meters similar to existing meters on existing switchgear. See Reference drawings for part numbers for original switchgear meters. Some meters have been replaced since the original installation. New meters shall match if possible meters presently installed on switchgear. The meters shall provide readings for current and voltage with selector switches selecting which of the three phase is indicated as shown on the drawings.

2.15 TAP CHANGER CONTROLS FOR SWITCHGEAR CUBICLES

The tap changer controls shall be identical in function to existing controls.

2.16 ESCUTCHEONS AND NAMEPLATES

Each control switch shall be provided with an escutcheon clearly marked to show each operating position. The switch identifications shall be engraved on the escutcheon plates or on separate nameplates.

2.16.1 Circuit Breaker Control Switches
The circuit breaker control switches with the pullout feature shall be of the three-position momentary-contact type with spring-return-to-neutral position and shall have black pistol-grip handles. Mechanical operation indicators, which show the last manual operation of the switch, shall be provided. Breaker control switch shall have pistol grip.

2.17 NAMEPLATES

Whether specifically stated or not, each item of equipment, mounted on or in the switchgear, which does not have a suitable designation included as an integral part of the device shall be provided with an engraved nameplate or with other suitable means of approved identification. Nameplates shall be made of laminated sheet plastic or of anodized aluminum, approximately 1/8-inch thick, engraved to provide white letters on a black background. Equipment of the withdrawal type shall be provided with nameplates mounted on the removable equipment in locations visible when the equipment is in place. The nameplates shall be fastened to the panels in proper positions with black-finished roundhead screws. Each operating unit door or panel or breaker control switch shall be provided with an identifying nameplate approximately 1 inch by 3 inches in size. Lettering size and type will be the same as on the existing switchgear. If 1″ by 3″ nameplates are too small for the legends indicated the nameplates shall be the size required for the legends provided. Breaker nameplates on the front of the cubicles shall all be the same size. The Contractor will be permitted to supply and attach to the end or back of the switchgear assembly a nameplate or trademark.

2.18 HEATERS

Each circuit breaker compartment shall be provided with strip heaters. A thermostat shall be provided to control the heaters – one for Bus 1 and one for Bus 2. The heaters shall be rated 240 volts minimum, single phase, 60-Hz but will operate on a 120-volt ac supply. The number and capacity of the heaters in each compartment shall be sufficient to provide 250 watts output when operating at 120 volts. The heaters and the thermostats shall be wired to terminal blocks within individual switchgear units and paralleled for two equally loaded circuits for external connections. The heaters shall be metal-enclosed and constructed of nickel chromium wire embedded in a high-grade refractory material to insure good insulation and rapid transfer of heat. Thermostats shall be adjustable through a minimum range of 60-90 degrees F and minimum contact rating shall be 10 amperes and 120 volts. The heaters and thermostats shall be accessible for ease of inspection and maintenance.

2.19 WIRE MARKERS

Wire markers for conductor termination identification shall be approved tube-type suitable for contact with rubber, neoprene or plastic. Tubing shall be sized to fit the wire being marked and shall have black marking on a lighter colored background.

2.20 SURGE ARRESTERS

2.20.1 Station Service Switchgear Surge Arresters

Each switchgear bus shall have surge arresters installed on the main bus. Surge arresters shall be heavy duty (10 kA) and be a combination of metal oxide and gapped arrester. Construction shall consist of Metal Oxide Varistors in series with a non-linear gap structure.

2.20.2 Transformer Surge Arresters

The surge arresters for the dry type transformers for the SQ and dam feeder transformers shall be connected at the connection point of the cable to the transformer in the transformer enclosure. The length of the lead from the connection point to the surge arresters shall not be more than 12 inches long. The connection from the terminal to the surge arrester and from the surge arrester to ground shall be made with flexible copper braid grounding straps 1 inch wide. The surge arresters shall be a series connected resistor and capacitor. The resistor shall be impedance matched to the power cable to the transformers. The capacitors shall be 5kV, 0.5 micro F.

2.21 THREADED FASTENERS AND JOINTS

Threads for all electrical, mechanical or structural, permanent or temporary connections to external devices shall meet the following requirements, or adapters shall be provided where practical. All bolts, studs, machine screws, nuts, and tapped holes shall be in accordance with ASME Standards B1.1. Threads for sizes 1/4 inch to 1 inch, inclusive, shall be NC or UNC series. The sizes and threads of all valves, pipe and fittings, conduit and fittings, tubing and fittings, and connecting equipment, shall be in accordance with ASME Standard B1.20.1. Manufacturer's standard threads and construction may be used on internal items.

2.22 PAINTING

All surfaces shall be thoroughly cleaned by sand blasting or shot blasting before painting. The interior surfaces of cabinets shall be finished with not less than one prime coat and one light-colored finish coat of enamel. All exterior surfaces, including cabinets, exposed mechanisms, raceways and piping, shall be given a rust inhibitive primer coat and two finish coats of enamel. The enamel used for the finish coat shall be of weather-resisting properties and shall be ANSI Indoor Light Gray No. 61 in color, or if approved, the manufacturer's standard color for the breakers. The color of the new cubicles shall match existing switchgear color. All finished metalwork shall be suitably wrapped or otherwise protected from damage during shipment and installation. Adequate paint of the same color and type shall be provided for touch-up of damage after installation.

2.23 TOOLS AND ACCESSORIES

The Contractor shall furnish one complete set of handling and testing accessories for testing the removable elements of the metal-clad circuit

breakers. A test cabinet shall be furnished and shall include all necessary secondary contacts, power cables, control cables, control relays, and control switches for simulating breaker operation outside of the switchgear enclosure. A molded-case air circuit breaker conforming to paragraph 2.8 shall be provided in the cabinet to disconnect the incoming control source. One complete lot of accessories shall be furnished under this contract. The complete lot of accessories shall include:

1 -Test cabinet with umbilical cord connector, as described above. Location of test cabinet shall be coordinated with GQAR.
1 –Breaker lifting device for lifting and moving breaker.
1 -Set of secondary couplers (if required).
1 –Closing lever for manually closing the breaker.
1 -Removable hand crank for operating the levering-in device.
1 –Complete set of all special wrenches and tools required for the installation, maintenance and repair of the equipment furnished under this section of the specification.

2.24 SPARE PARTS

2.24.1 General

At a minimum the Contractor shall furnish the following spare parts in the quantities stated below. In addition to the spare parts listed the Contractor shall furnish any additional spare parts recommended by the manufacturer and any special tools required to make normal repairs to the breakers. All spare parts shall be duplicates of the original parts furnished and interchangeable therewith. All spare parts shall be packed separately in containers plainly marked ‘SPARE PARTS’. A packing list listing the contents of each container and contract number shall be placed in a moisture proof envelope and securely fastened to the outside of the container.

2- 5 kV Vacuum breaker identical to those provided in this contract.
1- Complete set of secondary disconnecting devices for one three-pole breaker.
1- Solenoid coil of each type used.
1- Current transformer of each type and rating.
1- Voltage transformer of each type and rating.
1- Control switch of each type and rating.
1- Rewinding motor and limit switches for the stored-energy mechanism.
1 - Auxiliary switch complete.
3 - Primary disconnect assemblies.
2 - Indicating lamp assemblies of each type with lenses (one green, one red)
10 - Indicating lamps
1 - Lot of spare fuses of each type and rating.
1 - Lot of spare PT fuses.
1 - Lot of spare terminal block marking strips (one spare strip for each five terminal blocks of each size).

The Contractor shall complete the Spare Parts Receipt and shall submit a copy of the completed and signed receipt to the Contracting Officer after the spare parts and documentation have been delivered to the Government.

PART 3 EXECUTION

3.1 TESTING

3.1.1 General

Each circuit breaker and each cubicle shall be given manufacturer's routine shop tests and also other electrical and operating tests as specified below. In preparation for testing, each breaker shall be completely assembled into a single 3-pole unit, with interrupter poles, operating mechanism and housings, and with inter-pole conduit, connecting rods, installed, with all adjustments made and ready for operation. The factory test equipment and the test methods used shall conform to the applicable requirements of ANSI, IEEE and NEMA Standards, and shall be subject to the approval of the Government. The Contractor shall notify the Government in writing, 14 calendar days in advance of the date of the tests so that arrangements can be made for the GQAR to be present at the tests. The Government Quality Assurance Representative (GQAR) will witness all tests required herein unless waived in writing. The Contractor shall provide written notification to the Government 14 calendar days prior to shipment of equipment and no equipment shall be shipped until the Contracting Officer has approved it for shipment. See paragraph 3.2.1 for additional requirements on shipping. The Contractor shall furnish five certified copies of all test reports, including complete test data on all tests. The test data shall include: serial number identification of each item tested, date(s) when test was performed and key personnel present, a brief description of the test equipment and procedure used, the test criteria, and the values observed (corrected if necessary). Certification shall be by the GQAR (when present), and by a responsible member of the manufacturer's engineering or quality control organization. The cost of performing all tests shall be borne by the Contractor and shall be included in the unit prices for the items of the Schedule. The following tests shall be performed or shall have been previously performed on representative circuit breakers or on each circuit breaker, as specified below. Where conditions of two or more tests are identical, they may be performed simultaneously, unless a specific sequence is required. Where a more severe required test fully demonstrates capability to withstand a less severe test, and if the less severe test is waived in writing by the Government the lesser test need not be performed.

3.1.2 Design Tests

Design tests shall have been performed on circuit breakers identical to those furnished under this contract. Proof of adequacy of design shall be by certified reports of previously performed tests, or of tests, which will be performed. The Contractor’s certified report shall identified all design tests which were performed to certify the design and the Contractor shall permit review of design test data, oscillograph tracings, and other information by the GQAR. If any design tests are performed on circuit breakers or components to be furnished under this contract, the affected items shall be inspected after testing to insure that no damage or wear has occurred. Any items, which may have had the lifetime and reliability, expected of new and unused equipment degraded by the tests shall be replaced, or if approved, repaired. Applicable production tests shall be performed on the circuit breaker or components after they have been subjected to design tests, and needed replacements or repairs have been made. Design tests shall be as described in IEEE C37.09 and NEMA SG 4, as applicable for the specified ratings of the circuit breakers to be furnished under this contract.

3.1.3 Production Tests

3.1.3.1 General

Each circuit breaker shall be given production tests in accordance with the applicable requirements of IEEE C37.09, and with the following requirements given below. The Contractor shall submit test reports in accordance with paragraph 3.1.1.

3.1.3.3 Dielectric Tests

Wherever the option of substituting dielectric tests on component parts for those on completely assembled circuit breakers is allowed in the standards, tests shall be performed on completely assembled circuit breakers.

3.1.3.4 Circuit Breaker Operation Tests

a. The operating mechanism shall be thoroughly checked for proper operation and all necessary adjustments shall be made. The operating mechanism shall be tested and adjusted while operating the assembled breaker. Adjustments shall be made with all components of the breaker loaded equivalent to the final contact and accelerating spring load of the breaker.

b. Each operating mechanism shall be given a minimum of 5 closing and 5 opening operations by electrical control at each of the minimum, rated, and maximum control voltages, corresponding to the voltage ranges listed in ANSI C37.06 for 125-volt dc rated control voltage for indoor type breakers.

c. Operating speed recordings shall be made of the closing time, opening time, and trip-free operation time of all breakers. The above tests shall be made during each of the required operating tests at the specified voltages and pressures.

3.1.3.5 Control Circuit Dielectric Tests

All control circuits and devices shall be given, in addition to the standard required dielectric tests, a 1500 volt AC dielectric withstand capability test. This test shall be in accordance with IEEE Std. C37.09, Section 9 and IEEE Std. 4.

3.1.4 Routine and Operational Tests

After completion of the installation of the equipment and accessories, perform routine and complete operational tests as necessary to insure proper installation and verify proper operation. Testing of switchgear and breakers shall be per NETA ATS recommended procedures. It shall at a minimum include operation of the breaker in both the test and the operate positions both local and remote, Hi-pot testing of the breaker and bus, breaker contact resistance, accuracy and polarity of the instrument transformers. Routine tests shall include but not be limited to inspections and tests for location and mechanical alignment, damage to equipment porcelain or painted surfaces, electrical continuity of external circuits, voltage transformer phase rotation. Test CTs and VTs per IEEE and manufacturer’s recommendations. Operational tests shall include those necessary to verify the satisfactory operation of individual pieces of equipment. Operational testing shall include testing and calibration of the meters and transformers per NETA ATS

recommended procedures. Contractor shall check all controls, interlocks, auxiliary contacts and alarms at each cell to ensure that all controls, interlocks and alarms operate in accordance with the schematics. Submit a test plan procedure, for approval, listing the routine and operational tests to be conducted. The tests shall be witnessed by a GQAR. The Contractor shall furnish five certified copies of all test reports, including complete test data on all tests. The routine and operational tests shall be as outlined above and as recommended by the manufacturer and the Field Service Engineer.

3.2 INSTALLATION

3.2.1 General

Unless otherwise specified, execution of all installation work shall be in accordance with the National Electrical Code, NFPA 70, the National Electrical Safety Code, ANSI C2, and with the U.S. Army Corps of Engineers Safety and Health Manual, EM 385-1-1. The work under this contract is subject to the safety clearances and operating procedures currently practiced by the Dworshak Dam. All the construction activities shall be coordinated with the Contracting Officer’s Representative so that the construction will not adversely affect the daily operation of the powerhouse. Safety clearances shall be obtained before opening, entering or working on any existing equipment such as power centers, switchboards, and alarm cabinets. Work areas shall be kept clean and orderly at all times. Tools and construction equipment shall be put away at the end of each workday. If existing switchgear pad needs to be removed, Contractor shall minimize the dust generated and isolate the area to prevent other equipment from being contaminated by the dust. See Section 16050 paragraph 3.2 for more information on existing concrete pad. Dust and other debris must be prevented from entering electrical cabinets when drilling holes in existing concrete. If the creation of dust cannot be avoided the work area shall be vacuum-cleaned immediately after the activity. The floor will be saw cut as required for installation of the switchgear sill foundation. Sill will be grouted into place as required / recommended by switchgear manufacturer to provide level foundation for proper installation of switchgear cubicles and breakers. See section 2.3.4 for additional information on sill requirements.

Maximum total switchgear length including fire wall shall not exceed 42 ft. 7 in. in length or 7 ft. 8 in. (92") in depth. If the depth of the switchgear is over 6 ft. it will extend under the existing cable tray. The bottom of the existing cable tray support brackets are 101" above finished floor. Each section of equipment must be capable of fitting through a door opening through a 5’ thick wall. Door opening is 96 in. high X 79 in. wide. The actual opening is 85 3/4" wide and 96" tall but flooring edge at the bottom takes up 2" on both sides and at the top 2 conduits reduce the width by 3 3/4" and extend down from the top of the door 7 1/2". See the following photos. Front of switchgear shall be located a minimum of 6 ft. from the wall in front of the equipment. Breaker carts must be capable of moving under the cable tray supports to allow installation of the breakers. If the total length of the switchgear exceeds 32 ft. 3 in. bus duct routing may need to be adjusted to avoid conflicts with existing cable trays and other equipment. Additional bus duct fittings may be required for the new routing depending on length of switchgear.

The TJ02 bus duct routing must not be routed past the back edge of the switchgear or it will block inspection hatches for the Iso-Phase Bus

Duct. The inspection hatches are located 12 ft. above finished floor, 32 in. to rear of existing switchgear approximately in the center of the existing switchgear. See drawing DWP-1.8-6-1D11/2 for the approximate routing of the Unit 1 Iso-Phase Bus Duct.

If the depth of the switchgear is over 6 ft., the Station Service Annunciator Panel will be moved about 25 ft. to avoid clearance problems. Relocation of the panel is not part of this proposal.

Contractor shall include with his proposal the footprint of the proposed switchgear.

Contractor shall notify Contracting Officer’s Representative 14 days prior to shipment of equipment.

The Contractor shall provide to the Government, written request for all outages 14 calendar days in advance of each outage. The Project will notify the Contractor within 7 days if the requested outage can be scheduled at the time requested. If the outage cannot be scheduled at the time requested, the Project will provide a schedule for when the outage is possible.

FIRE
EXTINGUISHER

3.2.2 Installation Plan and Schedule

Contractor shall provide an installation plan and schedule, which gives a procedure indicating the schedule for replacement of each switchgear bus. Schedule shall indicate the expected length of each outage. Plan shall indicate how one bus and / or bus duct is to be isolated from the other bus and / or bus duct when existing equipment is being removed and new equipment installed. If existing pad is to be removed, include in the schedule when this work is to be performed.

3.2.3 Welding

All welding shall be performed by the electric-arc method, by a process which will exclude air from the molten metal and, where practicable, under procedure control using automatic machines. The design and construction of welded joints shall conform to the requirements of Part UW of section VIII of the code, or to AWS D1.1 as applicable. After being deposited, welds shall be cleaned by shot blasting unless otherwise approved, and shall show uniform sections, smoothness of weld metal, featheredges without overlap, and freedom from porosity and inclusions. Visual inspection at the edges and ends of welds shall indicate complete fusion with the base metal. Particular care shall be taken in aligning and separating the edges of members to be joined by butt-welding, so that complete penetration and fusion for the full depth of the joint will be assured. All pinholes, cracks, and other defects shall be repaired by chipping or grinding the defect to sound metal and rewelding. Where fillet welds are used, the members shall fit closely

and shall be held together during welding. The welding rods used for manual welding shall be suitable for the position in which the welding is performed.

3.2.3.1 Qualification of Welders and Tack Welders

Welders and tack welders shall be qualified and, as necessary, requalified for the particular type of work to be done. Welders and welding operators shall pass the qualification tests prescribed by AWS D1.1 within 12 months prior to performing work on this contract. The qualifications shall be submitted on Form E-4, Appendix E of AWS D1.1 or equal. The Contractor shall certify by name to the Contracting Officer, the welders so qualified including the date of qualification, code, and procedures under which qualified. The Contractor shall require the welder to repeat the qualifying tests when, in the opinion of the Contracting Officer, a reasonable doubt about proficiency exists. In such cases, the welder shall be considered recertified, as above, if the retest is successfully passed; otherwise, the welder shall be disqualified until successfully passing a retest. All expenses in connection with qualification and requalification shall be borne by the Contractor.

3.3 CONTRACTOR-FURNISHED TRAINING OF GOVERNMENT PERSONNEL

3.3.1 Training

After the circuit breakers have been placed in service, Field Engineering Services will instruct Project personnel on the theory, operation and maintenance of the new replacement circuit breakers. The course shall consist of Qty. two each – 4 hour duration classes for operators and Qty. one each - 8 hour duration class (one full working day) for maintenance personnel (3 separate sessions total). Classes shall be conducted for approximately 10 Government employees at Project for each session. The courses for the operators shall be scheduled so that all operators can attend. The operator’s course shall include circuit breaker design and theory of operation, construction of the actual breakers furnished and actual installation and removal of the breaker. The maintenance course shall include circuit breaker design and theory of operation, construction of the actual breakers furnished, complete maintenance tear down and rebuild of a breaker during the class, routine maintenance, trouble analysis, any special shipping and handling procedures and safety precautions. Demonstrations shall be on the actual circuit breakers and equipment furnished, to the maximum extent possible. Major overhaul procedures shall be covered briefly, with greater emphasis on emergency procedures. Course material shall use to the maximum extent possible, the site-specific operation and maintenance data. The Government may videotape the training sessions for future use.

A minimum of 60 calendar days prior to training, the Contractor shall submit for Government approval, a training outline detailing course topics, material, and subjects. The Contractor shall coordinate with the Government 60 calendar days prior to training to schedule training dates that are acceptable to the Project’s personnel. Government may require that the training be given on different days and in different weeks.

3.3.2 Qualification of Training Engineer

In addition to the qualifications indicated below for the field engineering service personnel, the person providing the training for the Project personnel shall have training provided by switchgear and breaker manufacturer on the operation and maintenance of the switchgear/breakers provided.

3.4 QUALIFICATIONS OF FIELD ENGINEERING SERVICE PERSONNEL

The Contractor shall provide qualified field engineering service personnel who are fluent in the English language to supervise, test, and install the new vacuum replacement breakers. The personnel shall have a minimum of two years experience in the installation and testing of new vacuum replacement breakers. The Field Engineering Service Supervisor shall certify that the equipment has been installed in accordance with the manufacturers recommendation and all warranties are in effect.

4.0 SUMMARY OF SUBMITTALS

Submittal register ENG Form 4288 to be furnished by the Contractor shall include the following:

Paragraph	Item	SD	AEA
16340-1.3.1.1	Breakers, Switchgear & Equipment	01	HDC
16340-1.3.1.2	Accessories and Spare Parts	01	HDC
16340-1.3.2.1	Shop Drawings and Catalog Data	04	HDC
16340-1.3.2.2	Outline Drawings	04	HDC
16340-1.3.3.1	Circuit Breaker& Switchgear Installation and Commissioning Instructions	06	HDC
16340-1.3.4.1	Schedule for Replacement of SWGR	07	HDC
16340-1.3.4.2	Training Schedule	07	HDC
16340-1.3.5.1	Outline of Training	08	HDC
16340-1.3.6.1	Circuit Breaker Design Tests	09	C
16340-1.3.6.2	Circuit Breaker Production Tests	09	C
16340-1.3.6.3	Field Test Procedures	09	HDC
16340-1.3.6.4	Circuit Breaker & SWGR Field Tests	09	C
16340-1.3.7.1	SWGR / Breaker Rating Certification	13	C
16340-1.3.7.2	Field Service Engineer	13	HDC
16340-1.3.7.3	Training Engineer	13	HDC
16340-1.3.8.1	Equipment Delivery Notification	18	C
16340-1.3.8.2	Factory Production Testing Notification	18	C
16340-1.3.8.3	Request For Equipment Outages	18	CD
16340-1.3.8.4	Training Schedule	18	C
16340-1.3.9.1	O & M Manuals Circuit Breaker / Switchgear	19	CD

Code for Submittal Description (SD)

01	-	Data
04	-	Drawings
06	-	Instructions
07	-	Schedules and Plans
08	-	Statements
09	-	Reports
13	-	Certificates
14	-	Samples
18	-	Records
19	-	Operation and Maintenance Manuals

Action Element for Approval (AEA)

C	-	Contractor
AE	-	Architect Engineer
ED	-	Engineering Division
CD	-	Construction Division
EDE	-	Engineering Division, Electrical Design
EDM	-	Engineering Division, Mechanical Design
EDS	-	Engineering Division, Structural Design
HDC	-	Hydroelectric Design Center

* * * * *

SPARE PARTS RECEIPT

Contract No:_____

Contract Name:_____

Contractors Name: _____
Technical Specification Number: **16340**

Paragraph Number: **2.24**

List of Spare Parts Delivered (Quantity and Description): *

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

All spare parts required in the technical specification section are included: Yes ☐ No ☐

All documentation required in the technical specification is complete and included: Yes ☐ No ☐

VERIFICATION: The above spare parts receipt is complete and correct, all required spare parts have been turned over to the Government, and all documentation is complete and included with the spare parts.

_____ _____
Contractor's Representative Date

_____ _____
Government's Representative Date

*Attach additional sheets as necessary.

SECTION 16440

DWSSI0416440

CONTROL PANEL XPC AND RELAY REPLACEMENT

TABLE OF CONTENTS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK
1.2 REFERENCES
1.3 SUBMITTALS

PART 2 PRODUCTS

2.1 PANEL XPC
2.2 RELAYS
2.3 FEEDER RELAYS
2.4 TRANSFORMER RELAYS
2.5 TEST SWITCHES
2.6 METERS
2.7 BREAKER CONTROL SWITCHES AND BREAKER INDICATION
2.8 CONTROLS, INDICATION AND ALARMS
2.9 MATERIALS
2.10 LOW-VOLTAGE ELECTRICAL CONNECTIONS
2.11 THREADED FASTENERS AND JOINTS
2.12 WELDING
2.13 PAINTING
2.14 TOOLS AND ACCESSORIES
2.15 SPARE PARTS

PART 3 EXECUTION

3.1 INSTALLATION
3.2 RELAY TESTS
3.3 METER TESTS
3.4 CONTRACTOR - FURNISHED TRAINING OF GOVERNMENT PERSONNEL
3.5 QUALIFICATIONS OF FIELD ENGINEERING SERVICES PERSONNEL

SECTION 16440

CONTROL PANEL XPC AND RELAY REPLACEMENT

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This section specifies the detailed requirements for the design, fabrication and installation of panel XPC and replacement of existing relays in the Station Service Switchgear. New multifunction microprocessor based relays for transformer and feeder protection will be installed in new panel XPC at Dworshak Dam. Duplicate breaker controls will be located on panel XPC. Digital meters will be installed in panel XPC to allow local monitoring and data acquisition on the incoming transformer feeders. The Contractor is responsible for the engineering design; fabrication and installation of panel XPC. The contractor is responsible for completing the interconnection design between panel XPC, switchgear and all other controls and alarms. The Contractor shall provide training on programming, testing and maintenance of the relays and meters. Contractor shall provide training on maintenance on all equipment in panel XPC. Application of the specified equipment will be in a hydroelectric powerhouse at an altitude below 3,300 feet, within ambient temperature extremes of 0°C to 40°C. The Contractor shall provide all project management, factory and field engineering, supervision, labor, material, tools, test equipment and transportation for a complete replacement of the existing electro-mechanical relays with new multifunction microprocessor relays located in panel XPC for the feeder and transformer breakers

1.2 REFERENCES

The publications form a part of this specification as applicable to the equipment being specified. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(2001) Unified Inch Screw Threads (UN and UNR Thread Form)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2002) Structural Welding Code - Steel

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE STD C37.91	(2000) IEEE Guide for Protective Relay Applications to Power Transformers

IEEE C37.90	(1994) IEEE Standard for Relays and Relay Systems Associated with Electrical Power Apparatus. (ANSI)
IEEE C37.90.1	(2002) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.
IEEE C37.90.2	(2001) IEEE Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
IEEE C37.100	(2001) Standard Definitions for Power Switchgear (ANSI)
IEEE 323	(1996) Standard For Qualifying Class 1E Equipment for Nuclear Power Generating Stations

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION PUBLICATIONS (NEMA)

NEMA AB 1	(2002) Molded Case Circuit Breakers
NEMA ICS 1	(2000) General Standards for Industrial Control and Systems
NEMA ICS 2	(2002) Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	(2001) Enclosures for Industrial Control and Systems

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

ANSI / NETA ETT-2000	(2000) Standard for Certification of Electrical Testing Technicians.
NETA ATS	(1999) Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

NATIONAL FIRE PROTECTION ASSOCIATION PUBLICATIONS (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 44	(2002) Rubber-Insulated Wires and Cables
UL 508	(2002) UL Standard for Safety Industrial Control Equipment Seventeenth Edition; with Revisions Through and Including 01/22/2001
UL 1581	(2003) Reference Standard for Electrical Wires, Cables, and Flexible Cords

U.S. ARMY CORPS OF ENGINEERS

EM 385-1-1 (2003) U.S. Army Corps of Engineers Safety and Health Manual

1.3 SUBMITTALS

Government approval is required for all submittals with a “GA” designation; submittals having an “FIO” designation are for information only. The following submittals shall be submitted in accordance with SECTION 01330.

1.3.1 SD-01 Data

1.3.1.1 Electrical Equipment; GA

Submit 30 calendar days after award of contract, manufacturer, cut sheets and general Descriptive Specifications. Submit 90 calendar days after award of contract, complete data on accuracy, programming, wiring diagrams, communications ports, contact rating, calibration instructions and maintenance requirements as applicable for the following:

a. Feeder Relays.
b. Transformer Relays.
c. Meters.
d. Test Switches.
e. Control switches.

1.3.2 SD-04 Drawings

Submit 120 calendar days after award of contract all drawings relating to panel XPC. The XPC control panel drawings shall detail all relay, control switch, meter, test switch and instrument transformer connection and wire designations/tags. These drawings will be submitted under Section 16050 Paragraph 1.4.2

1.3.3 SD-06 Instructions

1.3.3.1 Relay Settings; GA

Contractor shall provide recommended relay settings to the Government for approval with 4 copies of the relay manuals describing relays features and procedures no later than 60 days before installation of the relays. These settings shall be equivalent to the existing settings on the electromechanical relays or per the latest Government coordination study. Contractor shall provide a factory relay engineer to discuss the relay settings by telephone conference call with the Government as necessary to develop a full understanding of the relay features and settings. Each function available in the relays and default settings will be discussed. Factory relay engineer shall advise which relay functions, if any, should be disabled or restrained for our applications.

1.3.4 SD-07 Schedules and Plans

1.3.4.1 Accessories and spare parts list; FIO

A minimum of 60 days prior to delivery of new relays, meters, control switches and test switches, submit catalog data sheet and spare parts listing in accordance with paragraph 2.15.

1.3.4.2 XPC Installation Work Plan; GA

Contractor shall submit the XPC Work Plan 45 days prior to start of Installation of XPC and removal of existing relays, paragraph 3.1.2.

1.3.5 SD-09 Reports

1.3.5.1 Relay Factory Production Tests; FIO

Within 30 days following completion of testing, furnish five certified copies of all test reports, including complete test data on all tests.

1.3.5.2 Relay Field Testing, Calibration and Programming Reports; FIO

Within 14 days following completion of testing, furnish five certified copies of all test reports, including complete test data on all tests and relay set points after the programming was completed.

1.3.5.3 Meter Field Testing, Calibration and Programming Reports; FIO

Within 14 days following completion of testing, furnish five certified copies of all test reports, including complete test data on all tests and meter programming.

1.3.6 SD-13 Certificates

1.3.6.1 Relay Certification; FIO

Within 30 days after date of award, certify in writing that the relays comply with this specification and with applicable IEEE Standards,

1.3.6.2 Field Service Engineer; GA

Within 90 days of award the Contractor shall provide qualifications of the Field Service Engineer that proves his ability to perform the functions of the Field Service Engineer for installation and testing of the relays, paragraph 3.5.

1.3.6.3 Training Engineer; GA

At least 90 days prior to the scheduled training the Contractor shall provide qualifications of the Training Engineer that proves his ability to provide the training for the relays and other XPC equipment, paragraph 3.4.

1.3.7 SD-18 Records

1.3.7.1 Equipment Delivery Notification; FIO

Provide written notification 14 calendar days prior to shipment of equipment, paragraph 3.2.1.

1.3.7.2 Request for Equipment Outages; GA

Provide written request for all outages 14 calendar days in advance of each switchgear outage.

1.3.7.3 Outline of Contractor-Furnished Training; GA

A minimum of 60 calendar days prior to onsite training, a training outline detailing course topics, material, and subjects, paragraph 3.4.

1.3.7.4 Training Schedule and Notification; FIO

Training schedule shall be coordinate with government 60 calendar days prior to the equipment becoming operational. Training must be provided on a mutually acceptable date before the equipment can be placed in service, paragraph 3.4.

1.3.8 SD-19 Operation and Maintenance Manuals

1.3.8.1 Operations and Maintenance Manuals; FIO

Submit 30 days prior to delivery of panel XPC Operation and Maintenance Manuals for the relays, control switches, meters, test switches and all other equipment associated with the XPC panel. Contractor to provide calibration, configuration and programming manuals for all relays and meters. If the manufacture has commissioning recommendations those instructions shall be included. O & M Manuals shall give recommendations for the type and frequency of maintenance testing required. A CD in place of hard copies is not acceptable although if a CD is available the CD should be provided also.

PART 2 PRODUCTS

2.1 PANEL XPC

2.1.1 General

The control panel XPC shall be a free standing metal cabinet with relays, meters, control switches, test switches and breaker indication lights as shown on the contract drawings and as required by this specification. Panel will be fabricated with maximum height of 84 inches and a maximum depth of 36 inches. Contractor shall either limit length of control panel sections to 72 inches or verify clearances are adequate for moving longer sections of the control panel into place. Each section shall have hinged doors that allow full access to the inside of the cabinet. Hinged doors shall be a maximum of 36 inches wide. Adjacent doors will be capable of opening 90 degrees at the same time.

Relays, meters and test switches shall be semi flush mounted on the front of the control panel. Semi flush shall be defined as not extending more than 1″ from the front of the panel. Breaker control switches and indication lights shall be mounted in the same section as the associated breaker relay and shall be located below breaker relay. Drawing DWP-1.8-6-1D7/5 shows the general layout of the panel. Test switches shall be located in the same section as the associated relays.

Control switches shall be mounted at least 36″ but not more than 48″ above finished floor. Relay and meter displays shall not be more that 6’6″ above finished floor.

Fuses are not allowed in the control switch circuit. The only protection allowed on the control circuit for the close and trip is the control power circuit breaker in the switchgear.

See SECTION 16050 for general cabinet construction requirements. Panel will be fabricated by a UL Certified Panel Shop built in accordance with UL-508.

Contractor responsible for final layout, design, interconnect, fabrication and installation of control panel XPC.

2.2 RELAYS

2.2.1 General

The transformer and feeder relays shall be microprocessor-based relays, which provide three phase protection. The relays shall provide primary circuit protection required for the application outlined in this specification. Relays shall provide complete monitoring and shall have programmable trip and alarm contacts as specified in this specification and as shown on the drawings in addition to the relay trouble contact. This specification outlines the minimum number of contacts required for each type of relay, additional contacts may be required on the drawings or by the design. If the contractor’s design requires additional contacts, the Contractor shall provide the additional contacts. Relays shall have adjustable time delays to prevent tripping on inrush current. Relays shall provide a record of faults and event recorder. Relays shall have a communications port. Relays that will meet this specification (some basic models may require optional features) include but are not limited to the GE Multilin 745 (transformer) or 750 (feeder), Cooper Power Systems Edison – Pro, Schweitzer Engineering Laboratories SEL-351 (feeder), SEL-387E (transformer) or approved equal. If the contractor provides SEL relays, or other relays that do not offer a window based programming, a minimum of 8 additional hours of training for relay technicians will be required on programming relays. Relay manufacturer shall have a minimum of 5 years experience manufacturing microprocessor bases relays.

Contractor shall provide recommended relay settings to the Government for approval with 4 copies of the relay manuals describing relays features and procedures no later than 60 days before installation of the relays. These settings shall be equivalent to the existing settings on the electromechanical relays or per the latest Government coordination study. If the Contractor’s Field Engineering Service Personnel cannot adequately answer questions, as outlined in paragraph 3.1.3.4, on the relays the Contractor shall provide a factory relay engineer to discuss the relay settings with the Government as necessary to develop a full understanding of the relay features and settings. Each function available in the relays will be discussed. Factory relay engineer shall advice which relay functions, if any, should be disabled for our applications.

2.2.2 Relay metering and monitoring requirements:

a. Three phase LCD readout on current, voltage, frequency and power (may have to scroll through). Metering accuracy of 2% on phase currents, voltage and power. Power factor for accuracy requirements nominally between .8 leading to .8 lagging.

b. Event recorder with record of last 60 events.

c. Internal Relay failure alarm

d. Record of last 10 faults.

e. Access to real time monitoring of power usage via RS 232/ RS 485 communications port with required software to data link with PC.

2.2.3 Standards

Except as otherwise specified, the Relays provided by the Contractor shall conform to the applicable requirements of the following IEEE and ANSI Standards: C37.90, C37.90.1 C37.90.2 and C37.91.

2.2.4 Communications Ports

Each relay shall have a RS 232/ RS 485 port, which will allow down load to a plant PC of real time metering values, event recorder and fault data. Any software required to allow download of this information to the plant PC will be provided with the relays. Communications ports shall be capable of a minimum of 19,200 bps.

Each relay shall be capable of having the set points / programming downloaded to the relay from a laptop computer. All software required to allow the download shall be provided. The final relay settings for each relay will be saved on a separate CD to allow programming to be loaded into new relay quickly. Training shall cover use of communications ports.

2.2.5 Power Supply

Each relay power supply will be rated to operate with an input voltage of 70-140 V DC.

2.2.6 Contact Rating

Trip contacts shall be rated for 30 amp at 125 VDC. Relay failure alarm and other alarm contacts shall be rated for a minimum of 1 amp at 125 V DC/120 V AC.

2.2.7 Digital (logic) Inputs

Relays shall have a minimum of 4 programmable digital logic inputs.

2.2.8 Enclosure/Connections

Relay shall be mounted in the new XPC panel. The front of the relay enclosure shall not extend more than 1″ from the front of the front of the panel. The Contractor shall supply all mounting hardware required to securely mount the relay in the panel. All current, voltage, power and trip contact connections shall be on the back of the relay and shall accept ring type terminals. One communications port shall be provided on the front of the relay.

2.2.9 Auxiliary Relays

Auxiliary Relays are required for transferring voltage signal for feeder relays between Station Service Transformers depending on which transformer is feeding the bus. The Auxiliary Relays shall be heavy duty relays with 125 VDC coil. The contacts shall be rated for 30 amp AC continuous. Cutler Hammer type M model D26MRD or approved equal.

2.3 FEEDER RELAYS

2.3.1 General

The feeder relays shall provide three-phase protection. The feeder relays shall provide the primary protection required for feeder circuits and as outlined below. Relays shall comply with all other applicable paragraphs of this section, including but not limited to paragraph 2.2.

2.3.2 Feeder relays shall have at a minimum the following current and voltage inputs.

a. Three current transformer input, one for each phase.

b. One potential voltage input. The voltage input source will be toggled between TJ01 VT source and TJ02 VT source depending on which transformer is supplying the relay bus.

2.3.3 Feeder Relays trip timers shall have a range of 0.01 to 250 sec in .5 cycle steps with an accuracy of 1 cycle. Feeder relays shall at a minimum provide the following feeder breaker protection:

a. Complete time overcurrent (three phase). Pickup range shall be 0.25-15 amp in .1 amp steps.

b. Instantaneous overcurrent (three phase). Pickup range shall be 0.25-100 amp in .1 amp steps.

c. Residual overcurrent.

d. Under frequency load shed. Pickup range shall be 45-60 Hz in 0.01 HZ steps.

e. Negative sequence protection.

2.3.4 Feeder Relay shall have at a minimum the ANSI curves listed below.

ANSI – Extremely Inverse, Very Inverse, Normally Inverse Moderately Inverse, Definite Time.

2.3.5 Feeder Relay shall have the following output contacts.

a. One trip rated contacts.

b. Two alarm rated contacts.

c. One relay trouble contact.

2.4 TRANSFORMER RELAYS

2.4.1 General

The transformer relays shall provide three-phase protection. The transformer relays shall have the provide primary protection required for transformer circuits as recommended in IEEE Standard C37.91 and as outlined below. A three winding transformer relay is required with independent overcurrent trip settings on all three windings. Relays shall comply with all other applicable paragraphs of this section, including but not limited to paragraph 2.2.

2.4.2 Transformer relays shall have at a minimum the following current and voltage inputs.

a. Nine current transformer inputs, one for each phase on the high side of the transformer and one for each phase for each of the low side switchgear breakers.

b. One potential voltage input.

2.4.3 Transformer Relays shall at a minimum provide the following transformer protection:

a. Complete time overcurrent, 51 (three phase). Three independent trip points shall be programmable. One trip point for primary winding breaker and separate / independent overcurrent protection set points shall be provided for each of the 2 feeder breakers. A relay that combines the currents for both of the low side breakers for a common trip point is not acceptable. An overcurrent on one low side breaker shall not trip the other low side breaker. Pickup range shall be 0.25-15 amp in .1 amp steps.

b. Instantaneous overcurrent, 50 (three phase) Independent trip points shall be programmable for primary winding breaker and separate / independent instantaneous overcurrent protection shall be provided for each of the 2 feeder breakers. A relay that combines the currents for both of the low side breakers for a common trip point is not acceptable. An instantaneous overcurrent on one low side breaker shall not trip the other low side breaker. Pickup range shall be 0.25-100 amp in .1 amp steps.

c. Residual overcurrent.

d. Differential, 87 (three phase).

e. Under frequency load shed. Pick-up shall be 45-60 Hz in 0.01 Hz steps.

f. Negative sequence protection, 46.

2.4.4 Transformer relay shall have at a minimum the ANSI curves listed below.

ANSI – Extremely inverse, Very Inverse, Normally Inverse, Moderately Inverse, Definite Time.

2.4.5 Transformer Relay shall have the following output contacts.

a. Four trip rated contacts.

b. Three alarm rated contacts.

c. One relay trouble contact.

2.5 TEST SWITCHES

2.5.1 General

Three test switches shall be provided for each transformer relay. One-test switches shall be provided for each feeder relay. All trip circuits and alarm circuits shall be routed through the test switch. Molded insulating barriers shall separate incoming connections.

2.5.2 Test switches shall have the following features:

a. Switches rated 30 amp, 600 V continuous.

b. Connection points to accept ring type terminal.

c. Front access for connection of standard test-clip or plug leads.

d. Red handled knife-blade switch for voltage, trip or control circuits.

e. Black handled knife blade for current circuits.

f. Current switches shall have make before break short-circuit feature so that when the switch is opened the CT is automatically shorted out.

g. Insulated cover.

h. Capable of having individual switches operated independently or connected together using yoking bar.

i. Switches shall be 10 position – 3 – 2 pole shorting current switches and 4 potential or control circuits.

j. Third party recognized as a component part.

ABB (Westinghouse) Type FT-1 Test Switch, AVO International States type FMS-10FF Test Switch or equivalent.

2.6 METERS

2.6.1 General

2.6.1.1 The meters shall be digital meters with led readouts. The meters shall provide three phase indication of current, voltage and power.

2.6.2 The cabinet mounted relay shall be a digital meter with the following functions:

a. Continuously display A, B, C phase current

b. Continuously display A-B, B-C, C-A phase to phase voltage

c. Scroll through to display KW, KVA, KVAR, MWH

d. Programmable contacts – 3 minimum

e. RS485 or RS232 port

f. 125 V DC control power

g. Overall accuracy of Meter .3% for voltage, .3% for current, .5% for power (kW, kVA, kVAR)

h. “User friendly” programming – Less than 2 hour of training is required to enable plant electricians to change programming.

i. Display shall have a minimum of a 4-digit display

Manufacturer must have a minimum of 5 years experience manufacturing digital meters. Electro Industries or OTEC or approved equal.

2.7 BREAKER CONTROL SWITCHES AND BREAKER INDICATION

2.7.1 General

2.7.1.1 The control scheme shall be as shown on the drawings and as described herein, and shall be complete with all features necessary to perform closing, tripping and indication for all station service breakers at panel XPC.

2.7.2 The control switches shall have the following features:

a. Switches rated 30 amp, 600 V continuous, 60 amp short time.

b. Connection points to accept ring type terminal.

c. Silver-plated contacts.

d. Pistol grip (for breaker controls).

e. Spring return.

f. Multiple contacts on each deck with separate replaceable decks.

g. Normal life span of 40 year with a minimum of 10,000 operations.

h. In compliance with IEEE 323.

i. Same manufacturer and model as provided in switchgear cubicles Electro-switch or approved equal.

2.7.3 Indicating lights shall 24 V LED with resistor and be identical to those provided in new switchgear cubicles.

2.8 CONTROLS, INDICATION and ALARMS

2.8.1 General

2.8.1.1 The control scheme shall be as shown on the drawings and as described herein, and shall be complete with all features necessary to perform local and remote closing, tripping, and testing, as well as to automatically provide for safety, and remote indication and alarms, except where indicated otherwise below.

2.8.2 Design Responsibility

The contract drawings show the required control scheme. The contractor is responsible for the detailed design. Design shall use standard definitions as listed in IEEE C37.100. The design includes but is not limited to the following items:

a. Selection of the protective relays, meters, test switches, terminal blocks and associated equipment.

b. Development of any additional interconnect drawings not provided in this package required to remove existing protective relays and then install new relays, test switches and other equipment as indicated on the drawings. There are existing meters and other controls will need to be rewired so that there is no loss of function for the equipment. Contractor is responsible for any rewiring of CTs or other equipment required by his relay selection and design.

c. Drawing indicate only the general location of the new relays and test switches in panel XPC. Layout of the equipment will depend on the size of the relays and test switches selected by the contractor and location of wiring channels, terminal blocks and other equipment. Contractor is responsible for layout of equipment in panel.

d. Contractor responsible for verifying termination points for breaker trip and alarm circuits.

e. Contractor to complete elevation, three lines, schematic diagrams, wiring diagrams and terminal connections drawings as required showing the wire numbers and terminal block numbers and any other details required to provide complete “As –Built” drawings of the system at completion of the project.

f. Contractor to verify that all interlocks are operable.

2.9 MATERIALS

2.9.1 General

All articles, materials and equipment shall be the standard products of manufactures regularly engaged in the manufacture of these products and shall essentially duplicate items that have been in satisfactory use for at least five years prior to receipt of proposals. Devices and equipment used for the same or similar services shall be of the same make and type, and shall be interchangeable when of the same rating. In case the Contractor desires to use stock material not manufactured specifically for the work covered by these specifications, evidence satisfactory to the Government that such material conforms to the requirements of these specifications shall be submitted, in which case detailed tests of these materials may be waived. Control devices and equipment provided by the Contractor will comply with applicable sections of NEMA AB 1, ICS 1, ICS 2 and ICS 6 for that equipment.

2.9.2 Quality Control

Unless waived in writing, all tests or trials shall be made in the presence of a Government quality assurance representative (GQAR). Five copies of all test reports shall be submitted. The test reports shall be furnished as soon as practicable after the tests are made and shall be submitted in such forms as to provide means of determining compliance with the applicable specifications for the material tested.

2.9.3 Marking

Test specimens and samples for analysis shall be plainly marked to indicate the materials they represent and, if required, they shall be properly boxed and prepared for shipment.

2.9.4 Cost

Except as provided elsewhere, all costs of all tests and trials, excepting the pay and expense of the GQAR shall be borne by the Contractor and no separate payment will be made therefore.

2.10 LOW-VOLTAGE ELECTRICAL CONNECTIONS

2.10.1 Control Wiring

2.10.1.1 Wiring

Wiring within the operating mechanism housing, control cabinets, and terminal cabinet shall be neat and orderly in horizontal and vertical runs with 90 degree bends, with minimum tension or other stress on the insulation, without splices and securely held in place with cleats and straps. Leads to other devices external to the control cabinet, where not installed in channels or ducts, shall be formed into compact wire bundles suitably bound together and properly supported. Bindings and supports shall not cause damage or cold flow to the insulation.

2.10.1.2 Insulated Wire

Insulated wire shall be Underwriters Laboratories listed, type SIS, in accordance with UL 44. Insulated wire shall meet UL 1581 VW-1 flame test requirements. Wire such as XHHW or RHH or similar wire is NOT permitted for wiring internal to the control panel. All wires shall be single conductor, of stranded coated annealed copper, insulated for not less than 600-volt service. Conductors shall be Class B or Class C stranding, except for hinge wire, which shall be Class K stranding. Conductor size shall be not less than No. 14 AWG, except for current transformer secondary leads, which shall be not less than No. 10 AWG. All connections to device terminal studs or blocks shall be made with pressure indented ring terminals. Short, well protected and well supported runs of smaller wire sizes may be used only if specifically approved for each application, and only for internal functions which retain at least a 30% safety factor in wire ampacity. No PVC insulation is allowed.

2.10.1.3 Wire Markers

Wire markers for conductor termination identification shall be approved tube-type suitable for contact with rubber, neoprene or plastic. Tubing shall be sized to fit the wire being marked and shall have black marking on a lighter colored background. Kroy shrink tubing or other approved equal.

2.10.2 Terminal Blocks

All wiring between relays and external devices shall be terminated on terminal blocks or test switches after entering the cabinets. All specified additional features of equipment, such as spare contacts, shall each be wired to separate terminal block points. All terminal blocks shall accept ring type terminals. Any devices furnished with leads rather than terminals shall have the leads terminated on terminal blocks. Terminal blocks for specific equipment or groups of equipment shall be near that equipment in an accessible location. Terminal blocks for external wiring shall be grouped in a common area, preferably near the incoming conduit penetrations, with ample space for connecting external cables. At least ten percent of the total quantity of terminal block points shall be provided as additional spares. The spare terminals shall be located in large groups.

2.10.3 Wire and Cable Designations

The wire designations used on the Contractor's wiring diagrams shall be printed on the terminal block marking strips. The wire numbers will match the contract drawings in all cases where a wire number is provided. The Contractor will mark the wire and cable designations, for identification of remote (external) circuits, on prints of the Contractor’s terminal connection drawings and submit for Project Personnel approval. These drawings will be returned to the Contractor with any required changes who shall add these designations to the drawings and to the terminal block marking strips. Each conductor termination shall be identified with the wire designation as shown on the schematics, full line diagram or other drawings and the destination of the conductor (reverse address) on a non-metallic tube-type marker on the conductor. Installed markers shall be uniform in position on

the wires, and legends shall be visible when wires are terminated on terminal blocks or equipment.

2.11 THREADED FASTENERS AND JOINTS

Threads for all electrical, mechanical or structural, permanent or temporary connections to external devices shall meet the following requirements, or adapters shall be provided where practical. All bolts, studs, machine screws, nuts, and tapped holes shall be in accordance with ASME Standards B1.1. Threads for sizes 1/4 inch to 1 inch, inclusive, shall be NC or UNC series. The sizes and threads of all valves, pipe and fittings, conduit and fittings, tubing and fittings, and connecting equipment, shall be in accordance with ASME Standard B1.20.1. Manufacturer's standard threads and construction may be used on internal items.

2.12 WELDING

All welding shall be performed by the electric-arc method, by a process which will exclude air from the molten metal and, where practicable, under procedure control using automatic machines. The design and construction of welded joints shall conform to the requirements of Part UW of section VIII of the code, or to AWS D1.1 as applicable. After being deposited, welds shall be cleaned by shot blasting unless otherwise approved, and shall show uniform sections, smoothness of weld metal, featheredges without overlap, and freedom from porosity and inclusions. Visual inspection at the edges and ends of welds shall indicate complete fusion with the base metal. Particular care shall be taken in aligning and separating the edges of members to be joined by butt-welding, so that complete penetration and fusion for the full depth of the joint will be assured. All pinholes, cracks, and other defects shall be repaired by chipping or grinding the defect to sound metal and re-welding. Where fillet welds are used, the members shall fit closely and shall be held together during welding. The welding rods used for manual welding shall be suitable for the position in which the welding is performed. Welders and tack welders shall be qualified as required in Section 16340.

2.13 PAINTING

All surfaces shall be thoroughly cleaned by sand blasting or shot blasting before painting. The interior surfaces of cabinets shall be finished with not less than one prime coat and one light-colored finish coat of enamel. All exterior surfaces, including cabinets, exposed mechanisms, raceways and piping, shall be given a rust inhibitive primer coat and two finish coats of enamel. The enamel used for the finish coat shall be of weather-resisting properties and shall be ANSI Indoor Light Gray No. 61 in color, or if approved, the manufacturer's standard color. All finished metalwork shall be suitably wrapped or otherwise protected from damage during shipment and installation. Adequate paint of the same color and type shall be provided for touch-up of damage after installation.

2.14 TOOLS AND ACCESSORIES

The Contractor shall furnish a complete set of all special tools, recommended or cited in the maintenance instructions, for installation

or maintenance. Any accessories and appliances that are regularly furnished with these relays or that may be necessary for the satisfactory installation, adjustment and maintenance thereof shall be furnished regardless of whether such accessories or appliances are specifically called for in these specifications.

2.15 SPARE PARTS

2.15.1 General

Spare parts shall be furnished in the quantities recommended by the manufacturer. All spare parts shall be duplicates of the original parts furnished and interchangeable therewith. All spare parts shall be packed separately in containers plainly marked ‘SPARE PARTS’. A packing list listing the contents of each container and contract number shall be placed in a moisture proof envelope and securely fastened to the outside of the container. At a minimum supply the following parts:

a. Spare power supply for each type of relay.
b. One spare transformer relay.
c. Three spare feeder relays.
d. Two sets of 10 terminal blocks.
e. One control switch of each type used.
f. 15 indicating lights.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Unless otherwise specified, execution of all installation work shall be in accordance with the National Electrical Code, NFPA 70, the National Electrical Safety Code, ANSI C2, and with the U.S. Army Corps of Engineers Safety and Health Manual, EM 385-1-1. The work under this contract is subject to the safety clearances and operating procedures currently practiced by the Dworshak Dam Project Office. All the construction activities shall be coordinated with the Contracting Officer’s Representative so that the construction will not adversely affect the daily operation of the powerhouse. Safety clearances shall be obtained before opening, entering or working on any existing equipment such as power centers, switchboards, and alarm cabinets. The Contractor shall provide to the Government, written request for all outages 14 calendar days in advance of each switchgear outage.

The Contractor shall install the XPC panel and complete the wiring between the switchgear and the relays so that when the new switchgear bus is energized the new relaying in panel XPC is operational to provide protection for the switchgear, breakers and equipment. The XPC control panel work plan, required in paragraph 3.1.2, shall include details of when the panel installation and testing will be completed so that relaying protection is maintained.

All working areas shall be kept clean and orderly at all times. Tools and construction equipment shall be put away at the end of each workday. All discarded packing materials; wire ends and conduit pieces shall be placed in proper receptacles. Dust and other debris must be prevented from entering electrical cabinets when drilling holes in existing concrete. If the creation of dust cannot be avoided the work area shall be vacuum-cleaned immediately after the activity.

3.1.2 A Work Plan for Installation of Panel XPC, Removal of Existing Relays and Modifications of Existing Switchgear Controls

Both buses for the Station Service Switchgear cannot be shut down at the same time except when the two 4160 V buses are being electrically isolated from one another. There is a primary and backup breaker for each feeder. Contractor will be required to develop a work plan and design that will allow XPC panel to be installed and tested on one bus before any work is started on the controls and relaying for the matching breaker on the second bus. The only exception to this is when there are interlocks between breakers on different buses where the interlocks cannot be completed until work on the second bus has been completed. Temporary wiring shall be installed for at least one of the transformer relays since the overcurrent protection for the transformer feeders is located on Bus 1 cubicles and the differential protection is located on Bus 2 cubicles. The Station Service transformers shall not be without proper relaying protection for more than 4 days. The Contractor shall have sufficient personnel performing the work and testing so that the shutdown of the equipment can be minimized.

The panel XPC and switchgear contain control voltages from multiple sources and connections for multiple current transformers in the same area. Electricians will be working in areas where there will be energized control circuits. There is a possibility that a current transformer could be open circuited. Wiring in the XPC panel shall be arranged so that incoming CT and control terminations from Bus 1 are separate from Bus 2 to minimize the possibility of workers coming in contact with an energized circuit. Work plan shall indicate the safety precautions to be used to insure worker safety. Contracting Officer’s Representative must approve work plan before work can proceed.

3.1.3 Removal of Existing Relays

3.1.3.1 Existing relays shall be carefully removed from the cases in the switchgear and turned over to the Contracting Officer’s Representative. All current transformers that connect to circuits that could be energized shall be shorted out at the current transformer before the wiring is disconnected from the case. This should be necessary only for the transformer relays and meters. Wiring to the cases will be removed back to the terminal blocks or associated equipment as indicated on the drawings. This should be necessary only for the high side CT on the transformer differential circuit. All of the other relay wiring will be removed when the switchgear is removed. Annunciator wiring is covered in section 16050.

3.1.3.2 Interconnecting wiring shall be installed per contractor design, drawings, section 16050 and paragraph 2.10.

3.1.3.4 Relay - Routine and Operational Field Tests and Programming

On-site field engineering services shall be provided to inspect, test, install and program the relays. Field Engineering Service Personnel shall be available for a minimum of 8 hours to discuss relay set points, programming and relay features with HDC personnel to determine optimum setting and resolve any programming problems. This is in addition to the training for plant personnel. Field engineering services and testing shall acceptable to the relay manufacturer so that installation and testing of the relays do not void the relay manufacturer’s warranties. Submit a test plan procedure, for approval, listing the routine and operational tests to be conducted. See paragraphs 3.2 for minimum relay testing requirements. The routine and operational tests shall be as outlined in this specification and as recommended by the manufacturer and the Field Service Engineer.

3.2 RELAY TESTS

3.2.1 General

Each relay shall be given manufacturer's routine shop tests and also other electrical and operating tests as specified below. The factory test equipment and the test methods used shall conform to the applicable requirements of ANSI, IEEE, NEMA and NETA Standards. The Contractor shall provide written notification to the Government 14 calendar days prior to shipment of equipment and no equipment shall be shipped until the Contracting Officer has approved it for shipment. The cost of performing all tests shall be borne by the Contractor and shall be included in the unit prices for the items of the Schedule. Where conditions of two or more tests are identical, they may be performed simultaneously, unless a specific sequence is required. Where a more severe required test fully demonstrates capability to withstand a less severe test, the lesser test need not be performed.

3.2.2 Design Tests

Design tests shall have been performed on relays identical to those furnished under this contract. Proof of adequacy of design shall be by certified reports of previously performed tests, or of tests, which will be performed. The Contractor’s certified report shall identify all design tests, which were performed to certify the design.

3.2.3 Field Tests

3.2.3.1 General

Each relay shall be tested and programmed after the XPC panel has been installed. The tests shall be witnessed by the GQAR. At a minimum each relay will be fully tested for all functions specified. Testing shall check all programmed set points for each function. If no set points are programmed for a function that is required, a set point will be programmed in so the function can be tested. Relay programming will be reset for these functions after the tests are completed. Testing shall check all programmable auxiliary contacts. All transformer and feeder relay and meter current function testing shall be done with secondary current injection. Current for at least one test for each relay shall be injected at the switchgear current transformers so that all wiring

from switchgear to relay is tested. The current injection for the high side transformer CTs for the differential testing may be done at the panel. All test values, current, time, voltage, frequency, time shall be recorded on a test sheet as the tests are done. Test sheet shall give the acceptable range for each test. At the completion of the testing the Field Service Engineer performing the test and the GQAR shall sign the test results. The Field Service Engineer performing the test shall discuss the testing procedures with the GQAR prior to the testing starting. If the manufacturer's commissioning test procedures are more severe than the testing outlined below then the manufacturer's testing procedures shall be substituted, as applicable, for the testing outlined in this specification. The Contractor shall submit completed test reports within 30 days of completing relay testing. If construction is such that the testing for the relays for one bus is completed more than 30 days before the relays for the second bus can be tested then contractor shall made a separate submittal for the relays for each bus. The Contractor shall furnish five certified copies of all test reports, including complete test data on all tests. Test reports shall include final download from each relay showing all final set points. This shall be provided both in hard copy and on compact disc.

Verify CT polarity, phase rotation (existing and new), transformer phase shift, phase shift between high side winding and low side winding CTs as necessary so that relays and meters (new and existing) will function properly.

3.2.3.2 Test Equipment

All test equipment shall have been calibrated within a maximum of 1 year of the date of the testing or per equipment manufacturer's recommendations if manufacturer recommendation is less than a year. Provide test equipment calibration date, make, model, range and accuracy. Test equipment shall have the range and accuracy, (current, voltage and time increments) to accurately test the relays. At a minimum the relay / meter test equipment shall have the following functions.

a. Three phase current 0-30 amp per phase with variable phase shift between phases for testing differential (30 degree phase shift between high side and low side currents on Station Service Transformer)
b. Single phase voltage with variable frequency, 0.01 HZ resolution.
c. Three phase current and voltage.
d. Variable phase shift between current and voltage for power factor verification.
e. Accuracy of 0.1% on current and voltage
f. Timer with 0.01 second resolution
g. Current injection to start at preset level at same time as timer starts and signal stops timer when relay trip or auxiliary contact closes.

3.2.3.2 Feeder Relays

At a minimum the following tests shall be performed on each transformer relay.

a. Test time overcurrent for each of the 3 CT inputs separately and three phase – four tests at each test point. Preferred test

points are 2 X pickup and 5 X pickup unless 5 X pickup is higher than the instantaneous overcurrent level. If the 5 X pickup is above the instantaneous overcurrent level then either the highest practical test current shall be substituted or the instantaneous trip disabled for this test.

b. Test instantaneous overcurrent for each of the 3 CT inputs separately and three phase.
c. Test ground fault time overcurrent.
d. Test ground fault instantaneous overcurrent.
e. Test negative sequence with phase unbalance set at 10%.
f. Test under frequency function at 59 Hz.
g. Test metering accuracy for all meter displays on relay.

3.2.3.3 Transformer Relays

At a minimum the following tests shall be performed on each transformer relay.

a. Test time overcurrent for each of the 9 CT inputs separately and three phase. Preferred test points are 2 X pickup and 5 X pickup unless 5 X pickup is higher than the instantaneous overcurrent level. If the 5 X pickup is above the instantaneous overcurrent level then either the highest practical test current shall be substituted or the instantaneous trip disabled for this test.
b. Test instantaneous overcurrent for each of the 9 CT inputs separately and three phase.
c. Test ground fault time overcurrent for each set of 3 CT inputs.
d. Test ground fault instantaneous overcurrent for each set of 3 CT inputs.
e. Test negative sequence with phase unbalance set at 10%.
f. Current differential for each phase from high side to low side Bus 1 and high side to low side Bus 2 separately and three phase. When different curves are selected for different current levels the testing will test each current level.
g. Test under frequency function at 58 Hz.
h. Test metering accuracy for all meter displays on relay.

3.2.3.4 Circuit Operation Tests

After installation of all relays and other equipment the operation of the control circuit will be tested. Relay trips will be simulated to verify breaker trip circuits and alarm circuits. Operational tests will verify that all control switches and interlocks are operational.

3.2.3.5 Control Circuit Dielectric Tests

All control circuits and devices shall be given, in addition to the standard required dielectric tests, a 2500 volt AC dielectric withstand capability test. This test shall be in accordance with IEEE Std. C37.90, Section 9.

3.3 METER TESTS

3.2.1 General

Each meter shall be given manufacturer's routine shop tests and also other electrical and operating tests as specified below. The factory

test equipment and the test methods used shall conform to the applicable requirements of ANSI, IEEE and NEMA Standards. Each meter shall be tested and programmed after the XPC panel has been installed. Current injection shall be used to test the meters. Records shall be kept of the test current, voltages and phase shift and compared to the meter readings to verify the programming and accuracy of the meters. The following functions shall be tested.

a. Test current display on all three phases.
b. Test voltage display.
c. Test power, KW, KVA, KVAR and compare to phase angle between current and voltage.

3.4 CONTRACTOR-FURNISHED TRAINING OF GOVERNMENT PERSONNEL

Field Engineering Services will instruct Project personnel on the theory, operation and maintenance of the new relays. The courses for the relay maintenance personnel shall be of 8 hours minimum duration (one full working day). In addition to the relay maintenance courses there shall be two courses for operational personnel that will be a minimum of 4 hours each. The training for the operators will be scheduled to cover different shifts so that all may attend. The training shall be conducted for approximately 10 Government employees at the Project for each session. The relay maintenance course shall include relay design and theory of operation, calibration and programming of the relays provided, routine maintenance, and trouble analysis and safety precautions. The operations course shall include relay design, theory of operation, use of displays and explanation of trip and alarm messages. Demonstrations shall be on the actual relays furnished, to the maximum extent possible. Course material shall use to the maximum extent possible, the site-specific operation and maintenance data that the Contractor is providing for the project. The Government may videotape the training sessions for future use. A minimum of 60 calendar days prior to training, the Contractor shall submit for Government approval, a training outline detailing course topics, material, and subjects. The training schedule shall be coordinated with the Government at least 60 days prior to any element of the work becoming operational except for the transformer relays. That includes the circuit breakers and the relays and meters. The transformer relays will be placed in service as soon as possible to provide protection for the Station Service Transformers during construction. Government reserves the right to schedule the training with the contractor on a date that is acceptable to the needs of the government to include constraints outside the scope of the construction project.

The contractor personnel providing the training shall have at least 2 years experience on the relays and meters provided. The trainer shall be a factory representative of the relay manufacturer or have completed a relay training course taught by the manufacturer of the relays provided on the relays provided.

3.5 QUALIFICATIONS OF FIELD ENGINEERING SERVICE PERSONNEL

Qualified field engineering service personnel shall be provided who are fluent in the English language to supervise, test, and install the new relays. The personnel shall have a minimum of two years experience in

the installation and testing of microprocessor based relays. Field Engineering Service Personnel overseeing the relay testing shall either have attended a factory provided relay training course provided by the manufacturer of the relays provided or be certified as a Level III or higher electrical testing technician as defined by ANSI / NETA ETT-2000. The Field Engineering Service Personnel shall be capable of discussing the relay capabilities, programming and recommended settings of the relays with HDC personnel in order to optimize the performance of the relay. The Field Engineering Service Supervisor shall certify that the equipment has been installed in accordance with the manufacturer’s recommendations and all warranties are in effect.

4. SUMMARY OF SUBMITTALS

Submittal register ENG Form 4288 to be furnished by the Contractor shall include the following:

Paragraph	Item	SD	AEA
16440-1.3.1.1	Electrical equipment	01	HDC
16440-1.3.2	Drawings now submitted in 16050	04	HDC
16440-1.3.3.1	Relay Settings	06	HDC
16440-1.3.4.1	Accessories and Spare Parts List	07	C
16440-1.3.4.2	XPC installation work plan	07	HDC
16440-1.3.5.1	Relay factory tests	09	C
16440-1.3.5.2	Relay field-testing	09	C
16440-1.3.5.3	Meter field-testing	09	C
16440-1.3.6.1	Relay certification	13	C
16440-1.3.6.2	Field Service Engineer	13	HDC
16440-1.3.6.3	Training Engineer	13	HDC
16440-1.3.7.1	Equipment delivery notification	18	C
16440-1.3.7.2	Request for equipment outage	18	HDC
16440-1.3.7.3	Contractor furnished training	18	HDC
16440-1.3.7.4	Training schedule	18	C
16340-1.3.8.1	O&M manuals	19	C

Code for Submittal Description (SD)

01 - Data
04 - Drawings
06 - Instructions
07 - Schedules and Plans
08 - Statements
09 - Reports
13 - Certificates
14 - Samples
18 - Records
19 - Operation and Maintenance Manuals

Action Element for Approval (AEA)

C - Contractor
AE - Architect Engineer
ED - Engineering Division
CD - Construction Division
EDE - Engineering Division, Electrical Design
EDH - Engineering Division, Hydraulic Design
EDM - Engineering Division, Mechanical Design
EDS - Engineering Division, Structural Design
HDC - Hydroelectric Design Center

* * * * *

SPARE PARTS RECEIPT

Contract No.:_____

Contract Name: _____

Contractors Name: _____

Technical Specification Number: **16440**

Paragraph Number: **2.15**

List of Spare Parts Delivered (Quantity and Description): *

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

All spare parts required in the technical specification section are included: Yes ☐ No ☐

All documentation required in the technical specification is complete and included: Yes ☐ No ☐

VERIFICATION: The above spare parts receipt is complete and correct, all required spare parts have been turned over to the Government, and all documentation is complete and included with the spare parts.

_____ _____
CONTRACTOR'S REPRESENTATIVE DATE

_____ _____
Government's Representative Date

*Attach additional sheets as necessary.