

***PJM GENERATOR INTERCONNECTION  
Request Queue #A5  
Bergen 500 MW  
Facilities Study Report***

156685  
***October 2001***

## Table of Contents

<b><u>Title</u></b>	<b><u>Page</u></b>
<b>Scope</b>	
Description of Project	4
Interconnection Customer's Work	4
Scope of PSE&G's Work	5
Developer's Milestone Schedule	5
<b>Lines</b>	
- New Bergen #2 Generating Station – Bergen Switching Station 230kV line	5
- Upgrade 230kV Circuit Breaker Interrupting Ratings at Hudson and New Milford Switching Stations	6
<b>Substations</b>	
- Install 230kV Terminal Bergen Switching Station	7
<b>Protective Systems</b>	7
- Bergen #2 Generating Station Line Relaying	
- Bergen Switching Station Line Relaying	
- Bergen Switching Station 230kV Bus	
<b>Metering</b>	8
<b>Supervisory Control and Data Acquisition</b>	8
<b>Summary</b>	
Cost	9
Project Schedule	
Uncertainties/Qualifiers	9

## **Attachments**

1. Bill of Material
2. SCADA Point List
3. One Line Diagram – Existing Bergen Switching Station
4. One Line Diagram – Final Bergen Switching Station
5. Drawing List – Bergen #2
6. Drawing List – Bergen Switching Station
7. Project Schedule

## **INTRODUCTION**

### **Description of Project**

The PSEG Power (Project A5) is a 500 MW combined cycle, gas-fired generating facility consisting of two (2) GE Frame 7FA combustion turbines that will exhaust into two (2) Heat Recovery Steam Generator's (HRSG). The exhaust steam will drive one steam turbine generator. The facility is located in Ridgefield, Bergen County, New Jersey. The interconnection to the PJM system will be at Public Service Electric and Gas Company Bergen Switching Station via a new 230kV transmission line. The generation facility is located 1.1 mile from PSE&G's Switching Station.

### **Scope of Interconnection Customer's Work**

#### **Bergen Generating Station Substation**

The developer will be constructing a three (3) breaker, single 230kV bus substation. The three terminal positions will be allocated for connection of the two combustion turbine generators and one steam turbine. The 230kV transmission line will be directly connected to the single 230kV bus.

The relaying, controls and fiber optics to be installed at Bergen Generating Station Substation will consist of line relay protection ABB REL356 and RFL 9300 type relays and fiber optic interface. This equipment will be specified by PSE&G and furnished by the Interconnection Customer. Communications between Bergen Generating Station and Bergen Switching Station line relays is via overhead fiber optics installed in the shield wire.

PSE&G will purchase and delivery four (4) 230kV PT/CT combination units and associated revenue metering equipment. Installation of this equipment will be coordinated between PSE&G and the Interconnection Customer. The spare fourth PT/CT combination unit will be stored on the Bergen Generating Station site.

PSE&G will purchase and deliver one Electric System Operations Center (ESOC) telemetering equipment cabinet to send digital and analog data, as specified by ESOC, from the Project to the ESOC in Newark, NJ. The Project will install this equipment and pull all required ac and dc power and control cables to the ESOC telemetering equipment to meet PSE&G requirements. Maplewood personnel

will terminate all cables inside the ESOC cabinet and coordinate testing of all SCADA points with the Project.

### **Scope of PSE&G's Work**

- Construct a new 1.1 mile 230kV transmission line from developer's substation to PSE&G's Bergen Switching Station.
- Construct a new 230kV line position at Bergen Switching Station Bus Section 4.
- Upgrade Westinghouse 2300SF Circuit Breakers from 40kA to 50kA.
- Provide revenue metering grade measurement equipment.
- Provide Supervisory Control and Data Acquisition equipment.

### **Developer's Milestone Schedule**

It is currently PJM and PSE&G's understanding that the interconnection Customer (PSEG Power) has established the following major milestone dates:

Substation Energization:	October 26, 2001
Network Reinforcement	November 19, 2001
Initial Operation	January 23, 2002
Commercial Operation:	May 1, 2002

Network reinforcements must be completed prior to full load operation.

### **Lines**

New Bergen Generating Station – Bergen Switching Station 230kV Transmission Line H-2260.

#### Physical Description

The direct connection involves the construction of a new 230kV transmission line from the developer's substation to PSE&G's Bergen Switching Station. The line is 1.1 mile long. PSE&G will design and build the transmission line. This new line will require the following nine structures and concrete/caisson foundations, beginning at Bergen Generating Station:

Pole 1/1A, Pole 1/1, Pole 1/2, Pole 1/3, Pole 1/4, Pole 1/5, Pole 1/6, Pole 2/1 and Pole 2/2.

Each phase wire will be a single 1590 54/19ACSS/AW. One fiber optic static wire (Alcoa OGW 24/73/551) will also be installed.

#### Ratings

The line will be designed to provide adequate clearance at a maximum design temperature of 200C. The normal/emergency summer rating is 2375/2745amperes and a normal/emergency winter rating of 2539/2908 amperes.

### Design Criteria

The loading criteria conforms with the draft copy of PJM's Design Criteria for Electrical Transmission Lines Connected to PJM 69kV through 500kV Transmission lines.

Foundations are to be reinforced concrete piers on steel H-piles. Grounding to be via 250 kcmil copper cad welded to H-piles.

Support structures to be single steel poles, vertical configuration, single string insulators.

Ruling spans to be 500-1000 feet with maximum tension per conductor for 1000 ft. span for the conductor to be 15,600 lbs and for the static wire to be 5,600 lbs.

### Right of Way

PSE&G will obtain an easement from developer for 0.68 miles of the transmission line located on developer's property. Five (5) of the nine (9) structures will be on this easement. The remaining four (4) structures will be on property owned by PSE&G.

### Environmental Considerations/Permits

Wetlands permits are required for two (2) structures which are in a "Marshland Preservation" zone. Hackensack Meadowlands Development Commission Approval is required throughout as are Building Permits from the Borough of Ridgefield. An Army Corps of Engineers' permit is required for one (1) site.

FAA and FCC permits are required.

A permit is required for stringing wire over the NJ Turnpike.

Siting of the line was finalized after investigating several alternate routes. The route chosen is along what has been considered a "Utility Corridor" for many years and is the furthest from any residential property.

## **Reinforcement of Hudson Switching Station and New Milford Switching Station 230kV Circuit Breakers**

### Hudson Switching Station

Upgrade the interrupting rating of the existing 230kV circuit breakers, designated, Hudson BS7-12, and Hudson BS7-8.

### New Milford Switching Station

Upgrade the interrupting rating of the existing 230kV circuit breakers, designated, New Milford BS1-10, New Milford BS1-5, New Milford BS2-6 and New Milford BS2-10.

## **Substations**

### **Bergen Switching Station 230kV**

#### **Physical Description**

The direct connection of the PSE&G Power Bergen 2 Unit requires the addition of one (1) new 230kV line position in BS4, between the BS2-4 and BS3-4 circuit breakers, foundations, A-Frame dead-end structures, equipment support structures, bus and bus support structures.

#### **Ratings/Design Criteria**

Circuit Breaker: 242kV, 50kA, 2000A, SF6 insulated with CTs  
Line Disconnect Switch: 242kV, 100kA Momentary Asymmetrical, 900kV BIL, one (1) ground switch, manually operated.  
Bushing Current Transformer: CT 3000-5

#### **Permits**

The following permits are required and have been received:

- Hackensack Meadowlands Development Commission (HMDC)
- Municipal Construction Permit

### **Upgrade Hudson Switching Station and New Milford Switching Station 230kV circuit breaker interrupting rating.**

#### **Physical Description**

The Hudson Switching Station 230kV BS7-12 and BS7-8 circuit breakers and New Milford Switching Station 230kV BS1-10, BS1-5, BS2-6 and BS2-10 will be upgraded to accommodate the increased available fault current. The ABB upgrade kit from 40kA to 50kA interrupting capability

### **Protection Systems**

#### **PSEG Power Bergen Generating Station – Bergen Switching Station 230kV Line H-2260 Terminal Relaying**

#### **Physical Description**

The recommended primary and backup relay protection on the Bergen Switching Station to Bergen 2 230kV line are as follows: the line relay types will be ABB REL356 and RFL 9300. It is recommended that the

line relays at the remote end match the line relays indicated above. Fiber optic modem will provide the interface.

Breaker failure relaying is required for the two (2) 230kV breakers at Bergen Switching Station bus section 4 as well as the three (3) 230kV breakers at Bergen 2. It is recommended that SEL-2BFR relays be used for these schemes.

### **Metering**

PJM revenue metering will be at Bergen 2 Substation. Combination Instrument Transformers Type N5-900-230-202 manufactured by Haefely/Trench will be installed in the Bergen 2 Substation. Provide 230kV PT/CT devices and electric recording revenue metering equipment.

Install telemetry equipment in the Bergen 2 230kV switchyard. to provide the Electric System Operations Center the ability to monitor and measure electrical quantities.

Scientific Columbus Type JEM-10 will provide pulse outputs and communicate Import mw-hours, Export mw-hours.

### **Supervisory Control and Data Acquisition**

New Remote Telemetry Unit will be installed at Bergen 2 Generating Station. A dedicated full data communication line from the developer's RTU to PSE&G Electric System Operations for transmittal of all required digital and analog signals for PSE&G and PJM.



## SUMMARY

### Cost of facilities included in the Study

PSE&G's estimated cost including procurement, installation, commissioning and energization, documentation preparation and design review for the interconnection of A5 to the transmission system is \$6,550,000.

The breakdown is as follows:

Construct a new 1.1 mile 230kV transmission line from Bergen Generating Station to Bergen Switching Station	\$5,000,000
Establish a new terminal position for H-2260, Bergen Generating Station – Bergen Switching Station	\$ 645,000
Upgrade Hudson Switching Station and New Milford Switching Station 230kV circuit breakers	\$ 750,000
Revenue Metering	\$ 95,000
Supervisory Control and Data Acquisition	<u>\$ 60,000</u>
Total	\$6,555,000

<b>Direct Labor Costs</b>	<b>\$2,075,000</b>
<b>Indirect labor Costs</b>	<b>\$ 230,000</b>
<b>Material Costs</b>	<b>\$4,250,000</b>
<b>Carrying Costs</b>	N/A

### Project Schedule for Facilities included in this report

Project A5 Schedule: See Attachment #7

### Uncertainties/Qualifiers

The accomplishment of the work on PSE&G System is predicated on transmission outages on the 138kV system that will impact the operation of Bergen 1 generation during the summer period and the following:

- A four day outage of the E-1305 and F-1306, non consecutive days is required to perform wire stringing.
- Underlying 26kV distribution circuits are required for wire pulling.
- No transmission disturbance or related failures on the PSE&G Transmission System
- No environmental or regulatory delays
- No Contractor problems
- No Force Majeure
- Traffic slow-downs for four (4) days while installing wire across the New Jersey Turnpike.

# Attachment #1

## ***BILL OF MATERIAL***

230Kv Bushing Current Transformers Part No. 939A411-01  
 4” IPS Aluminum Tubing Schedule 40  
 350 kcm Copper cable  
 1590 kcm ACSR bare 61 strand cable  
 230kV Insulators  
 Bus clamp/hardware  
 4” PVC conduit

230kV Revenue Metering Units (4) Part No. N5-900-230-202  
 JEM10 Meter

GE Harris RTU  
 RTU Cabinet  
 JEMSTAR Power Supply for A/O  
 Terminal Blocks  
 Switches  
 RS485 Comm Mod for JEMSTAR

12 Fiber Outdoor  
 Optical Ground Wire Splice Box  
 Optical Ground Wire  
 OGW Splice Box Adapter  
 Underground Fiber Optic Adapter  
 Ground Wire Clamps  
 1590 kcm ACSS overhead conductors  
 Pole Structures  
 Insulator Strings

	DESCRIPTION	QTY
	STEEL POLES	9
	-	
	ASSEMBLY, DEADEND for 1590-54/19 ACSS/AW	54
	ASSEMBLY, DEADEND, PREFORMED, .571" TO .591" RANGE, (6).162"DIA. RODS, 50" LGTH	4
	ASSEMBLY, DEADEND for 12SMF-91mm2 / .55-OGW (works on 24 fiber also)	18
	BOLT, MACHINE, 3/4" X 2-1/2", SQUARE HEAD & HEX NUT, GALVANIZED	9
	BOX, SPLICE for 24SMF-91mm2/.551 or 24SMF-73mm2/551 OGW, AFL Mfg	5
	CLAMP, DOWNLEAD (WITH LATTICE ADAPTER .72 to 1.25"), for 91MM2/.551 OGW	38
	CLAMP/SUSP, 1.10-1.62", 5/8" BNC, 1-13/16" OPEN, 3-5/64"WL, 25k URS & SOCKET EYE	42
	CLAMP/SUSP, 5/8"BNC, 2"OPNG, 2-1/2"WL, 1/2" BOLTS, 25k URS & ARMOR RODS	1

	GREASE, OXIDATION AND CORROSION INHIBITING (PENETROX)	3
	INSULATOR, SYNTHETIC, OVAL EYE-BALL (52-5), 25k URS	54
	INSULATOR, SYNTHETIC, Y CLEVIS-BALL (52-8), 98" WL, 50k URS	42
	KIT, FIBER OPTIC BOX ENTRY CONNECTOR, 24SMF-73mm2/551-OGW	8
	KIT, FIBER OPTIC BOX ENTRY CONNECTOR, LOOSE TUBE FIBER OPTIC CABLE	2
	LINKAGE, CHAIN, 8 LINKS, 30" WL, 58k URS (FEET)	18
	LINKAGE, CHAIN, 9 LINKS, 33-3/4"WL, 58k URS (FEET)	54
	PLATE, HOISTING, 2-3/8" WL, (3) 15/16" DIA. HOLES, 50k URS	12
	SHACKLE,ANCHOR, 3-1/2" WL,1-1/4" OPNG, 3/4" DIA. BNC, 60k URS	231
	SLEEVE, REDUCING, COMPRESSION SPLICING, CU, FOR #8-7 STRAND TO #9 SOLID CU	9
	TERMINAL, CONNECTOR for 1590-54/19 ACSS/AW	54
	TERMINAL,CONNECTOR, (2) 1/2"U-BOLTS, .464" TO .743" CLAMP RANGE	4
	THIMBLE, SOLID, 13/16" DIA. HOLE, 2-1/8" SEAT DIA., 15-3/4" GROOVE DIA.	4
	WASHER, SQUARE, CURVED, 4" X 4" X 1/4" 15/16" DIA. HOLE, GALVANIZED	9
	WIRE, BARE, COPPER, SOFT DRAWN, 250 KCMIL, 19 STRAND, DIA. 0.574" (FEET)	450
	WIRE, OPTICAL GROUND, 24SMF-73mm2/551 (FEET)	6119
	WIRE, PHASE, 1590-54/19 ACSS/AW (FEET)	18657
	Y-CLEVIS SOCKET (52-8), 10-1/4"WL, 7/8" BNC, 50k URS	42
	Y-CLEVIS, SOCKET, 9-3/8" WL, 3/4" BNC, 30k URS	12
	Y-CLEVIS,EYE,90 DEG.,,3-1/2"WL,EYE WIDTH 1-5/8",EYE HOLE DIA. 11/16",25k URS	1

## Attachment #2

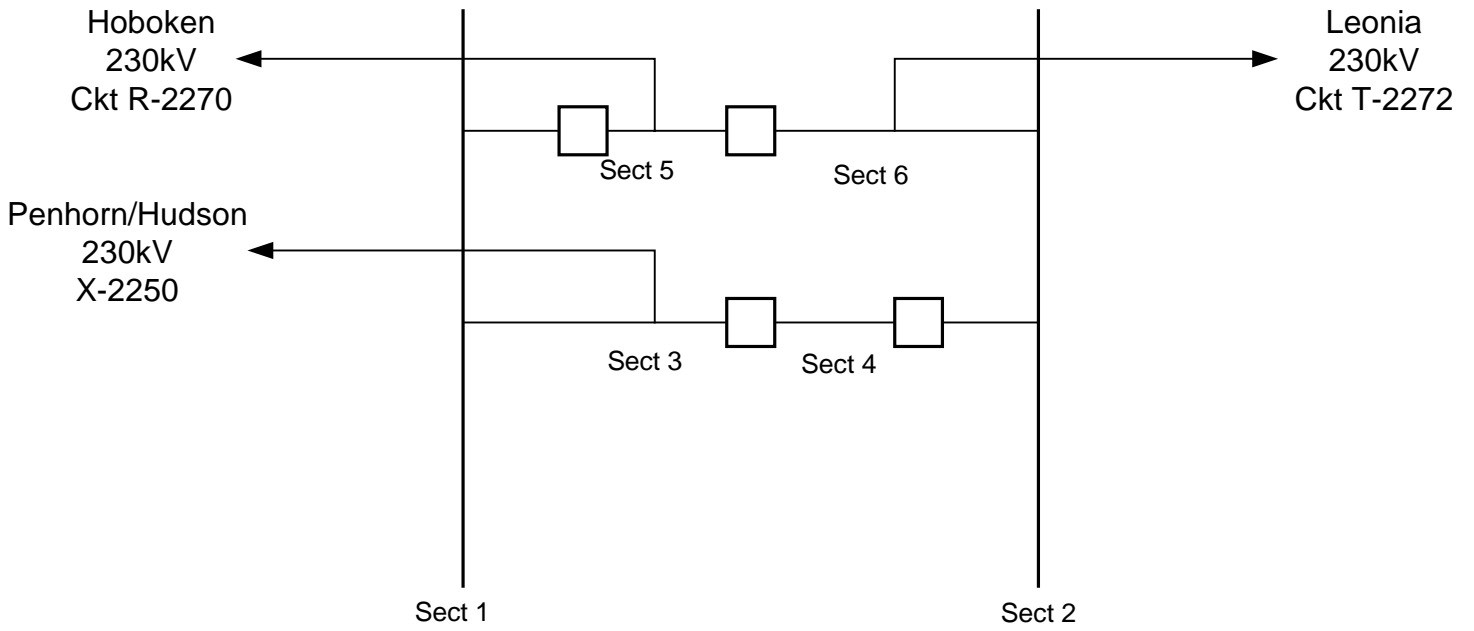
### SUPERVISORY CONTROL AND DATA ACQUISITION ELECTRIC SYSTEM OPERATIONS CENTER REQUIREMENTS

<b>19-Oct-00</b>	<b>Points Description</b>				
	* RTU local wiring				
<b>ESOC</b>					
<b>POINT #</b>	<b>CONTROLS</b>				
0	* Local/Remote				
1	* Set/Reset Control Test Point				
2	Opening of 52-T1 Breaker				
3	Opening of 52-T2 Breaker				
4	Opening of 52G-ST Breaker				
	<b>INDICATIONS</b>				
0	* Local/Remote (On/Off)				
1	* Set/Reset Control Test Point				
2	52-T1 Breaker (Open/Close)				
3	52-T2 Breaker (Open/Close)				
4	52G-ST Breaker (Open/Close)				
5	H-2260 Line Disconnect (Open/Close)				
6	Transformer A Diff operation (CTG-1)				
7	Transformer B Diff operation (CTG-2)				
8	Transformer C Diff operation (STG)				
9	Generator CTG-1 Diff operation				
10	Generator CTG-2 Diff operation				
11	Generator STG Diff operation				
12	230KV Line Diff (Regular) operation				
13	230KV Line Diff (Back-up) operation				
14	52-T1 Breaker Failure				
15	52-T2 Breaker Failure				
16	52G-SG Breaker Failure				
	<b>METERING ( DC 4-20mA) [GROSS MW/MVrs] [Kv]</b>	<b>ENG. FS</b>			
0	Generator CTG-1 Gross MWatts				
1	Generator CTG-1 Gross Mvars				
2	Generator CTG-1 kV				
3	Generator CTG-2 Gross MWatts				
4	Generator CTG-2 Gross Mvars				
5	Generator CTG-2 kV				
6	Generator STG Gross MWatts				
7	Generator STG Gross Mvars				
8	Generator STG kV				

	<b>METERING (AC) [NET MW/MVrs] [Kv]</b>	<b>PTR/CTR</b>			
	230kV (2EY-PT-A/B/C) Switchyard PT secondary leads	<b>2000/1</b>	<b>115 P-P</b>	<b>69 P-N</b>	
	Transformer 230kv Breaker 52-T1 CT secondary leads	<b>1200/5</b>			
	Transformer 230kv Breaker 52-T2 CT secondary leads	<b>1200/5</b>			
	Transformer 230kv Breaker 52G-ST CT secondary leads	<b>1200/5</b>			
	<b>JEMSTAR MTR MWHR [PULSES] REVENUE MTR</b>				
0	230Kv MWhrs OUT NET (KYZ)				
1	230Kv MWhrs IN NET (KYZ)				
	<b>JEMSTAR ANALOGS [TOTAL NET MW/MVrs] [KV]</b>				
	230KV NET Mwatts				
	230KV NET Mvars				
	230KV Volts				
	<b>JEMSTAR COMMUNICATIONS</b>				
	TD(A) / TD(B) / RD(A) / RD(B)				

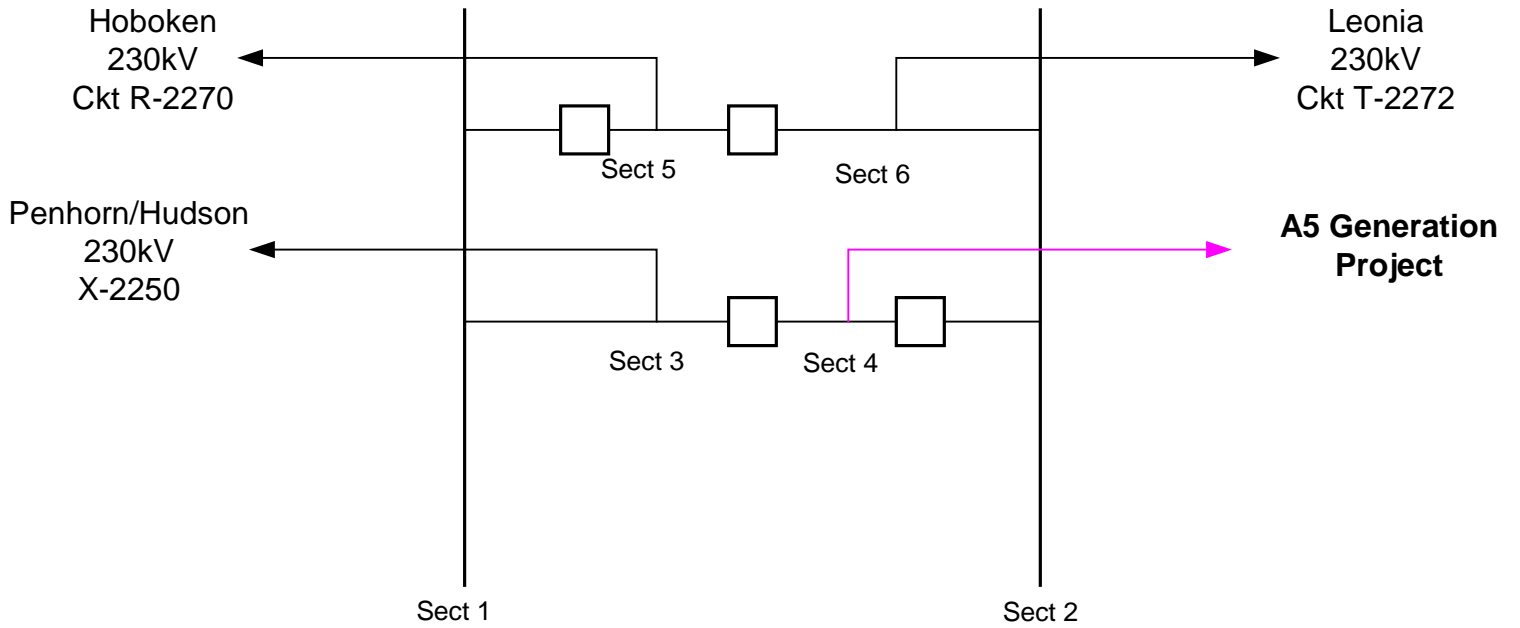
# Attachment #3

## Bergen 230kV Existing



# Attachment #4

## Bergen 230kV Existing A5 Generation Added





## Attachment #5

### Drawing List – Bergen #2

Drawing Number	Description
401200-0-SL-6-EY-1	Single Line Diagram
3982-E1	Three Line Diagram
3982-E2.1	Three Line Diagram
3982-E2.2	Three Line Diagram
3982-E3	Differential Relays – AC Schematic
3982-E4	Diff & Bkr Fail DC Schematic
3982-E5	Diff & Bkr Fail DC Schematic
3982-E6	Diff & Bkr Fail DC Schematic
3982-E7	Reg & BU DC Schematic
3982-E9	Bkr 52-T1 Control Schematic
3982-E8	Aux Tripping Relays-DC Schematic
3982-E10	Bkr 52-T2 Control Schematic
3982-E11	Bkr 52G-ST Control Schematic

## Attachment #6

### Drawing List – Bergen Switching Station

Drawing Number	Description
228971 A 1349	230kV One Line Control Diagram
228972 A 1349	230kV Potential One Line Diagram
228973 A 1350	230kV Swyd DC Distr. One Line Diagram
228976 A 1350	230kV Instr. & Cont. Racks HA Front Views
228977 A 1350	230KV Instr & Cont. Racks HB Front Views
228978 A 1350	230kV Instr. & Cont. Racks HC Front Views
228979 A 1350	230kV Instr. & Cont. Racks HD Front Views
228998 B 9894	230kV GCB 10H Control DC Schematic
228999 C 6442	230kV GCB 10H Bkr. Fail. Prot. DC Schem.
68256 A 8323	138kV OD Substation Control Cable Plan
230550 A 1352	230kV Swyd & Class H Substa
230551 A 1352	230kV Switchyard Bus Plan
230556 A 1352	230kV Swyd & Class H Substa.
230557 A 1352	230kV Swyd & Class H Substa-
230559 A 1352	230kV Swyd. & Class H Substa
230560 A 1352	230kV Swyd & Class H Grounding Plan
230562 A 1352	230kV Swyd Lighting Plan
230566 A 1352	230kV Swyd & Class H Cable Vaults & Conduits
262075 A 1998	230kV Bkr 12H Control Schematic
262076 B 748	230kV Bkr 12H BF & Gnd. Prot. DC Schematic
262077 B 748	230kV Bkr 12H CT Module Ground Prot.
262086 A 1571	Control Circuit Supervision – DC Schematic
272429 A 2193	230kV LP 12H BU Rel Prot. DC Schematic
272430 A 2193	230kV LP 12H Pri. Rel. Prot. DC Schematic
272881 B 9602	230kV LP 12H BU Rel. Prot. AC Schematic
272882 A 1571	230kV LP 12H Primary Rel Prot AC Schematic
231549 AB 3679	230kV Cont. Rm GCB 10H BF Rk HB-5 W/D
231559 AB 3680	LP 22H Rem Tr. Aux Rel Rack HC-13B W/D
231562 A 2247	230kV Cont. Rm LP1 1H Rack HC-4A W/D
231564 A 2249	230kV Cont. Rm Rack HC-4B W/D
231571 A 1391	230kV GCB 10H W/D
231577 AB 3680	230kV GCB 10H Cable Terminal Cab. W/D
247427 A 1738	230kV ESOC Ext. Connections
262093 B 748	230kV LP 12H Instr. Rk. HA 6F & RV
262094 A 1996	230kV LP 12H Instr. Rk. HA-6 W/D
262107 A 1996	230kV GCB 12H BF Rk.. HB-8 W/D
262109 A 1996	230kV Cont. Rm. Rack HB-14A W/D
262114 A 1996	230kV GCB 12H Recl. Rk. HC-8 W/D
262123 A 1996	230kV GCB 12H W/D

262132 A 1996	230kV LP 12H Bkr. 12H & Sh. Reactor 20HR
272448 B 9635	230kV LP 12H Pri Aux Rel Rk HB-6B
272449 A 2194	230kV LP 12H Pri. Aux Rel Rk HB-6B W/D
272875 A 1571	Control Room Spare rack HC-6A W/D
272880 A 1571	Control Room Spare rack HC-6B W/D
272885 B 9609	Spare Relay rack HC-6B Front & rear views
274013 B 9599	230kV LP 12 H Back-up Rela. Rk HD-6B F&RV
274014 B 9599	230kV LP 12H BU Prot Aux Rk HD-6B W/D
287074 B 9915	230kV LP 12H Pri. Rel Prot Rack HB-6A F&RV
287075 A 2462	230kV LP 12H Pri Rel Prot Rack HB-6A W/D
287076 B 9915	230kV LP 12H BU Rel Prot Rack HD-6A F&RV
287077 A 2462	230kV LP 12H BU Rel Prot. Rack HD-6A W/D









