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Subject: **Response to NRC Request for Additional Information Letter No. 354 Related to ESBWR Design Certification Application – Technical Specifications – RAI Number 16.2-82 S01**

Enclosures 1 and 2 contain the GE Hitachi Nuclear Energy (GEH) response to the subject NRC RAI transmitted via the Reference 1 letter.

If you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

Reference:

1. MFN 09-450, Letter from U.S. Nuclear Regulatory Commission to Jerald G. Head, *Request for Additional Information Letter No. 354 Related to ESBWR Design Certification Application,* June 25, 2009

Enclosures:

1. MFN 09-518 – Response to NRC Request for Additional Information Letter No. 354 Related to ESBWR Design Certification Application – Technical Specifications – RAI Number 16.2-82 S01
2. MFN 09-518 – DCD Markups for RAI Number 16.2-82 S01

cc:

AE Cubbage	USNRC (with enclosures)
JG Head	GEH (with enclosures)
DH Hinds	GEH (with enclosures)
eDRF	104-7631

Enclosure 1

MFN 09-518

Response to NRC Request for

Additional Information Letter No. 354

Related to ESBWR Design Certification Application

- Technical Specifications -

RAI Number 16.2-82 S01

NRC RAI 16.2-82 S01

1. *In RAI 16.2-82 the staff requested GEH to provide the basis for the proposed 24-hour completion time in GTS 3.8.1 for Required Action B.1, to restore DC sources to operable status, for the condition of one or more DC sources inoperable in one required division for other than one or both required battery chargers inoperable in one required division. This action is less restrictive than corresponding STS 3.8.4 Action B of the BWR/6 STS (NUREG-1434, Rev 3), which specifies a 2-hour completion time for Required Action B.1, to restore batteries to operable status, for the condition of one or two batteries on one division inoperable.*

   In its response to RAI 16.2-82, GEH stated that a complete loss of any two of the four divisions of DC and uninterruptible AC electrical power distributions will not prevent proper operation of any of the four divisions of emergency core cooling, with or without the loss of offsite power, because all required safety functions can be actuated by any two divisions. GEH stated that the design differences between the ESBWR and the design modeled for the BWR/6 STS support the 24-hour completion time of GTS 3.8.1 for restoration of inoperable DC sources in one required division. The applicant is requested to explain in greater detail the design differences between BWR/6 and ESBWR that justify the 24-hour completion time for restoring ESBWR DC sources in one required division to operable status or change it to a shorter completion time that the design difference can justify.

2. *In RAI 16.2-82 the staff requested GEH to provide the basis for the proposed 24-hour completion time in GTS 3.8.4 for Required Action A.1, to restore [the two inverters that supply one] required division [of the uninterruptible AC electrical distribution] to operable status, for the condition of [one or both inverters that supply] one required division [of the uninterruptible AC electrical distribution] inoperable. This action is consistent with corresponding STS 3.8.7 Action A of the BWR/6 STS (NUREG-1434, Rev 3), which specifies a 24-hour completion time for Required Action A.1, to restore the inverters to operable status, for the condition of one inverter in one division [Division 1 or 2] inoperable.*

   In its response to RAI 16.2-82, GEH stated that the 24-hour completion time used in the BWR/6 STS is based on use of the non-safety-related constant voltage transformer, powered by an offsite or [safety-related] onsite AC source rather than the battery, to support the uninterruptible AC buses. In the ESBWR design the constant voltage transformers have been deleted; and even with these transformers, the ESBWR onsite AC power sources that would supply them are nonsafety-related. In consideration of the differences between the ESBWR design and BWR/6 design modeled in the STS, the staff finds that the 24-hour completion time for GTS 3.8.4 Required Action A.1 is too long. The applicant is requested to provide additional justification for the 24-hour completion time or change it to an 8-hour completion time, which is consistent with Action B of GTS 3.8.6.

3. *If shorter completion times are proposed in response to 1 and 2 above, GEH must revise completion times in GTS 3.8.6 to be consistent with the completion times in GTS 3.8.1 and GTS 3.8.4.*

4. *The proposed periodic 24-hour completion time in GTS 3.8.1 for Required Action A.2, to verify battery [float current ≤ 30 amps], for the condition of one or both required battery chargers inoperable in one required division is consistent with the exponential charging current portion of the battery charge profile following the service test which is "24-hours" as specified in DCD Section 8.3.2.1.1. However, the staff finds that the BWR/6 STS bases reviewer's note for the periodic 12-hour completion time of corresponding Required Action A.2 of STS 3.8.4, to verify battery float current ≤ [2] amps, is not applicable to the ESBWR passive design. This is because the capacity drain from an ESBWR battery, following entry into GTS 3.8.1 Condition A, will be significantly less than the capacity drain from a BWR/6 battery, which has a shorter duty cycle than the ESBWR battery, following entry into STS 3.8.4 Condition A. The BWR/6 STS 3.8.4 Action A bases reviewer's note, which is apparently the basis for the reviewer's note for associated ESBWR COL Item 3.8.1-2, states:*

   ----------REVIEWER'S NOTE----------
   A plant that cannot meet the 12 hour Completion Time due to an inherent battery charging characteristic can propose an alternate time equal to 2 hours plus the time experienced to accomplish the exponential charging current portion of the battery charge profile following the service test (SR 3.8.4.3).

   The staff concludes that GTS 3.8.1, Required Action A.2 should specify a periodic completion time much shorter than 24 hours for restoring a partially discharged ESBWR battery. The applicant is requested to provide additional justification for the periodic 24-hour completion time, or propose a periodic completion time much shorter than 24 hours and provide justification.

GEH Response

Regarding design differences between ESBWR and the design modeled for the BWR/6 Standard Technical Specifications (STS), as outlined in the original response to RAI 16.2-82 (refer to MFN 07-023):

> Loss of a required division of DC in the design modeled in the BWR/6 STS could prevent proper operation of an entire associated division of emergency core cooling system pumps and valves when using either onsite or offsite power, could result in the failure of the diesel generator to start and load, and could hamper restoration of offsite power.

In the design reflected in the STS, generally, loss of one division of power (AC and/or DC) equates to loss of single failure protection for every safety-related function. These

safety-related functions require operation of components (e.g., ECCS pumps and valves; electrical distribution breakers for sequencing and/or power availability) that depend on a combination of AC (motive) power and DC (control) power.

For the ESBWR, complete loss of one required (i.e., one of three required) division does not affect the capability of any safety-related function. Each ESBWR safety-related function can be fully accomplished with any two divisions of the uninterruptable power supply (UPS) (which includes the associated 250 VDC battery power supplies). Furthermore, the ESBWR design for safety-related functions does not depend on offsite or diesel generator backed AC power.

In addition, each ESBWR UPS division is comprised of two rectifiers, two batteries, and two inverters. The two inverters are configured for parallel redundant operation to allow load sharing and the equal discharge of the divisional safety-related batteries. Each inverter normally carries approximately 50% of the load. If one inverter fails, 100% of the load is picked up by the remaining inverter. As such, any division with loss of one inverter (and/or its associated DC bus, battery or battery charger) can continue to support the safety-related function of that division, albeit for less than the design basis 72 hours.

The ESBWR DCD Generic Technical Specification (GTS) Actions for the electrical sources and distribution currently reflect one level of degradation within an entire division regardless of whether the impact is to one or both redundant components within that division. The ESBWR DCD GTS is revised to provide an additional new Action for divisional inoperabilities that impact only one of two redundant components within one division (i.e., one required battery charger, one battery, or one inverter). This level of degradation in one required division continues to provide support power for all safety-related systems as well as the ability to accommodate an additional single failure without immediate loss of any safety-related function. As such, the DCD is revised to present a 72-hour Completion Time for these conditions.

This allowance provides a reasonable time to return a division to operable status in the event (for example) one of its batteries is undergoing its periodic service testing at the time of an unanticipated inoperability of a remaining division of UPS power. Accomplishing recovery of the division in planned maintenance (e.g., completing or aborting the service test, recharging the battery, and restoring the line-up) can be expected within 72 hours, thus restoring three required divisions and avoiding an unnecessary plant shutdown transient.

To respond to the NRC request for shorter Completion Times for one required division with no ability to support its safety-related function, those Completion Times are revised to 8 hours (consistent with the RAI Part 2 identified acceptable time).

Additionally, clarifications are made to Chapter 8 to indicate that a single battery can carry its divisional loads for a period of time that is greater than 36 hours, but less than 72 hours.

Specific responses to the RAI follow:

RAI Part 1

> "*... 24-hour completion time of GTS 3.8.1 for restoration of inoperable DC sources in one required division.*"

GTS 3.8.1 is revised to replace the existing Action A related to inoperability of the battery charger with an action more specifically associated with inoperabilities in DC sources (battery and/or charger) associated with one 250 VDC bus on one required division. As discussed previously, this level of degradation continues to provide support power for all safety-related systems and the ability to accommodate an additional single failure without immediate loss of any safety-related function. Therefore, this Action is presented with a 72-hour Completion Time.

GTS 3.8.1 Condition B (editorially reworded) continues to reflect one required division with potentially no ability to support its safety-related function. As discussed previously, the Completion Time for this condition is shortened to 8 hours.

In conjunction with these changes, Action A is added to GTS 3.8.2, "DC Sources - Shutdown," allowing 72 hours for inoperabilities in DC sources (battery and/or charger) associated with one 250 VDC bus on one required division. As discussed previously, this level of degradation continues to provide support power for all safety-related systems and the ability to accommodate an additional single failure without immediate loss of any safety-related function.

RAI Part 2

> "*...24-hour completion time for GTS 3.8.4 Required Action A.1 is too long...*"

GTS 3.8.4 Action A is revised to address the inoperability of one of the two inverters on one required division. As discussed previously, this level of degradation continues to provide support power for all safety-related systems and the ability to accommodate an additional single failure without immediate loss of any safety-related function. Therefore, this Action is presented with a 72-hour Completion Time.

Action B is created to address the condition previously addressed by Action A for the inoperability of one required division of inverters. As requested, this Action is presented with an 8-hour Completion Time consistent with GTS 3.8.6.

Additionally, the existing Note to Required Action A.1 is deleted. This Note is no longer necessary since the GTS 3.8.4 Completion Times for inverter restoration are aligned with the Completion Times of GTS 3.8.6.

In conjunction with these changes, Action A is added to GTS 3.8.5, "Inverters - Shutdown," allowing 72 hours for inoperability of one of the two inverters on one required division. As discussed previously, this level of degradation continues to provide support power for all safety-related systems and the ability to accommodate an additional single failure without immediate loss of any safety-related function.

RAI Part 3

> "*...revise completion times in GTS 3.8.6 to be consistent with the completion times in GTS 3.8.1 and GTS 3.8.4*."

GTS 3.8.6 Actions are revised to present conditions (Actions A and C) addressing the inoperability of one of the two buses on one required division. As discussed previously, this level of degradation continues to provide support power for all safety-related systems and the ability to accommodate an additional single failure without immediate loss of any safety-related function. Therefore, this Action is presented with a 72-hour Completion Time. This Completion Time is consistent with the Completion Times presented in GTS 3.8.1 and 3.8.4.

GTS 3.8.6 Actions are revised to present conditions (Actions B, D, and E) addressing the inoperability of an entire required division of Electrical Power Distribution. The Completion Time for these conditions is 8 hours. This Completion Time is consistent with the Completion Times presented in GTS 3.8.1 and 3.8.4.

In conjunction with these changes, Actions A and B are added to GTS 3.8.7, "Distribution Systems - Shutdown," allowing 72 hours for inoperability of one of the two DC Electrical Power Distribution buses, and one of the two Uninterruptible AC Electrical Power Distribution buses, on one required division. As discussed previously, this level of degradation continues to provide support power for all safety-related systems and the ability to accommodate an additional single failure without immediate loss of any safety-related function.

RAI Part 4

> "*...GTS 3.8.1, Required Action A.2 should specify a periodic completion time much shorter than 24 hours for restoring a partially discharged ESBWR battery*..."

With the changes outlined in Part 1 of this response, existing Action A is no longer necessary. The intent of the existing Action A was to provide relaxed Completion Times for inoperability of a charger compared to inoperability of the battery. With the revised Completion Times discussed in Part 1, no additional relaxation for battery charger inoperabilities is deemed necessary.

GTS 3.8.3 Action B provides a Condition and Required Action for a partially discharged battery. Similar to the Required Action that is the subject of Part 4 of this RAI, this Action has an allowance of 24 hours to complete the battery recharge.

To address the staff's concerns, GTS 3.8.3 Condition B is split into 2 separate Conditions (Conditions B and C). Condition B is revised to apply when one battery on one required division is partially discharged as indicated by float current outside the limit. As discussed previously, this level of degradation continues to provide support power for all safety-related systems and the ability to accommodate an additional single failure without immediate loss of any safety-related function. Therefore, this Action retains a 24-hour allowance to complete the battery recharge. Condition C is created to apply when two batteries on one required division are partially discharged as indicated

by float currents being outside the required limits. This Action features a shortened allowance of 8 hours to complete the recharge of at least one battery.

DCD Impact

The DCD has been revised as described above and as shown in the markups in Enclosure 2. Changes associated with this RAI response are identified in the enclosed markups by enclosing the text within a black box.

Enclosure 2

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DCD Markups for

RAI Number 16.2-82 S01

batteries. The two inverters in each safety-related division will be configured for parallel redundant operation to allow load sharing and the equal discharge of the division's safety-related batteries. ~~A static transfer switch is provided for each inverter for transferring safety-related UPS AC load from the safety-related inverter outputs to a direct AC feed from the divisional Isolation Power Center through a safety-related regulating transformer should failure of the division's inverters occur. A manual maintenance transfer switch is provided for transferring safety-related UPS AC loads from the safety-related inverter output to a direct AC feed from the safety-related divisional Isolation Power Center through a safety-related regulating transformer in order to perform inverter maintenance without removing safety-related UPS AC loads from service.~~

Routine maintenance can be conducted on equipment associated with the safety-related UPS power supply. Inverters, rectifiers, and solid state switches can be inspected, serviced and tested channel by channel without tripping the RPS logic.

UPS Components - Each of the four safety-related divisions includes the following safety-related UPS components:

- Two solid-state UPS rectifiers, to convert 480 VAC to 250 VDC;
- Two solid-state UPS inverters, to convert 250 VDC to 120 VAC power;
- Two solid-state transfer switches to sense failure of each of the division's inverters; and

~~□One manual bypass switch for inverter or rectifier maintenance;~~

~~□One 480/120 VAC regulating transformer to supply a direct AC feed during inverter(s) or rectifier(s) maintenance or failure; and~~

- Power distribution panel boards to provide power to all safety-related loads requiring uninterruptible 120 VAC power.

Operating Configuration - The four divisions of safety-related UPS operate independently, providing power to all safety-related loads within their division requiring uninterruptible AC power. The normal power source for each division's inverters is the same division's isolation power center, which provides AC power to the rectifiers. Transfer from the 480 VAC power supply to the 250 VDC buses is done automatically and passively in case of loss of the normal power source. Each inverter normally carries approximately 50% of the load. If one inverter fails, 100% of the load is picked up by the remaining inverter for a period of time greater than 36 hours but less than 72 hours. If both inverters in a division are lost, the associated 120 VAC UPS buses are de-energized ~~Transfer from the inverter to the alternate AC source (provided via the division's Isolation Power Center through a regulating transformer) is done automatically in case of failure of both of the division's inverters~~. An alarm is provided in the main control room for any of the alternate operating lineups.

Nonsafety-Related Uninterruptible Power Supply System

The nonsafety-related UPS provides reliable, uninterruptible AC power for nonsafety-related equipment needed for continuity of power plant operation. UPS loads are divided into five load groups (load groups A, B, C, Technical Support Center [TSC]-A, and TSC-B). UPS load groups A and B each include two solid-state inverters, two solid-state rectifiers, two solid-state transfer switches, two manual transfer switches, and two regulating transformers with associated

Table 8.3-3

250VDC Safety-Related Battery Nominal Load Requirements

	DC Power (Watts)							
	Normal	**0-1 min DBA**	**1-5 min**	**5-7 min**	**7-15 min**	**15-17 min**	**17-60 min**	**1-72 hours**
Division 1	24697	26259	19618	22118	20501	20618	20501	20501
Division 2	24697	26259	19618	22118	20501	20618	20501	20501
Division 3	22040	23604	23993	26180	24563	24680	24563	24563
Division 4	22040	23604	23993	25805	24188	24305	24188	24188

Notes:

(1) The loads assumed for each divisional battery are estimated nominal values. These nominal loads are based on assumed equipment vendor information, best engineering load estimates, and preliminary Q-DCIS load values.

(2) The loads for RMUs powering solenoid valves and squib valves are based on the assumption that the solenoid valves would be operable (energized) for 72 hours. The Q-DCIS design limits the energized state of the squib valves to 2 minutes (time intervals 5-7 minutes and 15-17 minutes). This will conservatively encompass all design basis scenarios.

(3) 60°F is the minimum operable temperature used in the sizing calculation for the safety-related batteries in the four divisions shown above.

(4) The sizing calculation used for ESBWR safety-related lead acid batteries is the methodology of IEEE 485, which includes an overall margin that is conservative and bounding. The final margins of safety are factors greater than the IEEE standard required, based on the industry uncertainties of deep cycle discharge batteries. Aging factor, temperature factor, design margin factor, state of charge, and the ability to recharge in 24 hours (IEEE 946) were all employed in this calculation.

(5) The margins listed above in Notes 2, 3 and 4 ensure that a single 6000 Ah battery has the capacity to power a total division for a period of time greater than 36 hours but less than 72 hours at the end of a 20 year life.

Table 16.0-1-A (page 6 of 10)
COL - Applicant Open Items

COL Item	Description	Reviewer's Note
3.7.4-2	Turbine Bypass Valve cycling frequency	For SR 3.7.4.1, a Frequency of 31 days shall be specified unless an evaluation is performed and approved by the NRC using sufficient industry, site-specific, or manufacturer's operating experience or reliability studies that justifies extension to a longer Frequency (e.g., 92 days), a Reference to the evaluation and NRC approval is added to these Bases, and a commitment is made to establish appropriate procedural controls governing valve operation that support the extended Frequency.
3.7.6-1	SCRRI/SRI COLR-MCPR penalty option for inoperable control rods	An MCPR penalty is optional based upon completion of the required analyses to demonstrate that, given the specific inoperabilities that can be postulated and the number of selected control rods affected for each inoperability, sufficient margin exists to operate the unit with an MCPR penalty without exceeding the Fuel Cladding Integrity Safety Limit (FCISL) and the cladding 1% plastic strain limit during the licensing basis events requiring an acceptable operating MCPR limit as an initial condition. NRC approved analytical methods that evaluate the MCPR penalty must be included in TS 5.6.3, COLR, list of methods.
3.8.1-1	Acceptance criteria for battery charger testing.	Provide acceptance criteria for battery charger testing consistent with battery size.
3.8.1-2	~~Acceptance criteria for verification that battery is fully charged.~~Deleted	~~Provide acceptance criteria for verification that battery is fully charged consistent with battery manufacturer recommendations. Use of float current monitoring option requires that battery manufacturer confirm acceptability and acceptance criteria and that battery capacity includes margin for state of charge uncertainty~~Deleted
3.8.1-3	~~Use of a modified performance test for verification of battery capacity~~Deleted	~~Provide requirements for use of a modified performance test for verification of battery capacity consistent with battery manufacturer recommendations.~~Deleted
3.8.1-4	Battery Cell Parameters	Provide battery cell parameters consistent with manufacturer specifications.
3.8.1-5	Battery margin for aging factor and state of charge uncertainty.	Provide battery margin including aging factor and state of charge uncertainty.
3.8.3-1	Acceptance criteria for verification that battery is fully charged.	Provide acceptance criteria for verification that battery is fully charged consistent with battery manufacturer recommendations. Use of float current monitoring option requires that battery manufacturer confirm acceptability and acceptance criteria and that battery capacity includes margin for state of charge uncertainty
3.8.3-2	~~Use of a modified performance test for verification of battery capacity~~Deleted	~~Provide requirements for use of a modified performance test for verification of battery capacity consistent with battery manufacturer recommendations.~~Deleted

3.8 ELECTRICAL POWER SYSTEMS

3.8.1 DC Sources - Operating

LCO 3.8.1 DC Sources shall be OPERABLE to support the three Divisions of DC and Uninterruptible AC Electrical Power Distribution required by LCO 3.8.6, "Distribution Systems – Operating."

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~A. One or both required battery chargers inoperable on one required division.~~	~~A.1 Restore battery terminal voltage to greater than or equal to the minimum established float voltage.~~ ~~AND~~ ~~A.2 Verify battery is fully charged.~~ ~~AND~~ ~~A.3 Restore required battery chargers to OPERABLE status.~~	~~2 hours~~ ~~Once per 24 hours~~ ~~72 hours~~
A. One DC source on one required division inoperable.	A.1 Restore required DC Source to OPERABLE status.	72 hours

B. ~~One or more~~ Two DC Sources ~~inoperable~~ on one required division inoperable~~for reasons other than Condition A~~. ~~OR~~ ~~Required Action and associated Completion Time of Required Action A.1 not met.~~	B.1 Restore one required DC Source~~s~~ to OPERABLE status.	8 ~~24~~ hours
C. One or more DC Sources inoperable on two or more required divisions. OR Required Action and associated Completion Time of ~~Required Action A.2 or A.3, or~~ Condition A or B not met.	C.1 Be in MODE 3. AND C.2 Be in MODE 5.	12 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.1.1	Verify each required battery terminal voltage is greater than or equal to the minimum established float voltage.	~~31~~7 days

3.8 ELECTRICAL POWER SYSTEMS

3.8.2 DC Sources - Shutdown

LCO 3.8.2 DC Sources shall be OPERABLE to support the DC and Uninterruptible AC Electrical Power Distribution Divisions required by LCO 3.8.7, "Distribution Systems – Shutdown."

APPLICABILITY: MODES 5 and 6.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One DC source on one required division inoperable.	A.1 Restore required DC Source to OPERABLE status.	72 hours
BA. ~~One~~Two or more required DC Sources inoperable. OR Required Action and associated Completion Time of Condition A not met.	BA.1 Declare affected required features inoperable. OR BA.2.1 Suspend CORE ALTERATIONS. AND BA.2.2 Initiate action to suspend operations with a potential for draining the reactor vessel. AND BA.2.3 Initiate action to restore required DC Sources to OPERABLE status.	Immediately Immediately Immediately Immediately

3.8 ELECTRICAL POWER SYSTEMS

3.8.3 Battery Parameters

LCO 3.8.3 Battery parameters shall be within limits.

APPLICABILITY: When associated DC Sources are required to be OPERABLE.

ACTIONS

- NOTE -
Separate Condition entry allowed for each battery.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or two batteries on one required division with one or more battery cells float voltage < [~~2.14~~2.09] V.	A.1 Perform SR 3.8.1.1. AND A.2 Perform SR 3.8.3.1. AND A.3 Restore affected cell voltage ≥ [~~2.14~~2.09] V.	2 hours 2 hours 24 hours
B. One battery on one required division with [float current > 30 amps].	B.1 Perform SR 3.8.1.1. AND B.2 Restore battery [float current < 30 amps].	2 hours 24 hours
~~B~~C. ~~SR 3.8.3.1 not met for o~~One ~~or t~~Two batteries on one required division with [float current > 30 amps].	~~B~~C.1 Perform SR 3.8.1.1. AND ~~B~~C.2 ~~Verify battery is fully charged~~Restore one battery [float current~~(s)~~ < 30 amps].	2 hours ~~24~~8 hours

COL 16.0-~~2 H~~1-A 3.8.3-3

COL 16.0-1-A 3.8.3-1

COL 16.0-1-A 3.8.3-1

~~C. One or two batteries on one required division with charger voltage greater than maximum established design limit.~~	~~C.1 Restore charger voltage to less than or equal to maximum established design limit.~~	~~7 days~~
CONDITION	REQUIRED ACTION	COMPLETION TIME
---------- **- NOTE -** Required Action ~~C~~D.2 shall be completed if electrolyte level was below the top of plates. ---------- ~~C~~D. One or two batteries on one required division with one or more cell electrolyte level(s) less than minimum established design limits.	---------- **- NOTE -** Required Actions ~~C~~D.1 and ~~C~~D.2 are only applicable if electrolyte level was below the top of plates. ---------- ~~C~~D.1 Restore electrolyte level to above top of plates. AND ~~C~~D.2 Verify no evidence of leakage. AND ~~C~~D.3 Restore electrolyte level to greater than or equal to minimum established design limits.	8 hours 12 hours 31 days
~~D~~E. One or two batteries on one required division with battery ~~room average cell~~pilot cell electrolyte temperature less than minimum established design limit.	~~D~~E.1 Restore battery ~~roomaverage cell~~pilot cell electrolyte temperature to greater than or equal to minimum established design limit.	12 hours
~~E~~F. One or more required batteries in redundant required divisions with battery parameters not within limits.	~~E~~F.1 Restore battery parameters in all but one required division to within limits.	2 hours

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~F~~G. Required Action and associated Completion Time of Condition A, B, C, D, E or F~~E~~ not met. OR Required battery with one or more battery cell float voltage < [~~2.14~~2.09] V and ~~SR 3.8.3.1 not met~~[float current > 30 amps].	~~F~~G.1 Declare associated battery inoperable.	Immediately

COL 16.0-~~2-H~~1-A 3.8.3-3

COL 16.0-1-A 3.8.3-1

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.3.1	---------- **- NOTE -** Not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.1.1. ---------- Verify each required battery ~~is fully charged as indicated by [stabilized charging current or~~ [float current < 30 amps~~within limits~~].	~~31~~7 days
SR 3.8.3.2	Verify each required battery pilot cell float voltage is ≥ [~~2.14~~2.09] V.	31 days
SR 3.8.3.3	~~Verify each required battery terminal voltage is less than or equal to maximum established design limit.~~Verify each battery connected cell electrolyte level is greater than or equal to minimum established design limits.	31 days

COL 16.0-~~2-H~~1-A 3.8.3-1

COL 16.0-~~2-H~~1-A 3.8.3-3

3.8 ELECTRICAL POWER SYSTEMS

3.8.4 Inverters - Operating

LCO 3.8.4 Inverters shall be OPERABLE to support the three Divisions of Uninterruptible AC Electrical Power Distribution required by LCO 3.8.6, "Distribution Systems – Operating."

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One inverter on one required division inoperable.	~~---------- NOTE ---------- Enter applicable Conditions and Required Actions of LCO 3.8.6, "Distribution Systems - Operating" with any Uninterruptible AC Electrical Power Distribution bus de-energized. ----------~~ A.1 Restore required inverter ~~division~~ to OPERABLE status.	72~~24~~ hours
B. Two inverters on one required division inoperable.	B.1 Restore one required inverter to OPERABLE status.	8 hours

CONDITION	REQUIRED ACTION	COMPLETION TIME
CB. Two or more required divisions inoperable. OR Required Action and associated Completion Time of Condition A or B not met.	CB.1 Be in MODE 3. AND CB.2 Be in MODE 5.	12 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.4.1	Verify correct inverter voltage, frequency, and alignment to each required uninterruptible AC bus.	7 days

3.8 ELECTRICAL POWER SYSTEMS

3.8.5 Inverters - Shutdown

LCO 3.8.5 Inverters shall be OPERABLE to support the Uninterruptible AC Electrical Power Distribution Divisions required by LCO 3.8.7, "Distribution Systems – Shutdown."

APPLICABILITY: MODES 5 and 6.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One inverter on one required division inoperable.	A.1 Restore required inverter to OPERABLE status.	72 hours
BA. ~~One~~ Two or more required inverters inoperable. OR Required Action and associated Completion Time of Condition A not met.	BA.1 Declare affected required feature(s) inoperable. OR BA.2.1 Suspend CORE ALTERATIONS. AND BA.2.2 Initiate action to suspend operations with a potential for draining the reactor vessel. AND BA.2.3 Initiate action to restore required inverters to OPERABLE status.	Immediately Immediately Immediately Immediately

3.8 ELECTRICAL POWER SYSTEMS

3.8.6 Distribution Systems - Operating

LCO 3.8.6 Three Divisions of DC and Uninterruptible AC Electrical Power Distribution shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One ~~required division of~~ DC Electrical Power Distribution bus on one required division inoperable.	A.1 Restore required ~~division of~~ DC Electrical Power Distribution bus to OPERABLE status.	72~~2~~4 hours
B. Two DC Electrical Power Distribution buses on one required division inoperable.	B.1 Restore one required DC Electrical Power Distribution bus to OPERABLE status.	8 hours
C~~B~~. One ~~required division of~~ Uninterruptible AC Electrical Power Distribution bus on one required division inoperable.	C~~B~~.1 Restore required ~~division of~~ Uninterruptible AC Electrical Power Distribution bus to OPERABLE status.	72~~8~~ hours
D. Two Uninterruptible AC Electrical Power Distribution buses on one required division inoperable.	D.1 Restore one required Uninterruptible AC Electrical Power Distribution bus to OPERABLE status.	8 hours

CONDITION	REQUIRED ACTION	COMPLETION TIME
E. One Uninterruptible AC Electrical Power Distribution bus on one required division inoperable. AND DC Electrical Power Distribution bus associated with the redundant Uninterruptible AC Electrical Power Distribution bus on the same required division inoperable.	E.1 Restore required Uninterruptible AC Electrical Power Distribution bus to OPERABLE status. OR E.2 Restore required DC Electrical Power Distribution bus to OPERABLE status.	8 hours 8 hours
F~~C~~. Two or more required divisions of DC and Uninterruptible AC Electrical Power Distribution inoperable. OR Required Action and associated Completion Time of Condition A, B, C, D, or E~~B~~ not met.	F~~C~~.1 Be in MODE 3. AND F~~C~~.2 Be in MODE 5.	12 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.6.1	Verify correct breaker alignments and voltage to required DC and Uninterruptible AC Electrical Power Distribution buses.	7 days

3.8 ELECTRICAL POWER SYSTEMS

3.8.7 Distribution Systems - Shutdown

LCO 3.8.7 The necessary portions of DC and Uninterruptible AC Electrical Power Distribution shall be OPERABLE to support equipment required to be OPERABLE.

APPLICABILITY: MODES 5 and 6.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One DC Electrical Power Distribution bus on one required division inoperable.	A.1 Restore required DC Electrical Power Distribution bus to OPERABLE status.	72 hours
B. One Uninterruptible AC Electrical Power Distribution bus on one required division inoperable.	B.1 Restore required Uninterruptible AC Electrical Power Distribution bus to OPERABLE status.	72 hours

CONDITION	REQUIRED ACTION	COMPLETION TIME
CA. ~~One or more required divisions of DC and Uninterruptible AC Electrical Power Distribution inoperable.~~Two or more required DC Electrical Power Distribution buses inoperable. OR Two or more required Uninterruptible AC Electrical Power Distribution buses inoperable. OR One Uninterruptible AC Electrical Power Distribution bus and the DC Electrical Power Distribution bus associated with the redundant Uninterruptible AC Electrical Power Distribution bus on the same required division inoperable. OR Required Action and associated Completion Time of Condition A or B not met.	CA.1 Declare associated supported required feature(s) inoperable. OR CA.2.1 Suspend CORE ALTERATIONS. AND CA.2.2 Initiate action to suspend operations with a potential for draining the reactor vessel. AND CA.2.3 Initiate actions to restore required divisions of DC and Uninterruptible AC Electrical Power Distribution to OPERABLE status.	Immediately Immediately Immediately Immediately

BASES

LCO (continued)

Three of the four Divisions of DC Sources are required to be OPERABLE to ensure the availability of the required power to shut down the reactor and maintain it in a safe condition after an anticipated operational occurrence (AOO) or a postulated Design Basis Accident (DBA). Loss of one of the required Divisions of DC Sources does not prevent the minimum safety function from being performed (Ref. 4).

APPLICABILITY

The DC Sources are required to be OPERABLE in MODES 1, 2, 3, and 4 to ensure safe unit operation and to ensure that:

a. Acceptable fuel design limits and reactor coolant pressure boundary limits are not exceeded as a result of AOOs; and

b. Adequate core cooling is provided, and containment integrity and other vital functions are maintained in the event of a postulated DBA.

The DC electrical power requirements for MODES 5 and 6 are addressed in the Bases for LCO 3.8.2, "DC Sources - Shutdown."

ACTIONS ~~A.1, A.2, and A.3~~

~~Condition A represents one required division with one or both required battery chargers inoperable (e.g., the voltage limit of SR 3.8.1.1 is not maintained) on one required division. The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action A.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage. Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action A.2) from any discharge that might have occurred due to the charger inoperability.~~

BASES

ACTIONS (continued)

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus, there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DC system is designed to withstand.

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action A.2).

COL 16.0-2-H 3.8.1-2

Required Action A.2 requires that the battery be fully charged. A fully charged condition is achieved when [charging current has stabilized as indicated by three consecutive hourly current readings changing by < [0.5] amps while the battery voltage is being maintained within the limits of SR 3.8.1.1. Alternately, a fully charged condition is achieved when the float current is < [5.0] amps while the battery voltage is being maintained within the limits of SR 3.8.1.1. Either method verifies that a partially discharged battery has been fully recharged.] If at the expiration of the initial 24 hour period the battery is returned to the fully charged condition this indicates there may be additional battery problems and the battery must be declared inoperable.

COL 16.0-1-A 3.8.1-5

Required Action A.3 limits the restoration time for an inoperable battery charger to 72 hours. This action is applicable if an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage has been used. The 72 hour Completion Time

BASES

ACTIONS (continued)

~~provides a reasonable time to effect restoration of a qualified battery charger to OPERABLE status.~~

A.1

Condition A represents one DC Source inoperable on one required division (i.e., one required battery charger, one battery, or one battery and its associated required battery charger inoperable). In this Condition, the remaining OPERABLE battery and battery charger in the associated division can continue to support the immediate safety-related function following a transient event or DBA concurrent with a loss of offsite and onsite AC power, however, it may not have adequate capacity to support the associated division of the DC Electrical Power Distribution system for the required duration of 72 hours.

With one DC Source inoperable on one required division, the remaining required divisions of DC and Uninterruptible AC Electrical Power have the capacity to support a safe shutdown and to mitigate an accident condition even with an additional single failure, albeit for less than the design basis 72 hours. In this condition, continued power operation should not exceed 72 hours. The 72 hour Completion Time for the restoration of the inoperable DC source is consistent with the time allowed for one inoperable DC Electrical Power Distribution bus.

B.1

Condition B represents ~~one or~~ both DC Sources inoperable on one required division. ~~for reasons other than Condition A (i.e., one or both batteries inoperable, or the required charger and associated battery inoperable).~~ ~~Condition B also represents the inability to complete Required Action A.1 for restoration of a battery that is degraded as a result of an inoperable battery charger.~~ In this Condition, the affected division of the DC Sources may not have adequate capacity to support the associated division of the DC Electrical Power Distribution system ~~for the required duration of 72 hours~~ following a transient event or DBA concurrent with a loss of offsite and onsite AC power.

With ~~one or~~ both DC Sources inoperable on one required division, the two remaining required divisions of DC and Uninterruptible AC Electrical Power have the capacity to support a safe shutdown and to mitigate an accident condition even if power is lost to the supporting isolation power center ~~IPC~~ buses. However, a single failure could result in the loss of minimum necessary 250 VDC subsystems. Therefore, continued power

BASES

operation should not exceed 8~~24~~ hours. The 8~~24~~ hour Completion Time for the restoration of an inoperable DC source is consistent with the time allowed for an inoperable division of DC Electrical Power Distribution.

C.1 and C.2

When one or more DC Sources on two or more required divisions are inoperable, the remaining DC Sources may not have the capacity to supply power to the divisions of the DC Electrical Power Distribution system for the required duration of 72 hours following a transient event or DBA, concurrent with a loss of offsite and onsite AC power. If the Required Actions for restoration ~~of a required battery charger (i.e., Required Actions A.2 or A.3) or battery (i.e., Condition B)~~ cannot be met within the specified Completion Times, the plant remains vulnerable to a single failure that could impair the capability to reach safe shutdown or to mitigate an accident condition. Therefore, the unit must be placed in a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 12 hours and to MODE 5 within

ACTIONS (continued)

36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.8.1.1

Verifying battery terminal voltage while on float charge helps to ensure the effectiveness of the battery chargers, which support the ability of the batteries to perform their intended function. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery and maintain the battery in a fully charged state while supplying the continuous steady state loads of the associated DC subsystem. On float charge, battery cells will receive adequate current to optimally charge the battery. The voltage requirements are based on the nominal design voltage of the battery and are consistent with the minimum float voltage established by the battery manufacturer ([~~2.23~~]2.22 Vpc or [~~267.6~~]266.4 V at 25°C (77°F) at the battery terminals]). ~~Minimum established float voltages are temperature-compensated as a function of battery [room] temperature and are provided in the manufacturer operating manual.~~ This voltage maintains the battery in a condition that supports maintaining battery life~~, [(expected~~

BASES

APPLICABILITY

The DC Sources required to be OPERABLE in MODES 5 and 6 provide assurance that:

a. Required features to provide adequate coolant inventory makeup are available for the irradiated fuel assemblies in the core in case of an inadvertent draindown of the reactor vessel,

b. Required features necessary to mitigate the effects of events that can lead to core damage during shutdown are available, and

c. Instrumentation and control capability is available for monitoring and maintaining the unit in a cold shutdown condition or refueling condition.

The DC source requirements for MODES 1, 2, 3, and 4 are addressed in the Bases for LCO 3.8.1, "DC Sources- Operating."

ACTIONS

A.1

Condition A represents one DC Source inoperable on one required division (i.e., one required battery charger, one battery, or one battery and its associated required battery charger inoperable). In this Condition, the remaining OPERABLE battery and battery charger in the associated division can continue to support the immediate safety-related function following a transient event or DBA concurrent with a loss of offsite and onsite AC power, however, it may not have adequate capacity to support the associated division of the DC Electrical Power Distribution system for the required duration of 72 hours.

With one DC Source inoperable on one required division, the remaining required divisions of DC and Uninterruptible AC Electrical Power have the capacity to support a safe shutdown and to mitigate an accident condition even with an additional single failure, albeit for less than the design basis 72 hours. The 72 hour Completion Time for the restoration of the inoperable DC source is consistent with the time allowed for one inoperable DC Electrical Power Distribution bus.

ACTIONS (continued)

BA.1, BA.2.1, BA.2.2, and BA.2.3

When ~~one~~two or more DC Sources being used to support the DC and Uninterruptible AC Electrical Power Distribution Divisions required by LCO 3.8.7 are inoperable, or if the Required Action and associated

BASES

Completion Time of Condition A are not met, the remaining OPERABLE DC Sources may be capable of supporting sufficient systems to allow continuation of CORE ALTERATIONS and/or operations with a potential for draining the reactor vessel. By allowing the option to declare systems inoperable when the associated DC sources are inoperable, appropriate restrictions will be implemented in accordance with the ACTIONS of the affected system(s) LCO. In many instances, this would likely involve undesired administrative efforts. Therefore, the allowance for sufficiently conservative actions is made (i.e., to suspend CORE ALTERATIONS and any activities that could potentially result in inadvertent draining of the reactor vessel).

Suspension of these activities shall not preclude completion of actions to establish a safe conservative condition. These actions minimize the probability of the occurrence of postulated events. It is further required to immediately initiate action to restore the required DC source~~(~~s~~)~~ and to continue this action until restoration is accomplished in order to provide the necessary 250 VDC power to the plant safety systems.

The Completion Time of immediately is consistent with the required times for actions requiring prompt attention. The restoration of the required DC source~~(~~s~~)~~ should be completed as quickly as possible in order to minimize the time during which the plant safety systems may be without sufficient power.

SURVEILLANCE REQUIREMENTS

SR 3.8.2.1

SR 3.8.2.1 requires performance of all Surveillances required by SR 3.8.1.1 through SR 3.8.1.5. Therefore, see the corresponding Bases for Specification 3.8.1 for a discussion of each SR.

REFERENCES

1. Chapter 6.
2. Chapter 15.

BASES

Since the Required Actions only specify "perform," a failure of SR 3.8.1.1 or SR 3.8.3.1 acceptance criteria does not result in this Required Action not met. However, if one of the SRs is failed, the appropriate Condition(s), depending on the cause of the failures, is entered. If SR 3.8.3.1 is failed, then there is not assurance that there is still sufficient battery capacity to perform the intended function and the battery must be declared inoperable immediately.

ACTIONS (continued)

B.1, ~~and~~ B.2, C.1, and C.2

COL 16.0-1-A
3.8.3-1

One or two batteries on one required division with [float current > 30 amps]~~When SR 3.8.3.1 is not met, it~~ indicates that a partial discharge of the battery has occurred. This may be due to a temporary loss of a battery charger or possibly due to one or more battery cells in a low voltage condition reflecting some loss of capacity. Within 2 hours, verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage. If the terminal voltage is found to be less than the minimum established float voltage there are two possibilities, the battery charger is inoperable or is operating in the current limit mode. ~~LCO 3.8.1, Condition A, addresses charger inoperability.~~ If the charger is operating in the current limit mode after 2 hours that is an indication that the battery has been substantially discharged and likely cannot perform its required design functions. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within the allowed Completion Time~~24 hours~~ (Required Actions B.2 and C.2). The battery must therefore be declared inoperable. LCO 3.8.1 addresses battery and charger inoperability.

COL 16.0-~~2 H~~1-A
3.8.3-3

If the float voltage is found not to be satisfactory and there are one or more battery cells with float voltage less than [~~2.14~~2.09] V, the associated "OR" statement in Condition F is applicable and the battery must be declared inoperable immediately. If float voltage is satisfactory and there are no cells less than [~~2.14~~2.09] V, there is good assurance that, within 24 hours, the battery will be restored to its fully charged condition ~~(Required Action B.2)~~ from any discharge that might have occurred due to a temporary loss of the battery charger. As described in Reference 1, either the normal or the standby battery charger associated with each battery is capable of recharging its battery from the design minimum charge to fully charged condition within 24 hours while supplying the full load of the associated DC source.

BASES

COL 16.0-2-H 3.8.3-1

~~Required Action B.2 requires that the battery be fully charged. A battery is fully charged when [charging current has stabilized as indicated by three consecutive hourly current readings changing by < [0.5] amps while the battery voltage is being maintained within the limits of SR 3.8.1.1. Alternately, a battery is fully charged when the float current is < [5.0] amps while the battery voltage is being maintained within the limits of SR 3.8.1.1. Either method verifies that a partially discharged battery has been fully recharged.]~~

A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus, there is good assurance of fully recharging the battery within the allowed Completion Time.~~24 hours, avoiding a premature shutdown with its own attendant risk.~~

ACTIONS (continued)

COL 16.0-1-A 3.8.3-1

If Condition B is entered due to one battery on one required division with [float current > 30 amps], then 24 hours is allowed for recharging the battery (Required Action B.2). As discussed previously, 24 hours should be adequate to restore the battery to its fully charged condition from any discharge that might have occurred due to a temporary loss of the battery charger. However, if Condition C is entered due to two batteries on one required division with [float current > 30 amps], then only 8 hours is allowed to recharge at least one of the batteries (Required Action C.2). 8 hours should be adequate to recharge a battery following a short duration discharge. The more conservative Completion Time of 8 hours is based on engineering judgment considering the increased risk that the affected division of the DC and Uninterruptible AC Electrical Power Distribution System may not have adequate capacity to support the immediate safety-related function following a transient event or DBA concurrent with a loss of offsite and onsite AC power.

COL 16.0-~~2-H~~1-A 3.8.3-3

If the condition is due to one or more cells in a low voltage condition but still greater than [~~2.14~~2.09] V and float voltage is found to be satisfactory, this is not indication of a substantially discharged battery and 24 hours (Required Action B.2 for one affected battery) or 8 hours (Required Action C.2 for two affected batteries) is a reasonable time prior to declaring the battery inoperable.

Since Required Actions B.1 and C.1 only specify~~ies~~ "perform," a failure of SR 3.8.1.1 acceptance criteria does not result in the Required Action not

met. However, if SR 3.8.1.1 is failed, the appropriate Condition(s), depending on the cause of the failure, is entered.

~~C~~D.1, ~~C~~D.2, and ~~C~~D.3

~~With one or two batteries on one required division with charger voltage greater than maximum established temperature-compensated design limit, the batteries still retain sufficient capacity to perform the intended function. Therefore, the affected batteries are not required to be considered inoperable solely as a result of exceeding the temperature-compensated design limit. Within 7 days, the maximum established temperature-compensated design limit must be re-established.~~

~~At a constant battery voltage the charging current will increase as the temperature of the electrolyte increases. Therefore, cells in a battery at a higher temperature than others indicate a lower cell voltage. Continuous prolonged use at elevated temperatures will reduce the battery life. Based on tracking periods of excessive temperature-compensated terminal voltage, the impact on expected battery life can be monitored.~~ With one or two batteries on one required division with one or more cells electrolyte level above the top of the plates, but below the minimum established design limits, the batteries still retain sufficient capacity to perform the intended function. Therefore, the affected batteries are not required to be considered inoperable solely as a result of electrolyte level not met. Within 31 days, the minimum established design limits for electrolyte level must be re-established.

With electrolyte level below the top of the plates, there is a potential for dryout and plate degradation. Required Actions ~~C~~D.1 and ~~C~~D.2 address this potential (as well as provisions in Specification 5.5.10, Battery Monitoring and Maintenance Program). They are modified by a Note that indicates they are only applicable if electrolyte level is below the top of the plates.

ACTIONS (continued)

Within 8 hours, level is required to be restored to above the top of the plates. The Required Action ~~C~~D.2 requirement to verify that there is no leakage by visual inspection and the Specification 5.5.10.b item to initiate action to equalize and test in accordance with manufacturer's recommendation are taken from Annex D of IEEE Standard 450 (Ref. 4). They are performed following the restoration of the electrolyte level to above the top of the plates. Based on the results of the manufacturer's recommended testing, the battery may have to be declared inoperable and the affected cell(s) replaced.

BASES

~~D~~E.1

With one or two batteries on one required division with battery ~~room average cell~~pilot cell electrolyte temperature less than the minimum established design limit, 12 hours is allowed to restore the temperature to within limits. A low temperature results in reduced battery capacity. Since the battery is sized with margin, sufficient capacity exists to perform the intended function and the temporary degradation in battery capacity does not require the battery to be considered inoperable solely as a result of ~~room average cell~~pilot cell electrolyte temperature not met.

~~E~~F.1

With one or more required batteries in redundant required divisions with battery parameters not within limits, there is not sufficient assurance that battery capacity has not been affected to the degree that the batteries can still perform their required function, given that redundant divisions are involved. With redundant divisions involved, this potential could result in a total loss of function on multiple systems that rely upon the batteries. The longer Completion Times specified for battery parameters on one required division not within limits are therefore not appropriate, and the parameters must be restored to within limits on all but one required division within 2 hours.

~~F~~G.1

When any battery parameter is outside the allowances of the Required Actions for Condition A, B, C, D, E, or ~~E~~F, sufficient capacity to supply the maximum expected load requirement is not assured and the corresponding battery must be declared inoperable. Additionally, discovering one battery with one or more battery cells float voltage less than [~~2.14~~2.09] V and ~~SR 3.8.3.1 not met~~ [float current > 30 amps] indicates that the battery

COL 16.0-~~2 H~~1-A
3.8.3-3

COL 16.0-1-A
3.8.3-1

ACTIONS (continued)

capacity may not be sufficient to perform the intended functions. The battery must therefore be declared inoperable immediately.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.3.1

~~This SR verifies that a battery is fully charged as indicated by [stabilized charging current or float current within limits] while the battery is being maintained within the temperature-compensated float voltage limits required by SR 3.8.1.1.~~Verifying battery float current while on float charge is used to determine the state of charge of the battery. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery and maintain the battery in a charged state. The float current requirements are based on the float current indicative of a charged battery. ~~A fully charged condition exists when [charging current has stabilized as indicated by three consecutive hourly current readings changing by < [0.5] amps while the battery voltage is being maintained within the limits of SR 3.8.1.1. Alternately, a fully charged condition exists when the float current is < [5.0] amps while the battery voltage is being maintained within the limits of SR 3.8.1.1. Either method verifies that a battery is fully charged.]~~ The

COL 16.0-~~2 H~~1-A
3.8.3-1

[30 amp value] is based on returning the battery to [95]% charge and assumes a [5]% design margin for the battery. Use of float current to determine the state of charge of the battery is consistent with IEEE-~~1188~~450 (Ref. ~~1~~4) ~~and manufacturer recommendations~~. The ~~31~~7-day Frequency is consistent with IEEE-~~1188~~450 (Ref. ~~1~~4).

This SR is modified by a Note that states the float current requirement is not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.1.1. When this float voltage is not maintained, the Required Actions of LCO 3.8.1~~, ACTION A,~~ are being taken~~, which provide the necessary and appropriate verifications of the battery condition~~.

COL 16.0-~~2 H~~1-A
3.8.3-1

Furthermore, the float current limit [of ~~[2~~30~~]~~ amps] is established based on the nominal float voltage value and is not directly applicable when this voltage is not maintained.

SR 3.8.3.2 and SR 3.8.3.5

Optimal long-term battery performance is obtained by maintaining a float voltage within established design limits provided by the battery manufacturer, which corresponds to nominally [~~266.8~~]267.6 V at the battery terminals, or ~~[2.24]~~2.23 Vpc at 25°C (77°F)]. This provides adequate over-potential, which [limits the formation of lead sulfate and self-discharge, which could eventually render the battery inoperable]. Float voltages below [~~2.18~~2.13 Vpc at 25°C (77°F) but greater than ~~[2.14]~~2.09 Vpc], are addressed in Specification 5.5.10. SR 3.8.3.2 and SR 3.8.3.5 require verification that the cell float voltages are equal to or greater than the short-term absolute minimum voltage of [~~2.14~~2.09] Vpc. The Frequency for cell voltage verification every 31 days for pilot cell and

COL 16.0-~~2 H~~1-A
3.8.3-3

BASES

Inverter requirements for MODES 5 and 6 are covered in the Bases for LCO 3.8.5, "Inverters – Shutdown."

ACTIONS

A.1

Condition A represents one inverter inoperable on one required division. In this Condition, the affected division with one inverter remaining OPERABLE can continue to support the immediate safety-related function following a transient event or DBA concurrent with a loss of offsite and onsite AC power, however, it may not have adequate capacity to support the associated division of the Uninterruptible AC Electrical Power Distribution system for the required duration of 72 hours. With one ~~or both~~ inverter~~s~~ inoperable on one required division, ~~the associated Uninterruptible AC Electrical Power Distribution bus may be powered from the regulating transformers but the overall reliability of the associated Uninterruptible AC Electrical Power Distribution bus is reduced. With inverters in one required division inoperable,~~ the Uninterruptible AC Electrical Power Distribution buses in the ~~two~~ remaining required divisions are capable of supporting the minimum safety functions necessary to shut down the reactor and maintain it in a safe shutdown condition even with an additional single failure, albeit for less than the design basis 72 hours. In this condition, continued power operation should not exceed 72 hours.

~~Required Action A.1 allows 24 hours to fix the inoperable inverter and return it to service.~~ The 72~~24~~ hour limit is based upon engineering judgment, taking into consideration the time required to repair an inverter and the additional risk to which the plant is exposed because of the inverter inoperability. This risk has to be balanced against the risk of an immediate shutdown, along with the potential challenges to safety systems that such a shutdown might entail. ~~When the AC Vital Bus is powered from the regulating transformer, it is relying upon interruptible AC electrical power sources (offsite and onsite). The uninterruptible inverter source to the Uninterruptible AC Electrical Power Distribution buses is the preferred source for powering safety-related devices.~~

~~Required Action A.1 is modified by a Note stating that applicable Conditions and Required Actions of LCO 3.8.6 must be entered with any Uninterruptible AC Electrical Power Distribution bus de-energized. This Note is necessary to ensure that the ACTIONS for an inoperable Uninterruptible AC Electrical Power Distribution bus are taken if that bus cannot be energized from either the inverter or the safety-related regulating transformer. Otherwise, pursuant to LCO 3.0.6, these actions would not be entered even if the AC Vital Bus were de-energized.~~

BASES

~~Therefore, the ACTIONS are modified by a Note stating that ACTIONS for LCO 3.8.6 must be entered immediately. This ensures the Uninterruptible AC Electrical Power Distribution bus is re-energized within 8 hours.~~

B.1

Condition B represents two inverters inoperable on one required division. In this Condition, power to the associated Uninterruptible AC Electrical Power Distribution buses cannot be assured following a transient event or DBA concurrent with a loss of offsite and onsite AC power. With both inverters inoperable on one required division, the Uninterruptible AC Electrical Power Distribution buses in the two remaining required divisions are capable of supporting the minimum safety functions necessary to shut down the reactor and maintain it in a safe shutdown condition.

ACTIONS (continued)

The 8 hour Completion Time for the restoration of an inoperable inverter on one Uninterruptible AC Electrical Power Distribution bus is consistent with the time allowed for an inoperable division of Uninterruptible AC Electrical Power Distribution buses.

C~~B~~.1 and C~~B~~.2

When one or both inverters on two or more required divisions are inoperable, the remaining inverters may not have the capacity to support a safe shutdown and to mitigate an accident condition, especially if power is lost to the supporting isolation power center~~IPC~~ buses. If the Required Actions for restoration of a required inverter cannot be met within the specified Completion Time, the plant remains vulnerable to a single failure that could impair the capability to reach safe shutdown or to mitigate an accident condition. Therefore, the unit must be placed in a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 12 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.1

This Surveillance verifies that the inverters are functioning properly with all required circuit breakers closed and Uninterruptible AC Electrical Power Distribution buses energized from the inverter. The verification of proper voltage and frequency output ensures that the required power is readily available for Q-DCIS and the control power for safety-related systems connected to the Uninterruptible AC ~~Vital~~ Buses. The 7-day Frequency takes into account the availability of redundant inverters and other indications available in the control room that will alert the operator to inverter malfunctions.

REFERENCES

1. Chapter 6.
2. Chapter 15.

BASES

APPLICABILITY

The inverters required to be OPERABLE in MODES 5 and 6 provide assurance that:

a. Required features to provide adequate coolant inventory makeup are available for the irradiated fuel assemblies in the core in case of an inadvertent draindown of the reactor vessel,

b. Required features necessary to mitigate the effects of events that can lead to core damage during shutdown are available, and

c. Instrumentation and control capability is available for monitoring and maintaining the unit in a cold shutdown condition or refueling condition.

Inverter requirements for MODES 1, 2, 3, and 4 are covered in LCO 3.8.4, "Inverters - Operating."

ACTIONS

A.1

In this Condition, the affected division with one inverter remaining OPERABLE can continue to support the immediate safety-related function following a transient event or DBA concurrent with a loss of offsite and onsite AC power, however, it may not have adequate capacity to support the associated division of the Uninterruptible AC Electrical Power Distribution system for the required duration of 72 hours. With one inverter inoperable on one required division, the Uninterruptible AC Electrical Power Distribution buses in the remaining required divisions are capable of supporting the minimum safety functions necessary to shut down the reactor and maintain it in a safe shutdown condition even with an additional single failure, albeit for less than the design basis 72 hours.

The 72 hour limit is based upon engineering judgment, taking into consideration the time required to repair an inverter and the additional risk to which the plant is exposed because of the inverter inoperability.

BA.1, AB.2.1, AB.2.2, and BA.2.3

If ~~one~~ two or more required inverters are inoperable, or if the Required Actions for restoration cannot be met within the specified Completion Times, the remaining OPERABLE inverters may be capable of supporting sufficient required feature(s) to allow continuation of CORE ALTERATIONS and/or operations with a potential for draining the reactor vessel. By allowing

BASES

ACTIONS A.1

Condition A represents one ~~or both~~ 250 VDC Electrical Power Distribution bus~~es~~ in one required division inoperable. In this Condition, the remaining OPERABLE 250 VDC Electrical Power Distribution bus in the associated division can continue to support the immediate safety-related function following a transient event or DBA concurrent with a loss of offsite and onsite AC power. ~~In this Condition, power to the associated DC and Uninterruptible AC Electrical Power Distribution buses cannot be assured during an event that includes loss of power to the associated IPC bus, which supplies power to the battery chargers and the safety-related rectifiers and regulating transformers that are also capable of powering the required loads.~~

ACTIONS (continued)

With one ~~or both~~ 250 VDC Electrical Power Distribution bus~~es~~ inoperable ~~on~~in one required division, the ~~two~~ remaining required divisions of DC and Uninterruptible AC Electrical Power have the capacity to support a safe shutdown and to mitigate an accident condition even with an additional single failure, and even if power is lost to the supporting isolation power center~~IPC~~ buses, albeit for less than the design basis 72 hours. ~~Since a subsequent worst-case single failure could, however, result in the loss of minimum necessary DC electrical subsystems, continued power operation should not exceed 24 hours.~~ The ~~24~~ 72 hour Completion Time for restoration is based upon engineering judgment.

B.1

Condition B represents both 250 VDC Electrical Power Distribution buses in one required division inoperable. In this Condition, power to the associated Uninterruptible AC Electrical Power Distribution buses cannot be assured during an event that includes loss of power to the associated isolation power center bus, which supplies power to the battery chargers and the safety-related rectifiers.

With both 250 VDC Electrical Power Distribution buses inoperable in one required division, the two remaining required divisions of DC and Uninterruptible AC Electrical Power have the capacity to support a safe shutdown and to mitigate an accident condition even if power is lost to the supporting isolation power center buses. Since a subsequent worst-case single failure could, however, result in the loss of minimum necessary DC electrical subsystems, continued power operation should not exceed

BASES

8 hours. The 8 hour Completion Time for restoration is based upon engineering judgment.

CB.1

Condition BC represents one or both Uninterruptible 120 VAC Electrical Power buses inoperable in one required division. In this Condition, the remaining OPERABLE Uninterruptible 120 VAC Electrical Power Distribution bus in the associated division can continue to support the immediate safety-related function following a transient event or DBA concurrent with a loss of offsite and onsite AC power. In this condition, the voltage and frequency of the power being supplied to the safety-related loads for that division, including the Q-DCIS and the control power for safety-related systems, cannot be maintained within required limits even when the associated IPC bus remains energized. The two remaining divisions with OPERABLE Uninterruptible 120 VAC Electrical Power buses still have the capacity to support a safe shutdown and to mitigate an accident condition even with an additional single failure, and even if power is lost to the supporting isolation power centerIPC buses, albeit for less than the design basis 72 hours. Since a subsequent single failure could, however, result in the loss of minimum necessary Uninterruptible 120 VAC Electrical Power buses, continued power operation should not exceed 8 hours. The 728 hour Completion Time is based on engineering judgment.

ACTIONS (continued)

D.1

Condition D represents both Uninterruptible 120 VAC Electrical Power buses inoperable in one required division. In this condition, the voltage and frequency of the power being supplied to the safety-related loads for that division, including the Q-DCIS and the control power for safety-related systems, cannot be maintained within required limits even when the associated isolation power center bus remains energized. The two remaining divisions with OPERABLE 120 VAC Electrical Power buses still have the capacity to support a safe shutdown and to mitigate an accident condition even if power is lost to the supporting isolation power center buses. Since a subsequent single failure could, however, result in the loss of minimum necessary Uninterruptible 120 VAC Electrical Power buses, continued power operation should not exceed 8 hours. The 8 hour Completion Time is based on engineering judgment.

E.1 and E.2

Condition E represents inoperability of one Uninterruptible AC Electrical Power Distribution bus on one required division concurrent with inoperability of the DC Electrical Power Distribution bus associated with the redundant AC Electrical Power Distribution bus on the same division. With the inoperability of the DC Electrical Power Distribution bus, power to the associated Uninterruptible AC Electrical Power Distribution bus cannot be assured during an event that includes loss of power to the associated isolation power center bus. Therefore, in this condition, the required division is not able to support the immediate safety-related function following a transient event or DBA concurrent with a loss of offsite and onsite AC power. The two remaining required divisions of DC and Uninterruptible AC Electrical Power have the capacity to support a safe shutdown and to mitigate an accident condition even if power is lost to the supporting isolation power center buses. Since a subsequent worst-case single failure could, however, result in the loss of minimum necessary DC electrical subsystems, continued power operation should not exceed 8 hours. The 8 hour Completion Time for restoration is based upon engineering judgment.

F~~C~~.1 and F~~C~~.2

Condition F~~C~~ represents two or more required divisions with one or more DC or Uninterruptible AC Electrical Power Distribution buses (i.e., any combination) ~~one or both DC and Uninterruptible AC Electrical Power Distribution buses~~ inoperable, or the Required Action and associated Completion Time of Condition A, B, C, D, or E~~Condition B is~~ not met. When one or more DC or Uninterruptible AC Electrical Power Distribution buses (i.e., any combination) on two or more required divisions are inoperable, the remaining Electrical Power Distribution buses~~DC Sources~~ may not have the capacity to support a safe shutdown and to mitigate an accident condition~~, especially if power is lost to the supporting IPC buses~~. If the Required Actions for restoration of a required DC or Uninterruptible AC Electrical Power Distribution bus cannot be met within the specified Completion Time, the plant remains vulnerable to a single failure that could impair the capability to reach safe shutdown or to mitigate an accident condition. Therefore, the unit must be placed in a MODE that minimizes risk. To achieve this status, the plant must be brought to at least MODE 3 within 12 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

BASES

LCO (continued)

Maintaining these portions of DC and Uninterruptible AC Electrical Power Distribution energized ensures the availability of sufficient power to operate the plant in a safe manner to mitigate the consequences of postulated events during shutdown (e.g., inadvertent reactor vessel draindown).

APPLICABILITY

The DC and Uninterruptible AC Electrical Power Distribution is required to be OPERABLE in MODES 5 and 6 provide assurance that:

a. Systems to provide adequate coolant inventory makeup are available for the irradiated fuel in the core in case of an inadvertent draindown of the reactor vessel;

b. Required features necessary to mitigate the effects of events that can lead to core damage during shutdown are available, and

c. Instrumentation and control capability is available for monitoring and maintaining the unit in a cold shutdown condition or refueling condition.

DC and Uninterruptible AC ~~Vital Bus~~ electrical power distribution subsystem requirements for MODES 1, 2, 3, and 4 are covered in LCO 3.8.6, "Distribution Systems - Operating."

ACTIONS

A.1

Condition A represents one 250 VDC Electrical Power Distribution bus in one required division inoperable. In this Condition, the remaining OPERABLE 250 VDC Electrical Power Distribution bus in the associated division can continue to support the immediate safety-related function following a transient event or DBA concurrent with a loss of offsite and onsite AC power.

With one 250 VDC Electrical Power Distribution bus inoperable in one required division, the remaining required divisions of DC Electrical Power buses have the capacity to support a safe shutdown and to mitigate an accident condition even with an additional single failure, and even if power is lost to the supporting isolation power center buses, albeit for less than the design basis 72 hours. The 72 hour Completion Time for restoration is based upon engineering judgment.

BASES

ACTIONS (continued)

B.1

Condition B represents one Uninterruptible 120 VAC Electrical Power Distribution bus inoperable in one required division. In this Condition, the remaining OPERABLE Uninterruptible 120 VAC Electrical Power Distribution bus in the associated division can continue to support the immediate safety-related function following a transient event or DBA concurrent with a loss of offsite and onsite AC power. The remaining divisions with OPERABLE Uninterruptible 120 VAC Electrical Power buses still have the capacity to support a safe shutdown and to mitigate an accident condition even with an additional single failure, and even if power is lost to the supporting isolation power center buses. The 72 hour Completion Time is based on engineering judgment.

CA.1, CA.2.1, CA.2.2 and CA.2.3

~~Although redundant required features may require redundant divisions of electrical power distribution subsystems to be OPERABLE, one~~ If two or more required 250 VDC Electrical Power Distribution buses are inoperable, or two or more required Uninterruptible 120 VAC Electrical Power Distribution buses are inoperable, or one 120 VAC Electrical Power Distribution bus on one required division is inoperable concurrent with the 250 VDC Electrical Power Distribution bus associated with the redundant AC Electrical Power Distribution bus on the same division being inoperable, or if the Required Actions for restoration cannot be met within the specified Completion Times, the remaining OPERABLE electrical power distribution Division may be capable of supporting sufficient required features to allow continuation of CORE ALTERATIONS and operations with a potential for draining the reactor vessel. By allowing the option to declare required features associated with an inoperable distribution subsystem inoperable, appropriate restrictions are implemented in accordance with the affected distribution subsystem LCO's Required Actions. In many instances this option may involve undesired administrative efforts. Therefore, the allowance for sufficiently conservative actions is made; (i.e., to suspend CORE ALTERATIONS and any activities that could potentially result in inadvertent draining of the reactor vessel.

Suspension of these activities shall not preclude completion of actions to establish a safe conservative condition. These actions will minimize probability of the occurrence of postulated events. It is further required to immediately initiate action to restore the required AC and DC electrical power distribution subsystems and to continue this action until restoration