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Your ref: Project Number 740
Our ref: DCP/NRC1950

July 27, 2007

Subject: AP1000 COL Standard Technical Report Submittal of APP-GW-GLN-079, (TR 79), Revision 0

In support of Combined License application pre-application activities, Westinghouse is submitting AP1000 Standard Combined License Technical Report Number 79. This report identifies and justifies standard changes to the AP1000 Design Control Document (DCD). Most of the changes to the DCD identified in Technical Report 79 are included in the proposed amendment to the AP1000 Design Certification Rule (DCD Revision 16). However, Westinghouse advises that Technical Report 79 does include changes beyond those identified in DCD Revision 16. This report is submitted as part of the NuStart Bellefonte COL Project (NRC Project Number 740). The information included in this report is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification.

The purpose for submittal of this report was explained in a March 8, 2006 letter from NuStart to the NRC.

Pursuant to 10 CFR 50.30(b), APP-GW-GLN-079, Revision 0, "Electrical System Design Changes," (Technical Report Number 79), is submitted as Enclosure 1 under the attached Oath of Affirmation.

It is expected that when the NRC review of Technical Report Number 79 is complete, the changes to the DCD identified in Technical Report 79 will be considered approved generically for COL applicants referencing the AP1000 Design Certification.

Questions or requests for additional information related to content and preparation of this report should be directed to Westinghouse. Please send copies of such questions or requests for additional information to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Westinghouse requests the NRC to provide a schedule for review of the technical report within two weeks of its submittal.

D079
D063

NRO

Very truly yours,

D. J. Hutchings for

A. Sterdis, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

/Attachment

1. "Oath of Affirmation," dated July 27, 2007

/Enclosure

1. APP-GW-GLN-079, Revision 0, "Electrical System Design Changes," Technical Report Number 79

cc:	D. Jaffe	-	U.S. NRC	1E	1A
	E. McKenna	-	U.S. NRC	1E	1A
	S. Adams	-	Westinghouse	1E	1A
	G. Curtis	-	TVA	1E	1A
	P. Grendys	-	Westinghouse	1E	1A
	P. Hastings	-	Duke Power	1E	1A
	C. Ionescu	-	Progress Energy	1E	1A
	D. Lindgren	-	Westinghouse	1E	1A
	A. Monroe	-	SCANA	1E	1A
	M. Moran	-	Florida Power & Light	1E	1A
	C. Pierce	-	Southern Company	1E	1A
	E. Schmiech	-	Westinghouse	1E	1A
	G. Zinke	-	NuStart/Entergy	1E	1A
	M. DeMaglio	-	Westinghouse	1E	1A

ATTACHMENT 1

"Oath of Affirmation"

ATTACHMENT 1

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:)

NuStart Bellefonte COL Project)

NRC Project Number 740)

APPLICATION FOR REVIEW OF
"AP1000 GENERAL COMBINED LICENSE INFORMATION"
FOR COL APPLICATION PRE-APPLICATION REVIEW

W. E. Cummins, being duly sworn, states that he is Vice President, Regulatory Affairs & Standardization, for Westinghouse Electric Company; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission this document; that all statements made and matters set forth therein are true and correct to the best of his knowledge, information and belief.

W E Cummins

W. E. Cummins
Vice President
Regulatory Affairs & Standardization

Subscribed and sworn to
before me this 27th day
of July 2007.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Patricia S. Aston, Notary Public
Murrysville Boro, Westmoreland County
My Commission Expires July 11, 2011
Member, Pennsylvania Association of Notaries

Patricia S Aston
Notary

ENCLOSURE 1

APP-GW-GLN-079, Revision 0

"Electrical System Design Changes"

Technical Report 79

F-AP-3.2-1 REV. 0

AP1000 DOCUMENT COVER SHEET

TDC: ________ Permanent File: ________ APY: ________

RFS#: ________ RFS ITEM #: ________

AP1000 DOCUMENT NO.	REVISION NO.		ASSIGNED TO
APP-GW-GLN-079	0	Page 1 of 40	W- A. Sterdis

ALTERNATE DOCUMENT NUMBER: TR 79 WORK BREAKDOWN #:

ORIGINATING ORGANIZATION: Westinghouse Electric Company

TITLE: **Electrical System Design Changes**

ATTACHMENTS: N/A	DCP #/REV. INCORPORATED IN THIS DOCUMENT REVISION: APP-GW-GEE-173, Revision 3; APP-GW-GEE-200, Revision 1; APP-GW-GEE-201, Revision 2
CALCULATION/ANALYSIS REFERENCE: N/A	

ELECTRONIC FILENAME	ELECTRONIC FILE FORMAT	ELECTRONIC FILE DESCRIPTION
APP-GW-GLN-079 Rev. A	Microsoft Word	

☒ WESTINGHOUSE CLASS 3 (NON PROPRIETARY)

Class 3 Documents being transmitted to the NRC require the following two review signatures in lieu of a Form 36.

LEGAL REVIEW ~~T. J. White~~ @ 7/26/07 L A Campagna	SIGNATURE/DATE 7/27/07
PATENT REVIEW M.M. Corletti	SIGNATURE/DATE 7/28/07

☐ WESTINGHOUSE PROPRIETARY CLASS 2

ORIGINATOR M. A. DeMaglio	SIGNATURE/DATE 7/25/07		
REVIEWERS	SIGNATURE/DATE		
VERIFIER D. Li	SIGNATURE/DATE 7/25/07	VERIFICATION METHOD PAGE BY PAGE	
AP1000 RESPONSIBLE MANAGER M.M. Corletti	SIGNATURE* 7/28/07	APPROVAL DATE	

* Approval of the responsible manager signifies that document is complete, all required reviews are complete, electronic file is attached and document is released for use.

AP1000 Standard Combined License Technical Report

Electrical System Design Changes

Westinghouse Electric Company LLC
P.O. Box 355
Pittsburgh, PA 15230-0355

Document Number: APP-GW-GLN-079 **Revision Number:** 0

Title: Electrical system design changes

Brief Description of the change (what is being changed and why):

Penetration Changes (pages 3.8-4, 3.8-13, 3.8-107, 8.3-10, and 8.3-11):

The current design utilizes an epoxy construction type of electrical penetration. During design development, the recommendation has been made to revise current electrical penetration description to allow either an epoxy construction type of electrical penetration or a swaged construction type of electrical penetration

Additionally, a change from a welded connection to a supporting edge with a tapered leading edge and threaded rod to permit concentric alignment of the Electrical Penetration Assembly canister in the nozzle was made.

Note that pages 3.8-4 and 3.8-13 are included as a portion of this change but were not included in Revision 16 of the DCD. These will be added with the next revision.

Bus transfer (pages 1.2-29, 2.6.1-7, 2.6.1-10, 2.6.1-11, 8.1-1, 8.1-2, 8.1-4, 8.2-1, 8.3-1, 8.3-2, 14.2-62, and 14.2-63):

The addition of a fast bus transfer, along with an operator initiated maintenance transfer was made to the AP1000. This change required an additional Reserve Auxiliary Transformer (RAT) to allow complete bus transfer from Unit Auxiliary Transformers to Reserve Auxiliary Transformers. DCD figures 8.3.1-1 and 2.6.1-1 will be revised along with several portions of the DCD text.

Electrical Changes:

Item: Revision 15 of the DCD specifies that each onsite standby generator unit has a static exciter. Discussion with component supplier leads to an understanding that other excitation system types (e.g. rotating) will be more applicable to this size of machine. The DCD was changed to remove "static" from the description of the exciter type so that a more readily available design may be used (page 8.3-6).

Item: The short circuit rating of the 6.9KV switchgear busses identified on the figure 8.3.1-1 (AC Power Station One Line Diagram) is "500MVA". This value was revised to 63kA. This 63kA value will replace the 500 MVA value directly. This applies to both the DCD one line figure and to the DCD text/ tables (page 8.3-38 and 8.3-53).

Item: The penetration numbers currently shown in Revision 15 on figure 8.3.1-1 are incorrect and were revised to reflect the correct penetrations association with each RCP. This is a documentation change to reflect accurate numbering as developed through the numbering procedure and the latest layout drawing (page 8.3-53).

Item: Input and output isolation breakers to each RCP variable frequency drive unit were added (pages 8.3-53, 2.6.1-11, and 2.6.1-13).

Item: Figure 8.3.1-1 (plant single line drawing) of the DCD did not show the air cooled chillers VWS-MS-02 and VWS-MS-03 being fed from the 6.9KV busses directly. This is inconsistent with the design for this size

motor load and the DCD was revised to reflect these loads being directly connected to the 6.9kV busses. This change is a drawing update (page 8.3-53).

Item: Ancillary diesel 1-line Figure 8.3.1-3 was revised to reflect a 4 wire 100A distribution panel (from a 3-wire 50A), and a 100A breaker for both the diesel generator to the bus and for the test load tie to the bus from 50A (page 8.3-56).

The size of the ancillary diesel generator distribution panels are shown as 50A with an incoming breaker of 30A from the generator. Full load current of this generator is approximately 53A. The main breaker of the distribution panel should be sized at the full capacity of the generator at a minimum. The diesel generator test load will also be changed to 100A to allow for this generator to be tested at full capacity. Additionally, to facilitate the use of this source as a feed to 277Vac lighting circuits, these panels will be changed from 3W to 4W.

A review of industry standard product offering for 480Vac distribution panels shows that the minimum sized standard product is a 100A main breaker, 100A main bus. The rating of these panels will be changed to reflect this 100A rating based on the ready availability of standard product offerings.

Raw Water Feeder Breaker Change

The Revision 15 1-line figure, DCD figure 8.3.1-1 shows 3 feeders for 3 raw water pumps. The change is to have each of these three feeders support the respective raw water pump in addition to the auxiliaries of each pump (page 8.3-53).

Editorial Changes:

Item: Editorial change to identify load center EK-14 (page 2.6.1-4).

Item: Editorial change to identify AHU supply and return fans by tag number (page 2.6.1-4).

Item: Editorial change to identify load center EK-24 (page 2.6.1-5).

Item: Editorial change to identify AHU supply and return fans by tag number (page 6.6.1-6).

Item: Editorial change to add "unit" to describe the transformers for normal feed to the medium voltage system (page 8.3-3).

Item: Editorial change of tense from "will be" to "are" for alarm indications (page 8.3-7).

Item: Editorial change to add "," (comma) in description of Main Step up Transformer (page 8.3-38).

Document Number: APP-GW-GLN-079 **Revision Number:** 0

Title: Electrical system design changes

I. APPLICABILITY DETERMINATION

This evaluation is prepared to document that the change described above is a departure from Tier 1 & Tier 2 information of the DCD (APP-GW-GL-700) that may be included in plant specific FSARs without prior NRC approval.

A.	Does the proposed change include a change to:		
	1. Tier 1 of the AP1000 Design Control Document APP-GW-GL-700	☐ NO ☒ YES	(If YES prepare a report for NRC review of the changes)
	2. Tier 2 of the AP1000 Design Control Document, APP-GW-GL-700	☐ NO ☒ YES	(If YES prepare a report for NRC review of the changes)
	3. Technical Specification in Chapter 16 of the AP1000 Design Control Document, APP-GW-GL-700	☒ NO ☐ YES	(If YES prepare a report for NRC review of the changes)
B.	Does the proposed change involve:		
	1. Closure of a Combined License Information Item identified in the AP1000 Design Control Document, APP-GW-GL-700	☒ NO ☐ YES	(If YES prepare a COL item closure report for NRC review.)
	2. Completion of an ITAAC item identified in Tier 1 of the AP1000 Design Control Document, APP-GW-GL-700	☒ NO ☐ YES	(If YES prepare an ITAAC completion report for NRC review.)

☐ The questions above are answered no, therefore the departure from the DCD does not require prior NRC review unless review is required by the criteria of 10 CFR part 52 Appendix D Section VIII B.5.b. or B.5c

II. TECHNICAL DESCRIPTION AND JUSTIFICATION

Penetration Changes:

The current design utilizes an epoxy construction type of electrical penetration. During design development, the recommendation was made to revise current electrical penetration description to allow either an epoxy construction type of electrical penetration or a swaged construction type of electrical penetration.

This change will alleviate a concern regarding a limited number of electrical penetration suppliers.

Additionally, when the Containment Vessel is pressurized, the current configuration of the electrical penetration may not be able to accommodate the radial displacement of the Containment Vessel shell due to the electrical penetration being welded to the fixed enclosure. A change from a welded connection to a

supporting edge with a tapered leading edge and threaded rod to permit concentric alignment of the Electrical Penetration Assembly canister in the nozzle is recommended by a penetration manufacturer.

Figure 3.8.2-4 in the DCD was based on the epoxy construction type of electrical penetration. This DCD figure was revised to allow both types of electrical penetrations. Additionally text changes within the DCD were made to allow for penetration types other than epoxy construction type.

Bus transfer

The addition of a fast bus transfer, along with an operator initiated maintenance transfer was added to the AP1000. This change required an additional Reserve Auxiliary Transformer (RAT) to allow complete bus transfer from Unit Auxiliary Transformers to Reserve Auxiliary Transformers.

This change allows for the avoidance of a reactor trip due to a component failure or spurious actuation of the protective relaying associated with any of the Main Step Up transformers, Unit Auxiliary Transformers, or Isophase Bus Duct, which would cause a RCP trip and a reactor trip. This change provides additional investment protection and plant availability.

In addition to the above feature, there is the ability of operator initiated, sync supervised, closed transition transfers on a bus-by-bus basis added to the operation of the plant.

Electrical Changes

Item: Revision 15 of the DCD specifies that each onsite standby generator unit has a static exciter. Discussion with a component supplier leads to the understanding that other excitation system types (e.g. rotating) will be more applicable to this size of machine. During this evolution it was noted that static type excitation is not a standard commercial offering on machines below 15MW.

Item: The short circuit rating of the 6.9KV switchgear busses identified on the figure 8.3.1-1 (AC Power Station One Line Diagram) is "500MVA" [which loosely translates to 40kA interrupting capacity at 6.9KV]. This value was revised to 63kA. This 63kA value replaces the 500 MVA value directly. The calculated value of short circuit current which represents the DCD defined and calculation supported source equipment sizes (UAT and RAT at 70MVA), and with an impedance value low enough to allow for the starting of the largest pump is well in excess of 50KA (about 58KA conservatively).

Additionally, the term "MVA class" is a misnomer. This historical term was utilized as a convenience when the K factor of breakers was other than K = 1.0. Previously rated and utilized equipment allowed for additional rating beyond the listed kA value by a factor of "rated voltage/ utilized voltage" up to a rating of "(listed rating)(K factor)." With the current maximum short circuit rating K =1 method, the listed short circuit current value is to be utilized for all voltages up to and including maximum listed per IEEE standard. There is no upward adjustment for utilization voltages below maximum. Given this information, the "500MVA" rating was replaced directly with the 63KA interrupting rating required per calculation.

Item: The penetration numbers shown in figure 8.3.1-1 of Revision 15 of the DCD were incorrect and were revised to reflect the correct penetrations associated with each RCP. This is a documentation change to reflect accurate numbering as developed through the numbering procedure and the latest layout drawing. The

penetration numbers currently shown on the drawing are E9, E10, E25, and E26. As per the AP1000 numbering procedure, the correct penetration numbers are P10, P26, P9, and P25 for each of RCP 1B, 2B, 1A, and 2A respectively.

Item: Add input and output isolation breakers and VFD located output reactor (not shown on figure, internal detail) to each RCP variable frequency drive unit.

The Revision 15 design of the AP1000 represents a variable frequency drive unit, utilized for RCP startup, as being electrically bypassed only, without supporting input or output isolation breakers or VFD output reactor. With design development of the VFD module, the needs for both an input and an output isolation breaker (in addition to the already shown bypass breaker) for each drive unit have become evident. The lack of these breakers from the initial design was an omission. The output isolation breaker and the bypass breaker are electrically interlocked via the synchronous transfer control, which is a part of the VFD control. The addition of an input breaker allows for the VFD unit to be completely removed from service during normal plant operation (RCP in bypass). Without the addition of this input isolation breaker, the RCP pump will need to be offline in order to service the VFD unit.

Item: Figure 8.3.1-1 (plant single line drawing) of the DCD Revision 15 does not show the air cooled chillers VWS-MS-02 and VWS-MS-03 being fed from the 6.9KV busses ES-1 and ES-2 respectively directly. This is inconsistent with the design for this size motor load and the DCD was revised to reflect these loads being directly connected to the 6.9kV busses. This change is a drawing update.

Item: Ancillary diesel 1-line Figure 8.3.1-3 was revised to reflect a 4 wire 100A distribution panel (from a 3-wire SOA), and a 100A breaker for both the diesel generator to the bus and for the test load tie to the bus from SO (page 2.3-56).

Figure 8.3.1-3 of Revision 15 was revised to reflect a 4 wire 100A distribution panel, and a 100A breaker for both the diesel generator to the bus and for the test load tie to the bus.

The size of the ancillary diesel generator distribution panels are shown as 50A with an incoming breaker of 30A from the generator. Full load current of this generator is approximately 53A. The main breaker of the distribution panel should be sized at the full capacity of the generator at a minimum. The diesel generator test load will also be changed to 100A to allow for this generator to be tested at full capacity. Additionally, to facilitate the use of this source as a feed to 277Vac lighting circuits, these panels will be changed from 3W to 4W.

A review of industry standard product offering for 480Vac distribution panels shows that the minimum sized standard product is a 100A main breaker, 100A main bus. The rating of these panels will be changed to reflect this 100A rating based on the ready availability of standard product offerings.

Raw Water Feeder Breaker Change

The Revision 15 1-line figure, DCD figure 8.3.1-1 shows three feeders for three raw water pumps. The proposed change is to have each of these three feeders support the respective raw water pump and the associated auxiliaries of that pump.

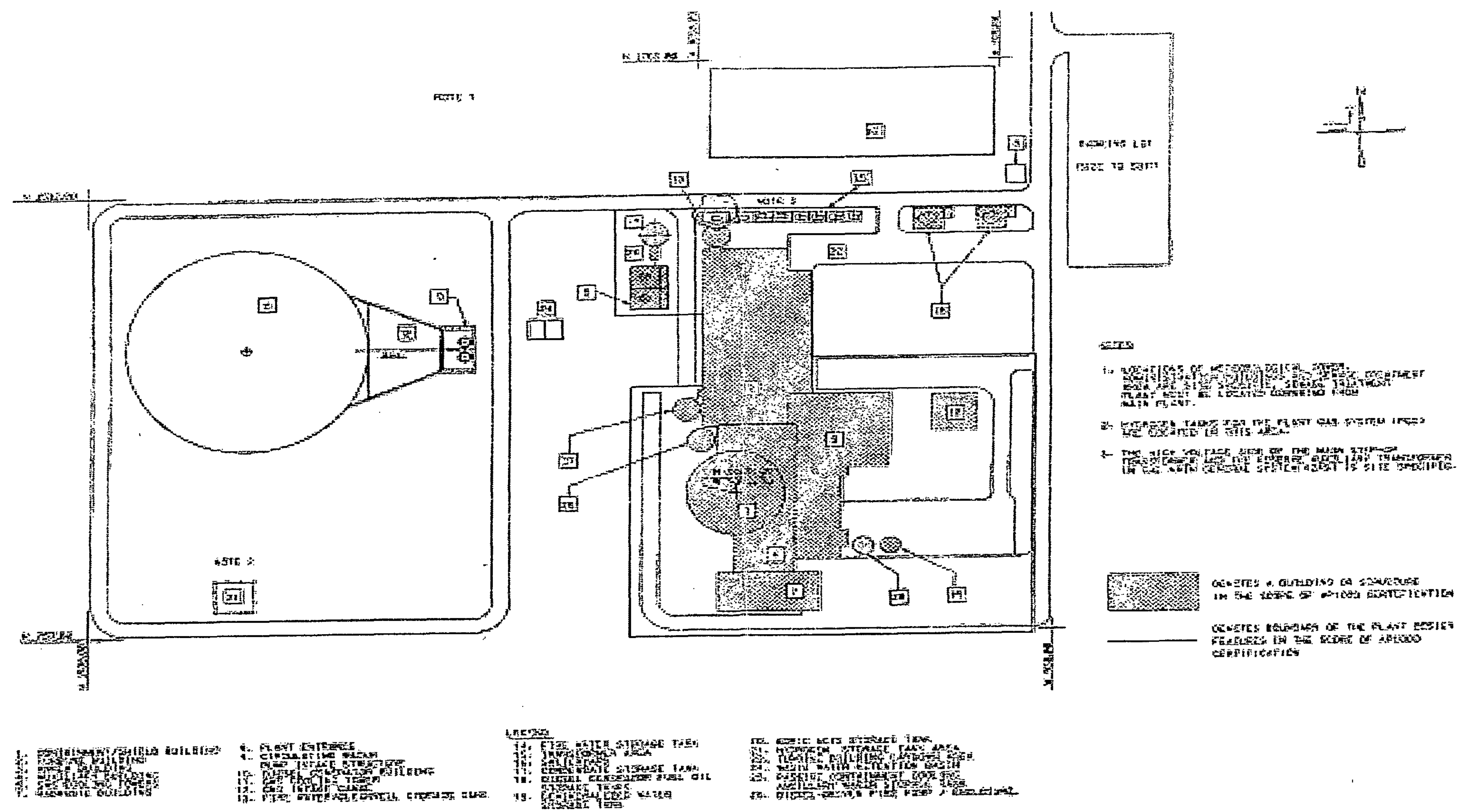
III. DCD MARK-UP

The DCD markups are include on the following pages of this technical report.

Document Number: APP-GW-GLN-079

Revision Number: 0

Title: Electrical system design changes



Document Number: APP-GW-GLN-079 **Revision Number:** 0

Title: Electrical system design changes

Table 2.6.1-2	
Load Description	**Power Source**
Load Center Transformers EK-11, EK-12, EK-13, EK-14	ZOS-MG-02A
Diesel Oil Transfer Module Enclosure A Electric Unit Heater	ZOS-MG-02A
Diesel Oil Transfer Module Enclosure A Fan	ZOS-MG-02A
Class 1E Division A Regulating Transformer	ZOS-MG-02A
Class 1E Division C Regulating Transformer	ZOS-MG-02A
Diesel Generator Fuel Oil Transfer Pump 1A	ZOS-MG-02A
Diesel Generator Room A Building Standby Exhaust Fans 1A and 2A	ZOS-MG-02A
Diesel Generator Service Module A Air Handling Unit (AHU) 01A Fan	ZOS-MG-02A
Startup Feedwater Pump A	ZOS-MG-02A
Service Water Pump A	ZOS-MG-02A
Service Water Cooling Tower Fan A	ZOS-MG-02A
Equipment Room AHU Supply and Return Fans VXS-MA-01A/02A	ZOS-MG-02A
Switchgear Room A AHU Supply and Return Fans VXS-MA-05A/06A	ZOS-MG-02A
Non-1E Battery Charger EDS1-DC-1	ZOS-MG-02A
Non-1E Battery Room A Exhaust Fan	ZOS-MG-02A
Non-1E Battery Charger EDS3-DC-1	ZOS-MG-02A

Table 2.6.1-2 (cont.)	
Load Description	**Power Source**
Class 1E Division A Battery Charger 1 (24-hour)	ZOS-MG-02A
Class 1E Division C Battery Charger 1 (24-hour)	ZOS-MG-02A
Class 1E Division C Battery Charger 2 (72-hour)	ZOS-MG-02A
Divisions A/C Class 1E Battery Room Exhaust Fan A	ZOS-MG-02A
Supplemental Air Filtration Unit Fan A	ZOS-MG-02A
Backup Group 4A Pressurizer Heaters	ZOS-MG-02A
Spent Fuel Cooling Pump 1A	ZOS-MG-02A
Load Center Transformers EK-21, EK-22, EK-23, EK-24	ZOS-MG-02B
Diesel Oil Transfer Module Enclosure B Electric Unit Heater	ZOS-MG-02B
Diesel Oil Transfer Module Enclosure B Fan	ZOS-MG-02B
Class 1E Division B Regulating Transformer	ZOS-MG-02B
Class 1E Division D Regulating Transformer	ZOS-MG-02B
Diesel Generator Fuel Oil Transfer Pump 1B	ZOS-MG-02B
Diesel Generator Room B Building Standby Exhaust Fans 1B and 2B	ZOS-MG-02B
Diesel Generator Service Module B AHU 01B Fan	ZOS-MG-02B
Startup Feedwater Pump B	ZOS-MG-02B
Service Water Pump B	ZOS-MG-02B
Service Water Cooling Tower Fan B	ZOS-MG-02B

Table 2.6.1-2 (cont.)	
Load Description	**Power Source**
RNS Pump 1B	ZOS-MG-02B
RNS Pump Room Unit Cooler Fan B	ZOS-MG-02B
Equipment Room B AHU Supply and Return Fans VXS-MA-01B/02B	ZOS-MG-02B
Switchgear Room B AHU Supply and Return Fans VXS-MA-05B/06B	ZOS-MG-02B
Non-1E Battery Charger EDS2-DC-1	ZOS-MG-02B
Non-1E Battery Room B Exhaust Fan	ZOS-MG-02B
Class 1E Division B Battery Charger 1 (24-hour)	ZOS-MG-02B
Class 1E Division B Battery Charger 2 (72-hour)	ZOS-MG-02B
Class 1E Division D Battery Charger 1 (24-hour)	ZOS-MG-02B
Divisions B/D Class 1E Battery Room Exhaust Fan B	ZOS-MG-02B
Supplemental Air Filtration Unit Fan B	ZOS-MG-02B
Backup Group 4B Pressurizer Heaters	ZOS-MG-02B
Spent Fuel Cooling Pump 1B	ZOS-MG-02B

Table 2.6.1-3

Equipment	Tag No.	Display	Control Function
6900 V Switchgear Bus 1	ECS-ES-1	Yes (Bus voltage, breaker position for all breakers on bus)	Yes (Breaker open/close)
6900 V Switchgear Bus 2	ECS-ES-2	Yes (Bus voltage, breaker position for all breakers on bus)	Yes (Breaker open/close)
Unit Auxiliary Transformer A	ZAS-ET-2A	Yes (Secondary Voltage)	No
Unit Auxiliary Transformer B	ZAS-ET-2B	Yes (Secondary Voltage)	No
Reserve Auxiliary Transformer A	ZAS-ET-4A	Yes (Secondary Voltage)	No
Reserve Auxiliary Transformer B	ZAS-ET-4B	Yes (Secondary Voltage)	No

Table 2.6.1-5

Component Name	Tag No.	Component Location
RCP Circuit Breaker	ECS-ES-31	Auxiliary Building
RCP Circuit Breaker	ECS-ES-32	Auxiliary Building
RCP Circuit Breaker	ECS-ES-41	Auxiliary Building
RCP Circuit Breaker	ECS-ES-42	Auxiliary Building
RCP Circuit Breaker	ECS-ES-51	Auxiliary Building
RCP Circuit Breaker	ECS-ES-52	Auxiliary Building
RCP Circuit Breaker	ECS-ES-61	Auxiliary Building
RCP Circuit Breaker	ECS-ES-62	Auxiliary Building
6900 V Switchgear Bus 1	ECS-ES-1	Annex Building
6900 V Switchgear Bus 2	ECS-ES-2	Annex Building
6900 V Switchgear Bus 3	ECS-ES-3	Turbine Building
6900 V Switchgear Bus 4	ECS-ES-4	Turbine Building
6900 V Switchgear Bus 5	ECS-ES-5	Turbine Building
6900 V Switchgear Bus 6	ECS-ES-6	Turbine Building
Main Generator	ZAS-MG-01	Turbine Building
Generator Circuit Breaker	ZAS-ES-01	Turbine Building
Main Step-up Transformer	ZAS-ET-1A	Yard
Main Step-up Transformer	ZAS-ET-1B	Yard
Main Step-up Transformer	ZAS-ET-1C	Yard
Unit Auxiliary Transformer A	ZAS-ET-2A	Yard
Unit Auxiliary Transformer B	ZAS-ET-2B	Yard
Reserve Auxiliary Transformer A	ZAS-ET-4A	Yard
Reserve Auxiliary Transformer B	ZAS-ET-4B	Yard
Ancillary Diesel Generator #1	ECS-MG-01	Annex Building
Ancillary Diesel Generator #2	ECS-MG-02	Annex Building
Ancillary Diesel Generator Distribution Panel 1	ECS-ED-01	Annex Building
Ancillary Diesel Generator Distribution Panel 1	ECS-ED-02	Annex Building

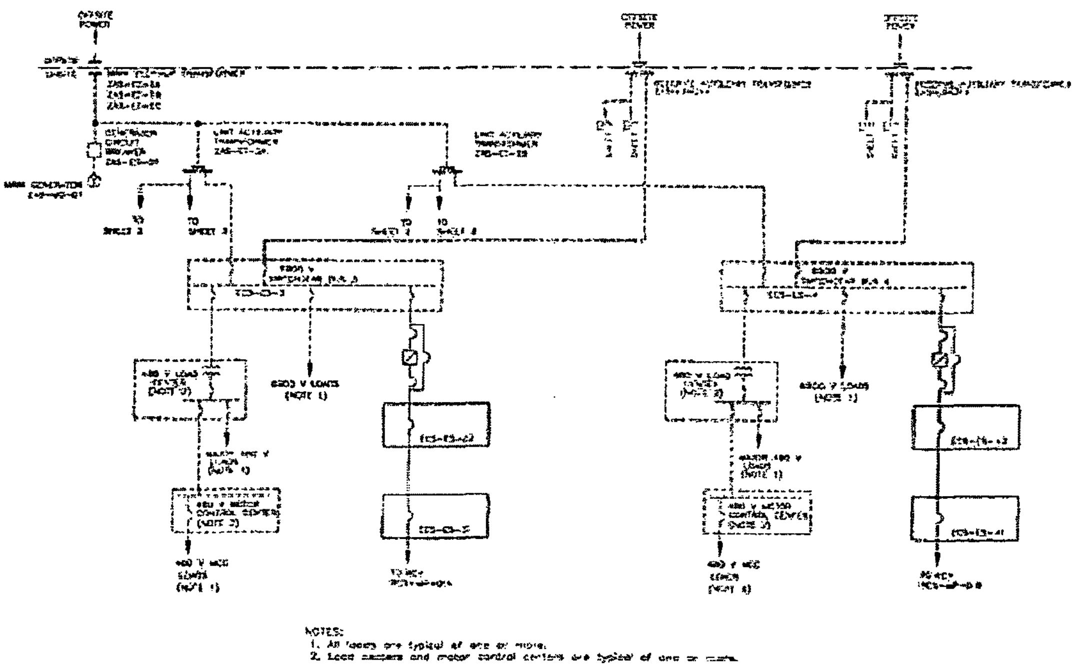


Figure 2.6.1-1 (Sheet 1 of 4)
Main ac Power System

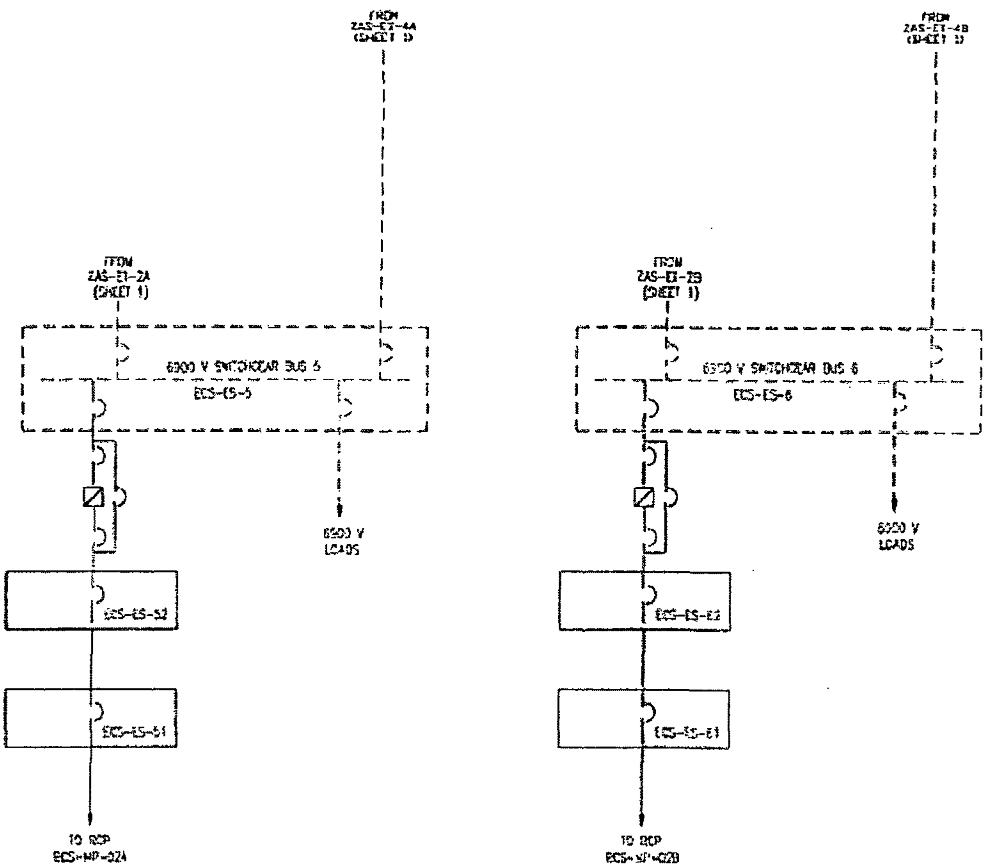


Figure 2.6.1-1 (Sheet 3 of 4)
Main ac Power System

thermal growth of the main steam and feedwater piping during plant operation, relative seismic movements, and containment accident and testing conditions. Cover plates are provided to protect the bellows from foreign objects during construction and operation. These cover plates are removable to permit in-service inspection.

The fuel transfer penetration, shown in Figure 3.8.2-4, sheet 5, is provided to transfer fuel between the containment and the fuel handling area of the auxiliary building. The fuel transfer tube is welded to the penetration sleeve. The containment boundary is a double-gasketed blind flange at the refueling canal end. The expansion bellows are not a part of the containment boundary. Rather, they are water seals during refueling operations and accommodate differential movement between the containment vessel, containment internal structures, and the auxiliary building.

3.8.2.1.6 Electrical Penetrations

Figure 3.8.2-4, sheet 6, shows a typical 12-inch-diameter electrical penetration. The penetration assemblies consist of ~~three~~ conductor modules (or ~~six~~ medium voltage cable modules in a similar 18-inch-diameter penetration) passing through a bulkhead attached to the containment nozzle. Electrical design of these penetrations is described in subsection 8.3.1.1.6~~5~~.

Electrical penetrations are designed to maintain containment integrity under design basis accident conditions, including pressure, temperature, and radiation. Double barriers permit testing of each assembly to verify that containment integrity is maintained. Design and testing is according to IEEE Standard 317-83 and IEEE Standard 323-74.

3.8.2.2 Applicable Codes, Standards, and Specifications

[*The containment vessel is designed and constructed according to the 2001 edition of the ASME Code, Section III, Subsection NE, Metal Containment, including the 2002 Addenda. Stability of the containment vessel and appurtenances is evaluated using ASME Code, Case N-284-1, Metal Containment Shell Buckling Design Methods, Class MC, Section III, Division 1, as published in the 2001 Code Cases, 2001 Edition, July 1, 2001.*]*

Structural steel nonpressure parts, such as ladders, walkways, and handrails are designed to the requirements for steel structures defined in subsection 3.8.4.

Section 1.9 discusses compliance with the Regulatory Guides and the Standard Review Plans.

3.8.2.3 Loads and Load Combinations

Table 3.8.2-1 summarizes the design loads, load combinations and ASME Service Levels. They meet the requirements of the ASME Code, Section III, Subsection NE. The containment vessel is designed for the following loads specified during construction, test, normal plant operation and shutdown, and during accident conditions:

D Dead loads or their related internal moments and forces, including any permanent piping and equipment loads

*NRC Staff approval is required prior to implementing a change in this information; see DCD Introduction Section 3.5.

or end plate are established based on piping support loads or stiffness requirements. The capacities of these penetrations are greater than the capacity of the containment vessel cylinder.

Mechanical penetrations for the large-diameter high-energy lines, such as the main steam and feedwater piping, include expansion bellows. The piping and flued head have large pressure capability. The response of expansion bellows to severe pressure and deformations is described in NUREG/CR-5561 (Reference 4). The bellows can withstand large pressure loading but may tear once the containment vessel deflection becomes large. Testing reported in NUREG/CR-6154 (Reference 26) has shown that the bellows remain leaktight even when subjected to large deflections sufficient to fully compress the bellows. Such large deflections do not occur as long as the containment vessel remains elastic. As described in subsection 3.8.2.4.2.6, the radial deflection of the shell increases substantially once the containment cylinder yields. The resulting deflections are assumed to cause loss of containment function. The containment penetration bellows are designed for a pressure of 90 psig at design temperature within Service Level C limits, concurrent with the relative displacements imposed on the bellows when the containment vessel is pressurized to these magnitudes.

Electrical penetrations have a pressure boundary consisting of the sleeve and an end plate containing a series of modules. The electrical pressure boundary is designed and built to the requirements of the ASME code, Section III, Class MC, subsection NE. The pressure capacity of these elements is large and is greater than the capacity of the containment vessel cylinder at temperatures up to the containment design temperature. Electrical penetration assemblies are also designed to satisfy ASME Service Level C stress limits under a pressure of 90 psig at design temperature. Tests at pressures and temperatures representative of severe accident conditions are described in NUREG/CR-5334 (Reference 5), where typical nuclear industry ~~the Westinghouse~~ penetrations were irradiated, aged, then tested ~~to 75 psia at 400°F~~. One design was tested to 135 psia at 700°F Other electrical penetration assemblies were tested to ~~higher pressures and temperatures~~ 75 psia at 400°F and 155 psia at 361°F. These tests showed that the electrical penetration assemblies withstand severe accident conditions. The electrical penetration assemblies are qualified for the containment design basis event conditions as described in Appendix 3D. The assemblies are similar to one of those tested by Sandia as reported in NUREG/CR-5334 (Reference 5). The ultimate pressure capacity of the electrical penetration assemblies is primarily determined by the temperature. The maximum temperature of the containment vessel below the operating deck during a severe accident is below the temperature at which the assemblies from the three suppliers in the Sandia tests were tested.

3.8.2.4.2.6 Material Properties

The containment vessel is designed using SA738, Grade B material. This has a specified minimum yield of 60 ksi and ultimate of 85 ksi. Test data for materials having similar chemical properties were reviewed. In a sample of 122 tests for thicknesses equaling or exceeding 1.50 inches and less than 1.75 inches, the actual yield had a mean value of 69.1 ksi with a standard deviation of 3.3 ksi. Thus, the actual yield is expected to be about 15 percent higher than the minimum yield. Membrane yield of the cylinder is predicted to occur at an internal pressure of 178 psig.

A stress-strain curve for material with chemistry similar to SA738, Grade B, indicated constant yield stress of 81.3 ksi from a strain of 0.002 to 0.006 followed by strain-hardening up to a

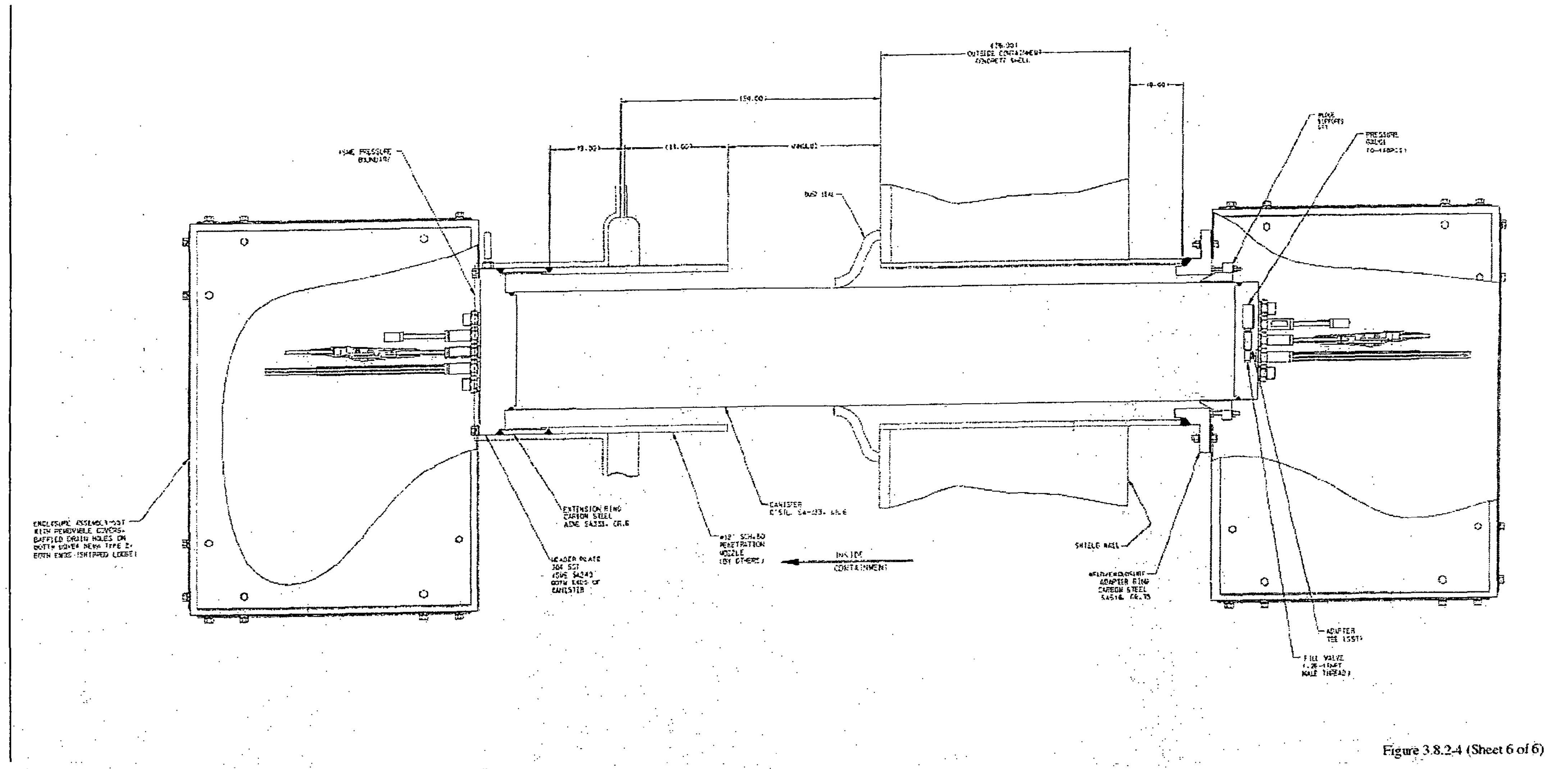


Figure 3.8.2-4 (Sheet 6 of 6)

Containment Penetrations Typical Electrical Penetration

Document Number: APP-GW-GLN-079 **Revision Number:** 0

Title: Electrical system design changes

CHAPTER 8

ELECTRIC POWER

8.1 Introduction

8.1.1 Utility Grid Description

The operating company grid system and interconnections to other grid systems and generating stations are site-specific.

8.1.2 Onsite Power System Description

The onsite power system is comprised of the main ac power system and the dc power system. The main ac power system is a non-Class 1E system. The dc power system consists of two independent systems: Class 1E dc system and non-Class 1E dc system. The ac and dc onsite power system configurations are shown on Figures 8.3.1-1 and 8.3.2-1, -2 and -3, respectively.

The normal ac power supply to the main ac power system is provided from the station main generator. When the main generator is not available, plant auxiliary power is provided from the switchyard by backfeeding through the main stepup and unit auxiliary transformers. This is the preferred power supply. When neither the normal nor the preferred power supply is available due to an electrical fault at either the main stepup transformer, unit auxiliary transformer, isophase bus, or 6.9kv nonsegregated bus duct, fast bus transfer will be initiated to transfer the loads to the reserve auxiliary transformers powered by maintenance sources of power. In addition, two non-Class 1E onsite standby diesel generators supply power to selected loads in the event of loss of ~~both~~ the normal, ~~and~~ preferred, and maintenance power sources. The reserve auxiliary transformers also serve as a source of maintenance power. ~~There is also a maintenance source of power provided through a reserve auxiliary transformer.~~ The maintenance sources are ~~is~~ site-specific.

The main generator is connected to the offsite power system by three single-phase stepup transformers. The normal power source for the plant auxiliary ac loads comes from the generator buses through two unit auxiliary transformers of identical rating. In the event of a loss of the main generator, the power is maintained without interruption from the preferred power supply by an autotrip of the main generator breaker. Power then flows from the switchyard to the auxiliary loads through the main and unit auxiliary transformers.

A spare single-phase main stepup transformer is provided in the transformer area. The spare can be placed in service upon failure of one phase of the main stepup transformers.

The onsite standby power system, powered by the two onsite standby diesel generators, supplies power to selected loads in the event of loss of other ac power sources. Loads that are priority loads for investment protection due to their specific functions (permanent nonsafety loads) are selected for access to the onsite standby power supply. Availability of the standby power source is not required to accomplish any safety function.

The maintenance power suppliesy is are provided at the medium voltage (6.9 kV) buses through normally open circuit breakers. Bus transfer to maintenance source is manualeither is automatic under fast bus transfer logic or may be initiated manually.

Four independent divisions of Class 1E 125 Vdc battery systems are provided for the Class 1E dc and UPS system. Divisions B and C have two battery banks; one battery bank is sized to supply power to safety-related loads for at least 24 hours and the other battery bank is sized to supply power to a second set of safety-related loads for at least 72 hours following a design basis event (including the loss of all ac power). Divisions A and D have one 24-hour battery bank. The loads are assigned to each battery bank, depending on their required function, during the 72 hour coping period so that no manual or automatic load shedding is required for the first 24 hours. Two ancillary diesel generators are provided for power for Class 1E post-accident monitoring, MCR lighting, MCR and I&C room ventilation, and power to refill the PCS water storage tank and spent fuel pool if no other sources of ac power are available.

A single spare Class 1E battery bank is provided for both Class 1E and non-Class 1E battery systems and a separate spare charger is provided for each of the systems. In order to preserve independence of each Class 1E dc system division, plug-in locking type disconnects are permanently installed to prevent connection of more than one battery bank to the spare. In addition, kirk-key interlock switches are provided to prevent transfer operation of more than one switchboard at a time. The spare battery bank is located in a separate room and is capable of supplying power to the required loads on any battery being temporarily replaced with the spare.

The non-Class 1E 125 Vdc power system provides continuous, reliable power to the plant nonsafety-related dc loads. Operation of the non-Class 1E dc system is not required to accomplish any safety function.

Uninterruptible power supplies (UPS) to the four independent divisions of the Class 1E 120 Vac instrument buses are included in the Class 1E dc system. The normal power to the uninterruptible power supply comes from the respective Class 1E 125 Vdc bus. The backup power comes from the main ac power system through Class 1E 480-208Y/120V voltage regulating transformers. The same configuration applies for the uninterruptible power to the non-divisional, non-Class 1E 120 Vac instrument buses. The normal power to the non-Class 1E uninterruptible power supply comes from the non-Class 1E 125 Vdc bus and the backup power comes from the main ac power system through a voltage regulating transformer.

8.1.3 Safety-Related Loads

The safety-related loads requiring Class 1E power are listed in Tables 8.3.2-1, -2, -3 and -4. Safety-related loads are powered from the Class 1E 125 Vdc batteries and the associated Class 1E 120 Vac instrument buses.

8.1.4.2.2 Power Generation Design Basis

- The main ac power system is a non-Class 1E system and nonsafety-related. The normal power supply to the main ac power system comes from the station main generator through two identically rated unit auxiliary transformers.
- The onsite standby power system supplies ac power to the selected permanent nonsafety loads in the event of a main generator trip concurrent with the loss of preferred power source and maintenance power source when under fast bus transfer conditions. The onsite standby diesel generators are automatically connected to the associated 6.9 kV buses upon loss of bus voltage only after the generator rated voltage and frequency is established. Loads that are important for orderly plant shutdown are sequentially connected as shown in subsection 8.3.1 during this event.

8.2 Offsite Power System

8.2.1 System Description

The normal ac power supply to the main ac power system is provided from the main generator. When the main generator is not available, plant auxiliary power is provided from the switchyard by backfeeding through the main stepup and unit auxiliary transformers. This is the preferred power supply. When neither the normal nor the preferred power supply are available due to an electrical fault at either the Main Step Up transformer, unit auxiliary transformer, the isophase bus, or 6.9kv non segregated bus duct, fast bus transfer will be automatically initiated to transfer the loads to the reserve auxiliary transformers powered by maintenance sources of power. In addition, two non-Class 1E onsite standby diesel generators supply power to selected plant loads in the event of loss of ~~both the~~ normal, ~~and~~ preferred, and maintenance power sources. The reserve auxiliary transformers also serve as a source of maintenance power.

The maintenance sources are site-specific. ~~There is also a maintenance source of power provided through a reserve auxiliary transformer to supply power to selected loads. The maintenance source is site specific.~~ Maintenance power is provided at the medium voltage level (6.9 kV) through normally open circuit breakers. Bus transfer to the maintenance source is ~~manual~~automatic under fast bus transfer logic or may be initiated manually. Connection of the preferred and maintenance power supplies to the utility grid or other power sources is site-specific.

The main generator is connected to the offsite power system via three single-phase main stepup transformers. The normal power source for the plant auxiliary ac loads is provided from the isophase generator buses through the two unit auxiliary transformers of identical ratings. In the event of a loss of the main generator, the power is maintained without interruption from the preferred power supply by an auto-trip of the main generator breaker. Power then flows from the transformer area to the auxiliary loads through the main and unit auxiliary transformers.

The transmission system is site-specific.

The transmission line structures associated with the plant are designed to withstand standard loading conditions for the specific-site as provided in Reference 1.

Automatic load dispatch is not used at the plant and does not interface with safety-related action required of the reactor protection system.

8.3 Onsite Power Systems

8.3.1 AC Power Systems

8.3.1.1 Description

The onsite ac power system is a non-Class 1E system comprised of a normal, preferred, maintenance and standby power supplies. The normal, preferred, and maintenance power supplies are included in the main ac power system. The standby power is included in the onsite standby power system. The Class 1E and non-Class 1E 208/120 Vac instrumentation power supplies are described in subsection 8.3.2 as a part of uninterruptible power supply in the dc power systems.

8.3.1.1.1 Onsite AC Power System

The main ac power system is a non-Class 1E system and does not perform any safety-related functions. It has nominal bus voltage ratings of 6.9 kV, 480 V, 277 V, 208 V, and 120 V.

Figure 8.3.1-1 shows the main generator, transformers, feeders, buses, and their connections. The ratings of major ac equipment are listed in Table 8.3.1-3.

During power generation mode, the turbine generator normally supplies electric power to the plant auxiliary loads through the unit auxiliary transformers. The plant is designed to sustain a load rejection from 100 percent power with the turbine generator continuing stable operation while supplying the plant house loads. The load rejection feature does not perform any safety function.

During plant startup, shutdown, and maintenance the generator breaker remains open. The main ac power is provided by the preferred power supply from the high-voltage switchyard (switchyard voltage is site-specific) through the plant main stepup transformers and two unit auxiliary transformers. Each unit auxiliary transformer supplies power to about 50 percent of the plant loads.

A maintenance source is provided to supply power through ~~a~~ two reserve auxiliary transformers. The maintenance source and the associated reserve auxiliary transformers primary voltage are site specific. The reserve auxiliary transformers ~~is~~ are sized so that ~~it~~ they can be used in place of either of the unit auxiliary transformers, if needed.

The two unit auxiliary transformers have two identically rated 6.9 kV secondary windings. Secondaries of the auxiliary transformers are connected to the 6.9 kV switchgear buses by nonsegregated phase buses. The primary of the unit auxiliary transformer is connected to the main generator isolated phase bus duct tap. The 6.9 kV switchgear designation, location, connection, and connected loads are shown in Figure 8.3.1-1. The buses tagged with odd numbers (ES1, ES3, etc.) are connected to one unit auxiliary transformer and the buses tagged with even numbers (ES2, ES4, etc.) are connected to the other unit auxiliary transformer. These 6.9 kV buses are provided with an access to the maintenance source through normally open circuit breakers connecting the bus to the reserve auxiliary transformer. Bus transfer to the maintenance source is manual or automatic through a fast bus transfer scheme.

The arrangement of the 6.9 kV buses permits feeding functionally redundant pumps or groups of loads from separate buses and enhances the plant operational flexibility. The 6.9 kV switchgear powers large motors, and the load center transformers. There are two switchgear (ES1 and ES2) located in the annex building, and four (ES3, ES4, ES5 and ES6) in the turbine building.

The main stepup transformers have protective devices for sudden pressure, neutral overcurrent, and differential current. The unit auxiliary transformers have protective devices for sudden pressure, overcurrent, differential current, and neutral overcurrent. The isophase bus duct has ground fault protection. If these devices sense a fault condition the following actions will be automatically taken:

- Trip high-side (grid) breaker
- Trip generator breaker
- Trip exciter field breaker
- Trip the 6.9 kV buses connected to the faulted transformer
- Initiate a fast bus transfer of ES1-ES6 6.9kv buses.

The reserve auxiliary transformers has have protective devices for sudden pressure, overcurrent, and differential current. The reserve auxiliary transformers protective devices trip the reserve supply breaker and any 6.9 kV buses connected to the reserve auxiliary transformers.

The onsite standby power system powered by the two onsite standby diesel generators supplies power to selected loads in the event of loss of normal, and preferred ac power supplies followed by a fast bus transfer to the reserve auxiliary transformers. Those loads that are priority loads for defense-in-depth functions based on their specific functions (permanent nonsafety loads) are assigned to buses ES1 and ES2. These plant permanent nonsafety loads are divided into two functionally redundant load groups (degree of redundancy for each load is described in the sections for the respective systems). Each load group is connected to either bus ES1 or ES2. Each bus is backed by a non-Class 1E onsite standby diesel generator. In the event of a loss of voltage on these buses, the diesel generators are automatically started and connected to the respective buses. In the event of a fast bus transfer, the diesel connection to the bus will be delayed such that fast bus and residual transfer is allowed to initiate. The source incoming breakers on switchgear ES1 and ES2 are interlocked to prevent inadvertent connection of the onsite standby diesel generator and preferred/maintenance ac power sources to the 6.9 kV buses at the same time. The diesel generator however, is capable of being manually paralleled with the preferred or reserve power supply for periodic testing. Design provisions protect the diesel generators from excessive loading beyond the design maximum rating, should the preferred power be lost during periodic testing. The control scheme, while protecting the diesel generators from excessive loading, does not compromise the onsite power supply capabilities to support the defense-in-depth loads. See subsection 8.3.1.1.2 for starting and load sequencing of standby diesel generators.

The reactor coolant pumps (RCPs) are powered from the four switchgear buses located in the turbine building, one RCP per bus. Variable-speed drives are provided for RCP startup and for RCP operation when the reactor trip breakers are open. During normal power operation (reactor

trip breakers are closed), 60 Hz power is provided directly to the RCPs and the variable-speed drives are not connected.

Each RCP is powered through two Class 1E circuit breakers connected in series. These are the only Class 1E circuit breakers used in the main ac power system for the specific purpose of satisfying the safety-related tripping requirement of these pumps. The reactor coolant pumps connected to a common steam generator are powered from two different unit auxiliary transformers. The bus assignments for the reactor coolant pumps are shown in Figure 8.3.1-1.

The 480 V load centers supply power to selected 460 V motor loads and to motor control centers. Bus tie breakers are provided between two 480 V load centers each serving predominantly redundant loads. This intertie allows restoration of power to selected loads in the event of a failure or maintenance of a single load center transformer. The bus tie breakers are interlocked with the corresponding bus source incoming breakers so that one of the two bus source incoming breakers must be opened before the associated tie breaker is closed.

The 480 V motor control centers supply power to 460 V motors not powered directly from load centers, while the 480/277 V, and 208/120 V distribution panels provide power for miscellaneous loads such as unit heaters, space heaters, and lighting system. The motor control centers also provide ac power to the Class 1E battery chargers for the Class 1E dc power system as described in subsection 8.3.2.

Two ancillary ac diesel generators, located in the annex building, provide ac power for Class 1E post-accident monitoring, MCR lighting, MCR and I&C room ventilation, and pump power to refill the PCS water storage tank and the spent fuel pool, when all other sources of power are not available.

Each ancillary ac generator output is connected to a distribution panel. The distribution panel is located in the room housing the diesel generators. The distribution panel has incoming and outgoing feeder circuit breakers as shown on Figure 8.3.1-3. The outgoing feeder circuit breakers are connected to cables which are routed to the divisions B and C voltage regulating transformers and to the PCS pumps. Each distribution panel has the following outgoing connections:

- Connection for Class 1E voltage regulating transformer to power the post-accident monitoring loads, the lighting in the main control room, and ventilation in the main control room and divisions B and C I&C rooms.

- Connection for PCS recirculation pump to refill the PCS water storage tank and the spent fuel pool.

- Connection for local loads to support operation of the ancillary generator (lighting and fuel tank heating).

- Temporary connection for a test load device (e.g., load resistor).

See Figure 8.3.1-3 for connections to post-72-hour loads.

Each of the generators is directly coupled to the diesel engine. Each diesel generator unit is an independent self-contained system complete with necessary support subsystems that include:

- Diesel engine starting subsystem
- Combustion air intake and engine exhaust subsystem
- Engine cooling subsystem
- Engine lubricating oil subsystem
- Engine speed control subsystem
- Generator, ~~static~~ exciter, generator protection, monitoring instruments and controls subsystems

The diesel-generator starting air subsystem consists of an ac motor-driven, air-cooled compressor, a compressor inlet air filter, an air-cooled aftercooler, an in-line air filter, refrigerant dryer (with dew point at least 10°F less than the lowest normal diesel generator room temperature), and an air receiver with sufficient storage capacity for three diesel engine starts. The starting air subsystem will be consistent with manufacturer's recommendations regarding the devices to crank the engine, duration of the cranking cycle, the number of engine revolutions per start attempt, volume and design pressure of the air receivers, and compressor size. The interconnecting stainless steel piping from the compressor to the diesel engine dual air starter system includes air filters, moisture drainers, and pressure regulators to provide clean dry compressed air at normal diesel generator room temperature for engine starting.

The diesel-generator combustion air intake and engine exhaust subsystem provides combustion air directly from the outside to the diesel engine while protecting it from dust, rain, snow and other environmental particulates. It then discharges exhaust gases from the engine to the outside of the diesel generator building more than 20 feet higher than the air intake. The combustion air circuit is separate from the ventilation subsystems and includes weather protected dry type inlet air filters piped directly to the inlet connections of the diesel engine-mounted turbochargers. The combustion air filters are capable of reducing airborne particulate material, assuming the maximum expected airborne particulate concentration at the combustion air intake. Each engine is provided with two filters as shown in Figure 8.3.1-4. A differential pressure gauge is installed across each filter to determine the need for filter replacement. The engine exhaust gas circuit consists of the engine exhaust gas discharge pipes from the turbocharger outlets to a single vertically mounted outdoor silencer which discharges to the atmosphere. Manufacturer's recommendations are considered in the design of features to protect the silencer module and other system components from possible clogging due to adverse atmospheric conditions, such as dust storms, rain, ice, and snow.

The diesel-generator engine cooling system is an independent closed loop cooling system, rejecting engine heat through two separate roof-mounted, fan-cooled radiators. The system consists of two separate cooling loops each maintained at a temperature required for optimum engine performance by separate engine-driven coolant water circulating pumps. One circuit cools the engine cylinder block, jacket, and head area, while the other circuit cools the oil cooler and

turbocharger aftercooler. The cooling water in each loop passes through a three-way self-contained temperature control valve which modulates the flow of water through or around the radiator, as necessary, to maintain required water temperature. The temperature control valve has an expanding wax-type temperature-sensitive element or equivalent. The cooling circuit, which cools the engine cylinder blocks, jacket, and head areas, includes a keep-warm circuit consisting of a temperature controlled electric heater and an ac motor-driven water circulating pump.

The diesel-generator engine lubrication system is contained on the engine skid and includes an engine oil sump, a main engine driven oil pump and a continuous engine prelube system consisting of an ac and dc motor driven prelube pump and electric heater. The prelube system maintains the engine lubrication system in service when the diesel engine is in standby mode. The lube oil is circulated through the engine and various filters and coolers to maintain the lube oil properties suitable for engine lubrication.

The diesel generator engine fuel oil system consists of an engine-mounted, engine-driven fuel oil pump that takes fuel from the fuel oil day tank, and pumps through inline oil filters to the engine fuel injectors and a separate recirculation circuit with a fuel oil cooler. The recirculation circuit discharges back to the fuel oil day tank that is maintained at the proper fuel level by the diesel fuel oil storage and transfer system.

The onsite standby diesel generators are provided with necessary controls and indicators for local or remote monitoring of the operation of the units. Essential parameters are monitored and alarmed in the main control room via the plant data display and processing system as described in Chapter 7. Indications and alarms that ~~will be~~are available locally and in the main control room are listed in Table 8.3.1-5.

The design of the onsite standby diesel generators does not ensure functional operability or maintenance access or support plant recovery following design basis events. Maintenance accessibility is provided consistent with the system nonsafety-related functions and plant availability goals.

The piping and instrumentation diagrams for the onsite standby diesel generator units and the associated subsystems are shown on Figures 8.3.1-4 and 8.3.1-5.

The onsite standby power supply system is shown schematically on one line diagram, Figure 8.3.1-1.

The onsite diesel generators will be procured in accordance with an equipment specification which will include requirements based upon the manufacturer's standards and applicable recommendations from documents such as NUREG/CR-0660 (Reference 15). Capability to detect system leakage and to prevent crankcase explosions will be based upon manufacturer's recommendations. Control of moisture in the starting air system by the equipment described above will be based upon manufacturer's recommendations. Dust and dirt in the diesel generator room is controlled by the diesel generator building ventilation system described in subsection 9.4.10. Personnel training is addressed as part of overall plant training in subsection 13.2.1. Automatic engine prelube by the equipment described above will be based upon manufacturer's recommendations. Testing, test loading and preventive maintenance is addressed as part of overall plant testing and maintenance in Chapter 13. Instrumentation to

ET2A and ET2B (X windings) via nonsegregated buses. The nonsegregated buses are routed from the transformer yard to the annex building in the most direct path practical.

The switchgear ES3, ES4, ES5, and ES6 are located in the turbine building electrical switchgear rooms. The incoming power is supplied from the unit auxiliary transformers ET2A and ET2B (Y windings) via nonsegregated buses to ES3 and ES4 and from ET2A and ET2B (X windings) to ES5 and ES6.

The Class 1E medium voltage circuit breakers, ES31, ES32, ES41, ES42, ES51, ES52, ES61, and ES62, for four reactor coolant pumps are located in the auxiliary building.

The 480 V load centers are located in the turbine building electrical switchgear rooms 1 and 2 and in the annex building electrical switchgear rooms 1 and 2 based on the proximity of loads and the associated 6.9 kV switchgear.

The 480 V motor control centers are located throughout the plant to effectively distribute power to electrical loads. The load centers and motor control centers are free standing with top or bottom cable entry and front access. The number of stacks/cubicles vary for each location.

8.3.1.1.5 Heat Tracing System

The electric heat tracing system is nonsafety-related and provides electrical heating where temperature above ambient is required for system operation and freeze protection.

The electric heat tracing system is part of the AP1000 permanent nonsafety-related loads and is powered from the diesel backed 480 V ac motor control centers through 480 V - 208Y/120V transformers and distribution panels.

8.3.1.1.6 Containment Building Electrical Penetrations

The electrical penetrations are in accordance with IEEE 317 (Reference 2).

The penetrations conform to the same functional service level as the cables, (for example, low-level instrumentation is in a separate nozzle from power and control). The same service class separation requirements apply within inboard/outboard terminal boxes.

Individual electrical penetrations are provided for each electrical service level and follows the same raceway voltage grouping described in subsection 8.3.1.3.4. Optical fibers are installed in Instrumentation and Control or Low Voltage Power electrical penetrations. ~~For modular-type penetrations (three penetration modules in one nozzle), it is permissible to assign:~~

- ~~One module for low voltage power~~
- ~~One module for 120/125V control and signal~~
- ~~One module for instrumentation signal~~

~~It is possible to combine low voltage power with 120/125V control in the same module.~~

The electrical penetrations conductor modules are in penetrations of the same service class. Modules for instrumentation signals will be in instrumentation penetrations; modules for control power (e.g. 120/125V) will be in control power penetrations; modules for low voltage power (e.g. 600VAC) will be in low voltage power penetrations.

It is possible to combine low voltage power with control power in the same electrical penetration assembly.

Penetrations carrying medium voltage power cables have thermocouples to monitor the temperature within the assembly at the spot expected to have the hottest temperature.

Electrical circuits passing through electrical penetrations have primary and backup protective devices. These devices coordinate with the thermal capability curves (I^2t) of the penetration assemblies. The penetrations are rated to withstand the maximum short-circuit currents available either continuously without exceeding their thermal limit, or at least longer than the field cables of the circuits so that the fault or overload currents are interrupted by the protective devices prior to a potential failure of a penetration. Penetrations are protected for the full range of currents up to the maximum short circuit current available.

Primary and backup protective devices protecting Class 1E circuits are Class 1E in accordance with IEEE 741 (Reference 10). Primary and backup protective devices protecting non-Class 1E circuits are non-Class 1E.

Penetration overcurrent protection coordination curves are generated based on the protection requirements specified by the penetration equipment manufacturer. When necessary, penetrations are protected for instantaneous overcurrent by current limiting devices such as current-limiting fuses, current-limiting breakers, or reactors.

8.3.1.1.7 Grounding System

The AP1000 grounding system will comply with the guidelines provided in IEEE 665 (Reference 18) and IEEE 1050 (Reference 20). The grounding system consists of the following four subsystems:

- Station grounding grid
- System grounding
- Equipment grounding
- Instrument/computer grounding

The station grounding grid subsystem consists of buried, interconnected bare copper conductors and ground rods (Copperweld) forming a plant ground grid matrix. The subsystem will maintain a uniform ground potential and limit the step-and-touch potentials to safe values under all fault conditions.

The system grounding subsystem provides grounding of the neutral points of the main generator, main step-up transformers, auxiliary transformers, load center transformers, and onsite standby diesel generators. The main and diesel generator neutrals will be grounded through grounding transformers providing high-impedance grounding. The main step-up and load center transformer

Table 8.3.1-3

COMPONENT DATA - MAIN AC POWER SYSTEM (NOMINAL VALUES)

1. Main Stepup Transformer	
	3 single phase, FOA, 65°C rise, liquid filled
2. Unit Auxiliary Transformers (UATs)	
	3 phase, 3 winding
	H = 70 MVA, OA, 65°C
	X = 35 MVA, OA, 65°C
	Y = 35 MVA, OA, 65°C
Reserve Auxiliary Transformer (RAT)	
	3 phase, 3 winding
	H = 70 MVA, OA, 65°C
	X = 35 MVA, OA, 65°C
	Y = 35 MVA, OA, 65°C
3. 6.9 kV Switchgear	
	medium voltage metal-clad switchgear
	~~MVA Class – 500 MVA~~Interrupting Current Rating – 63KA
	vacuum-type circuit breaker
4. 480 V Load Centers	
Transformers - Indoor, Air-Cooled Ventilated Dry-Type, Fire Retardant:	2500 kVA, AA, 3 phase, 60 Hz 6900 - 480 V
Main Bus Ampacity	4000 amperes continuous
480V Breakers	metal enclosed draw-out circuit breaker or motor-starter (contactor)
	65,000 A RMS symmetrical interrupting rating
5. 480 V Motor Control Centers	
Horizontal Bus	800 A continuous rating
	65,000 A RMS symmetrical bracing
Vertical Bus	300 A continuous rating
	65,000 A RMS symmetrical bracing
Breakers (molded case)	65,000 A RMS symmetrical interrupting rating

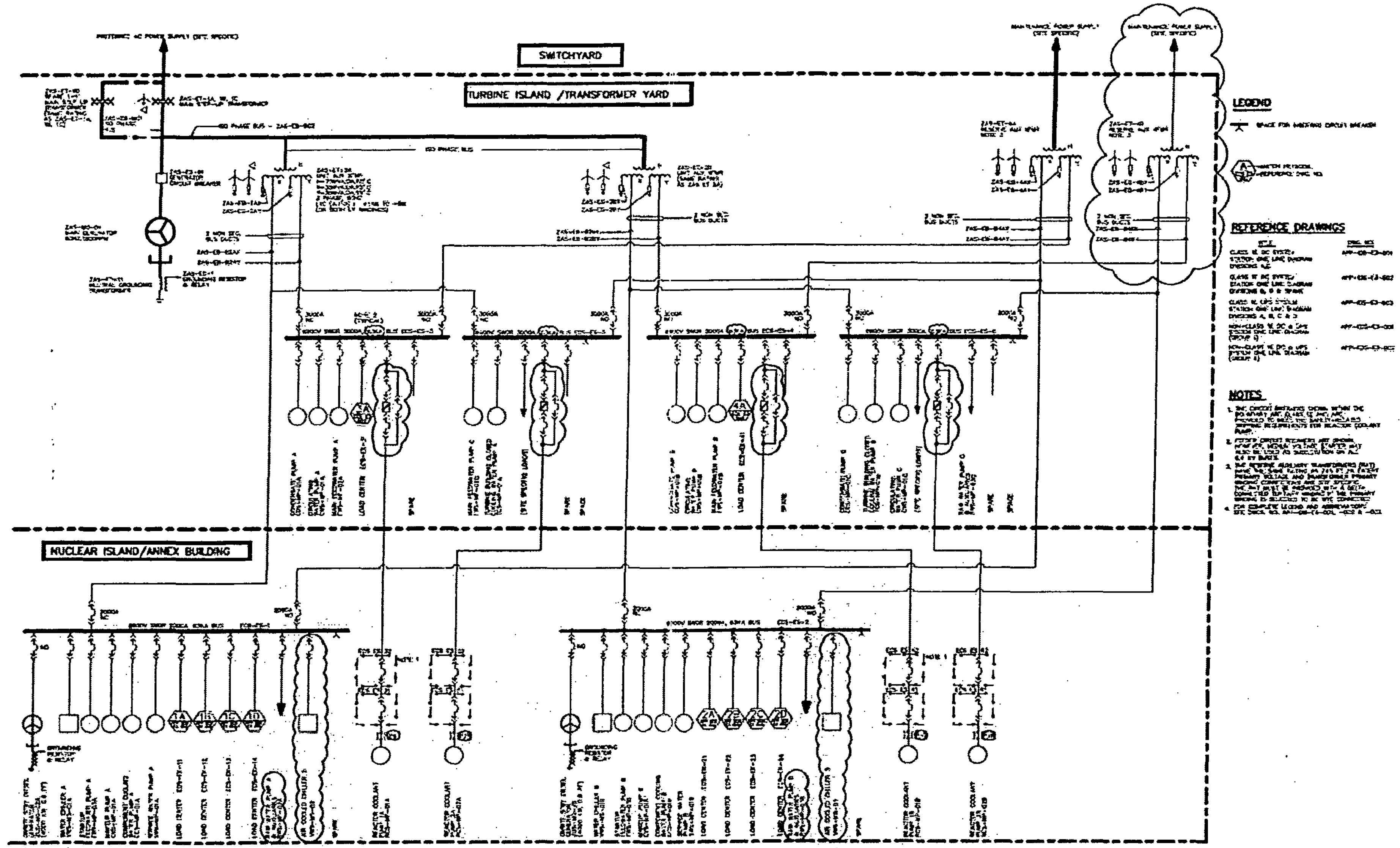


Figure 8.3.1-1

AC Power Station One Line Diagram

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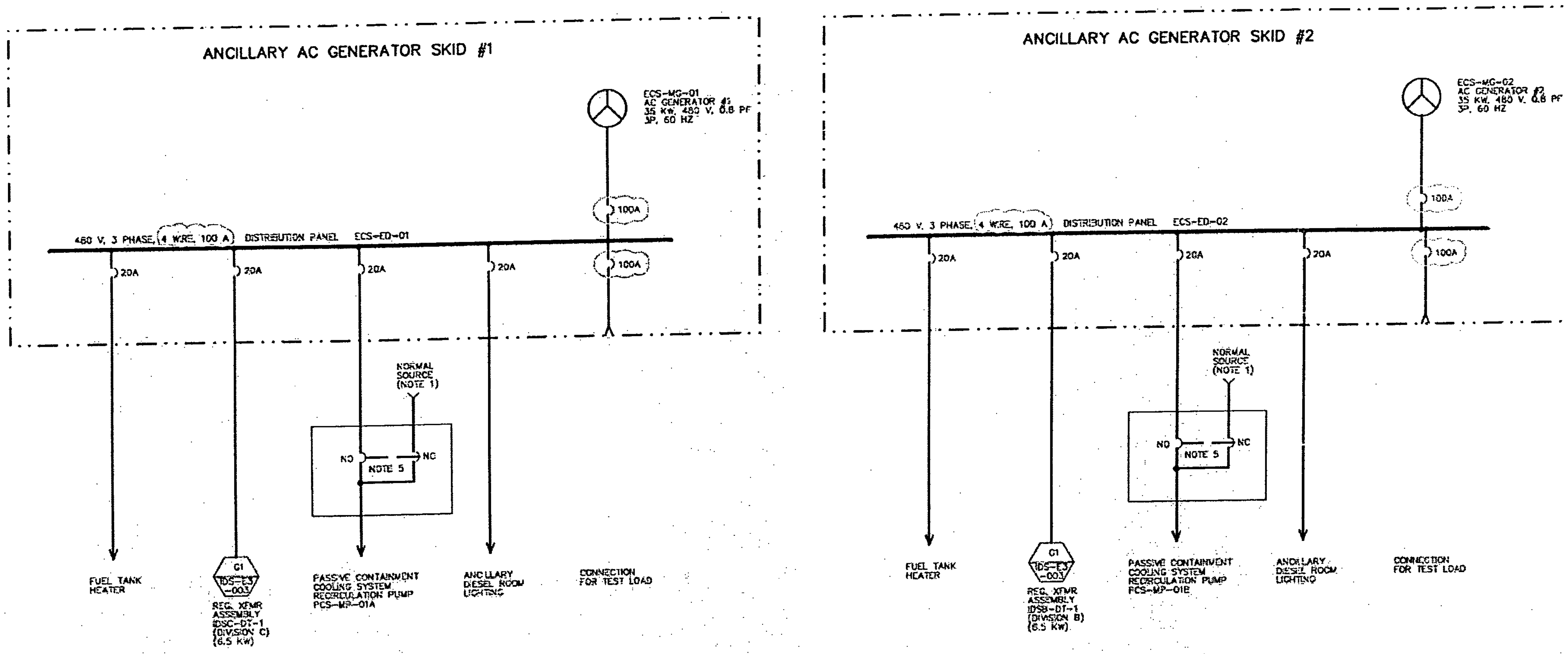

Figure 8.3.1-3

Post 72 Hour Temporary Electric Power One Line Diagram

c) Correct outputs or actuation functions, for the manual actuation logic mode, are verified by demonstrating that each manual actuation function results in the proper output as indicated by contact operation, component actuation, or electrical test.

d) Proper operation of indications and alarms for the specified inputs, including those which provide reactor trip or engineered safety features actuation status, are verified by injecting simulated input signals.

14.2.9.2.15 Main AC Power System Testing

Purpose

The purpose of the main ac power system testing is to verify that the as-installed components properly perform the following nonsafety-related function:

- Provide ac electrical power to plant nonsafety-related loads as described in subsection 8.3.1; and the following nonsafety-related function:
- Provide onsite power for post-72 hour electrical requirements.

Prerequisites

The construction tests for the individual components associated with the main ac power system have been completed. The required test instrumentation is properly calibrated and operational. Additionally, the plant offsite grid connection is complete and available.

General Test Methods and Acceptance Criteria

The capability of the main ac power system to provide power to plant loads under various plant operating conditions is verified. The system components to be tested include the ancillary diesel generator, the medium and low voltage power system, load centers, motor control centers, and instrumentation and controls. The following tests verify that the main ac power system provides its functions as specified in subsection 8.3.1 and appropriate design specifications:

a) Verify the operability of medium-voltage supply breakers.

b) Energize the diesel-backed buses from their associated onsite standby diesel-generator supplies. Verify the bus voltages are within design limits. This test can be performed in conjunction with the testing of the standby diesel generator.

c) Energize the medium voltage buses from their associated unit auxiliary transformer. Verify the bus voltages are within design limits.

d) Energize each medium voltage bus from the reserve auxiliary transformer. Verify the bus voltages are within design limits.

e) Operate the automatic and maintenance bus transfer schemes. Verify successful transfer and return operation.

ef) Verify correct operation of the manual controls, annunciation, and instrumentation for the 480 V load centers and their 4160 V feeder breakers.

gf) Simulate fault conditions at the 480 V load centers and verify alarms and operation of trip devices and protective relays.

hg) Energize the 480 V load centers. Verify the bus voltages are within design limits.

ih) Verify the operability of motor control center supply breakers.

ji) Simulate fault conditions at the motor control centers and verify alarms and operation of trip devices and protective relays.

jk) Energize the motor control centers. Verify the bus voltages are within design limits.

lk) Start ancillary diesel generators, energize voltage regulating transformers. Verify the input voltages to the regulating transformers are within design limits.

14.2.9.2.16 Non-Class 1E dc and Uninterruptible Power Supply System Testing

Purpose

The purpose of the non-Class 1E dc and uninterruptible power supply system testing is to verify the ability to provide continuous, reliable power for the non-Class 1E control and instrumentation defense-in-depth loads.

Prerequisites

The construction tests for the individual components associated with the non-Class 1E dc and uninterruptible power supply system have been completed. Permanently installed and test instrumentation are properly calibrated and operational. The 480 V ac system is in operation to supply power to the battery chargers. Additionally, a test load is available for the performance of battery capacity tests.

General Test Methods and Acceptance Criteria

The non-Class 1E dc and uninterruptible power supply system consists of electrical equipment including batteries, battery chargers, inverters, static transfer switches, and associated instrumentation and alarms that is used to supply power for the non-Class 1E control and instrumentation loads. Performance is observed and recorded during a series of individual component and integrated system tests. These tests verify that the non-Class 1E dc and uninterruptible power supply system operates as specified in subsection 8.3.2 and appropriate design specifications:

a) The capability of each of the three non-Class 1E batteries serving defense-in-depth loads is verified to meet or exceed the required ampere-hour rating by a battery performance test in accordance with IEEE 450. Following this discharge, the voltage of each cell is verified to be greater than or equal to the specified minimum cell voltage.

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IV. REGULATORY IMPACT

A.	Does the proposed change include a change to:		
	1. Tier 1 of the AP1000 Design Control Document APP-GW-GL-700	☐ NO ☒ YES	(If YES prepare a report for NRC review of the changes)
	2. Tier 2* of the AP1000 Design Control Document, APP-GW-GL-700	☐ NO ☒ YES	(If YES prepare a report for NRC review of the changes)
	3. Technical Specification in Chapter 16 of the AP1000 Design Control Document, APP-GW-GL-700	☒ NO ☐ YES	(If YES prepare a report for NRC review of the changes)
B.	Does the proposed change involve:		
	1. Closure of a Combined License Information Item identified in the AP1000 Design Control Document, APP-GW-GL-700	☒ NO ☐ YES	(If YES prepare a COL item closure report for NRC review.)
	2. Completion of an ITAAC item identified in Tier 1 of the AP1000 Design Control Document, APP-GW-GL-700	☒ NO ☐ YES	(If YES prepare an ITAAC completion report for NRC review.)

☐ The questions above are answered no, therefore the departure from the DCD in a COL application does not require prior NRC review unless review is required by the criteria of 10 CFR Part 52 Appendix D Section VIII B.5.b. or B.5c

C. FSER IMPACT

There is no impact on the FSER. The electrical changes described above have no effect on design function.

D. SCREENING QUESTIONS (Check correct response and provide justification for that determination under each response)

1. Does the proposed change involve a change to an SSC that adversely affects a DCD described design function? ☐ YES ☒ NO

   There is no change to a design function of any safety related equipment.

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2. Does the proposed change involve a change to a procedure that adversely affects how DCD described SSC design functions are performed or controlled? ☐ YES ☒ NO

   The proposed electrical changes have no effect on operation of the reactor coolant system. The changes have no effect on the initiation or operation of the passive core cooling system.

3. Does the proposed activity involve revising or replacing an DCD described evaluation methodology that is used in establishing the design bases or used in the safety analyses? ☐ YES ☒ NO

   The proposed electrical changes do not require changes to the evaluation of the response to postulated accident conditions. The changes to the design do not require changes to the structural or safety analysis of any safety related equipment.

4. Does the proposed activity involve a test or experiment not described in the DCD, where an SSC is utilized or controlled in a manner that is outside the reference bounds of the design for that SSC or is inconsistent with analyses or descriptions in the DCD? ☐ YES ☒ NO

   The proposed electrical changes do not require an additional test or experiment or changes to testing.

E. EVALUATION OF DEPARTURE FROM TIER 2 INFORMATION (Check correct response and provide justification for that determination under each response)

   10 CFR Part 52, Appendix D, Section VIII. B.5.a. provides that an applicant for a combined licensee who references the AP1000 design certification may depart from Tier 2 information, without prior NRC approval, if it does not require a license amendment under paragraph B.5.b. The questions below address the criteria of B.5.b.

1. Does the proposed activity result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the plant-specific DCD?	☐ YES ☒ NO
The proposed electrical changes described will not cause any new accident initiators, the proposed changes are bounded by previous analysis cases, and there are no new accident initiators and no effect on the frequency of evaluated accidents.	
2. Does the proposed activity result in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety and previously evaluated in the plant-specific DCD?	☐ YES ☒ NO
The proposed electrical changes will not increase the likelihood of a malfunction of SSC. The operating conditions for the reactor coolant system and passive core cooling system are not altered.	

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3. Does the proposed activity result in more than a minimal increase in the consequences of an accident previously evaluated in the plant-specific DCD?	☐ YES ☒ NO
The proposed electrical changes have no effect on the operation, performance, and pressure boundary integrity of the safety related equipment. Therefore, there is no increase in the calculated release of radioactive material during postulated accident conditions.	
4. Does the proposed activity result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the plant-specific DCD?	☐ YES ☒ NO
The proposed electrical changes have no effect on the design functions or reliability of the safety related equipment or other components and operation of the passive core cooling system. Therefore, there is no increase in the calculated release of radioactive material due to a malfunction of an SSC.	
5. Does the proposed activity create a possibility for an accident of a different type than any evaluated previously in the plant-specific DCD?	☐ YES ☒ NO
The proposed electrical changes have no effect on the operation, performance, and pressure boundary integrity of the plant equipment. The proposed changes are bounded by the loss of AC and loss of RCP analysis cases. The response of the safety related equipment and the passive core cooling system to postulated accident conditions is not altered by the proposed changes. The proposed changes do not introduce any additional failure modes; therefore, there is no possibility of an accident of a different type than any evaluated previously in the DCD.	
6. Does the proposed activity create a possibility for a malfunction of an SSC important to safety with a different result than any evaluated previously in the plant-specific DCD?	☐ YES ☒ NO
The proposed electrical changes have no effect on the design functions of the safety related equipment or operation of the passive core cooling system. There are no additional failure modes or the possibility for a malfunction of an SSC important to safety with a different result than any evaluated previously.	
7. Does the proposed activity result in a design basis limit for a fission product barrier as described in the plant-specific DCD being exceeded or altered?	☐ YES ☒ NO
There is no change to the design function of the safety related equipment. The criteria to provide for pressure boundary integrity are not exceeded or altered.	
8. Does the proposed activity result in a departure from a method of evaluation described in the plant-specific DCD used in establishing the design bases or in the safety analyses?	☐ YES ☒ NO
The proposed electrical changes will apply for all plants, They have no impact on the design bases and the safety analyses.	

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☒	The answers to the evaluation questions above are "NO" and the proposed departure from Tier 2 does not require prior NRC review to be included in plant specific FSARs as provided in 10 CFR Part 52, Appendix D, Section VIII. B.5.b
☐	One or more of the answers to the evaluation questions above are "YES" and the proposed change requires NRC review.

F. IMPACT ON RESOLUTION OF A SEVERE ACCIDENT ISSUE

10 CFR Part 52, Appendix D, Section VIII. B.5.a. provides that an applicant for a combined licensee who references the AP1000 design certification may depart from Tier 2 information, without prior NRC approval, if it does not require a license amendment under paragraph B.5.c. The questions below address the criteria of B.5.c.

1. Does the proposed activity result in an impact features that mitigate severe accidents. If the answer is Yes answer Questions 2 and 3 below.	☐ YES ☒ NO
The systems and components identified in the DCD Subsection 1.9.5 and Appendix 19 B that mitigate severe accidents are not impacted by the proposed electrical changes.	
2. Is there is a substantial increase in the probability of a severe accident such that a particular severe accident previously reviewed and determined to be not credible could become credible?	☐ YES ☒ NO ☐ N/A
3. Is there is a substantial increase in the consequences to the public of a particular severe accident previously reviewed?	☐ YES ☒ NO ☐ N/A

☒	The answers to the evaluation questions above are "NO" or are not applicable and the proposed departure from Tier 2 does not require prior NRC review to be included in plant specific FSARs as provided in 10 CFR Part 52, Appendix D, Section VIII. B.5.c
☐	One or more of the he answers to the evaluation questions above are "YES" and the proposed change requires NRC review.

G. SECURITY ASSESSMENT

1. Does the proposed change have an adverse impact on the security assessment of the AP1000. ☐ YES ☒ NO

The proposed electrical changes will not alter barriers or alarms that control access to protected areas of the plant. The design changes will not alter requirements for security personnel; therefore, the proposed changes do not have an adverse impact on the security assessment of the AP1000.

5.0 REFERENCES

1. APP-GW-GL-700, AP1000 Design Control Document, Revision 15.