NRC RESOLUTION OF FACILITY COMMENTS

Question #21

Facility comment: accept two correct answers “B” and the original key answer “C”.

NRC Resolution:

Facility comment accepted. The facility provided provided technical documentation that the key answer “C” is an operating experience concern in addition to answer “B”, which is the original reason for the precaution on which the question is based.

Question # 87

Facility comment: delete this question due to three correct answers.

NRC Resolution:

Facility comment accepted. The stem of this question is not sufficiently focused to single out the original key answer “B”. The facility provided procedures which would allow “A” and ”D” as correct answers as well.

Question # 91

Facility comment: accept two correct answers “C” and original key answer “D”.

NRC Resolution:

Facility comment partially accepted. Change answer from “D” to “C”. The original correct answer is based on **OP** guidance to delay breaking vacuum until turbine speed is below 1200 RPM after tripping the turbine. The question stem gives a condition in which the turbine has failed to automatically trip, which places the crew in an **ON**. The ON contains the 1200 RPM caution in step 3.3, but allows immediately breaking vacuum in step 3.4 in the event of excessively high vibration. Since the question stem would have turbine vibration at 20 mils and still increasing at eight minutes after the turbine trip, the NRC prefers to accept *immediately* breaking vacuum, answer “C”, as the ONLY correct answer.

RO QUESTION 21

Question

The Computer UPS 1D656 has been operating on Alternate AC due to maintenance on the inverter.

The inverter is being returned to service in accordance with OP–157–001, Computer and Vital UPS.

A precaution in the procedure states "Never close Battery Input Breaker (CB–1) without Precharge light illuminated."

If Battery Input Breaker CB–1 is closed without the Precharge light illuminated then...

A. damage to the battery bank will occur.

B. Battery Input Breaker (CB–1) will immediately trip open.

C. damage to the UPS internal circuit capacitors will occur.

D. the alternate AC source input to the Static Switch, Breaker CB–4, will immediately trip open.

Answer Explanation

A. Incorrect – concern is damage to the UPS solid–state electronics, not the DC battery.

B. Incorrect – No time delay on transfer back to preferred source

C. Correct – IAW TM–OP–017 Page 31. PRECHARGE pushbutton and indicating light (Not shown on Figure): on the Static Inverter Panel are provided for status indication for the UPS circuit cards. If the PRECHARGE light is not lit, the pushbutton must be depressed prior to closing CB–1. This is required in order to power up the printed circuit cards inside the UPS. This prevents damage to the UPS internal circuit capacitors. IAW OP–157–001 Step 2.3.2 Precaution Never close Battery Input Breaker (CB–1) without Precharge light illuminated or equipment damage may occur.

D. Incorrect – The preferred source breaker will not trip, the electrical transient will be confined to the UPS solid–state electronics.

Examination Analysis

Two of the nine applicants selected an incorrect answer to the question. Both selected Distractor B. Neither applicant asked the proctor for clarification of the question.

Recommended Change

Accept Distractor B as a second correct answer to the question, in addition to the original keyed answer C.

Justification For Change

The keyed answer to this question is Distractor C, and was justified in the question explanation by reference to OP-157-001, Step 2.3.2.b:

> *b. Never close Battery Input Breaker (CB 1) without Precharge light illuminated or equipment damage may occur.*

Specific explanation of the type of equipment damage that may occur is provided in the associated training material for the Computer UPS, TM-OP-017, *208/120 VAC Distribution*:

> *If the PRECHARGE light is not lit, the pushbutton must be depressed prior to closing CB-1. This is required in order to power up the printed circuit cards inside the UPS. This prevents damage to the UPS internal circuit capacitors.*

The inclusion of the precaution in the operating procedure describing the potential for equipment damage, and the explanation of the type of damage that could be expected in the TM-OP supports Distractor C and it remains a correct answer to the question.

The two Reactor Operator applicants both selected Distractor B as their answer. During the examination review the applicants expressed an understanding that tripping of the battery input breaker (CB-1) was an equally likely outcome of attempting to supply DC power to the inverter without precharging the UPS internal circuit capacitors first.

Engineering was consulted as to the design purpose of the precharge function of a solid-state inverter and the expected response of the inverter if the battery input breaker was closed without a precharge performed. Engineering generated EWR 1728861 in response. Engineering documented their conclusions in the EWR the following regarding closing the battery input breaker without a precharge:

> *...the design purpose of the precharge circuit is to limit the DC inrush. Consequently, this prevents tripping of the Battery Input Breaker. There is concurrence among three different [vendor] contacts that, during the proposed situation [of closing the battery input breaker without a precharge], the Battery Input Breaker would trip.*

The basis for the conclusion that the battery input breaker would trip was based on vendor evaluation of the inrush current to the capacitor banks in the inverter capable of being supplied from the station battery, and the trip characteristics of the battery input breaker on the inverter. The vendor concluded that

> *...closing the input breaker without precharging the capacitor bank will result in the input breaker tripping.*

Because the vendor contacts expressed doubts regarding the potential for equipment damage in the situation of closing the battery input breaker without a precharge, because of the trip of the battery input breaker, Engineering performed an additional evaluation of the precaution in OP-157-001 Step 2.3.2.b. Engineering concluded that the capacitor damage related informally by Maintenance personnel, and that appears to be the source of both the precaution in the operating procedure and the statement in the training material, remains a viable failure mechanism. Review of available past revisions of OP-157-001 show that the precaution was already incorporated into the procedure in 1990. Prior to this, maintenance of electrolytic capacitors was not routinely performed. Engineering concluded in the EWR that electrolytic capacitors could be damaged by high inrush current, as a result of their age.

Based on the Engineering evaluation that concluded tripping of the battery input breaker was a likely outcome of attempting to energize the inverter without a precharge, Distractor B is a second correct answer to the question.

B. Battery Input Breaker (CB–1) will immediately trip open.

The operating procedure precaution, the training material, and the Engineering evaluation supporting the potential for equipment damage to occur, Distractor C remains a correct answer as justified in the original submittal. Distractors A and D remain incorrect as explained in the original submittal.

References

OP-157-001, *Computer And Vital UPS*

TM-OP-017, *208/120 VAC Distribution*

EWR 1728861

SRO QUESTION 91

Question

Unit 1 startup is in progress. Reactor power is 22 percent.

Turbine startup in progress. Ten minutes ago 1410 rpm was selected.

Annunciator TURBINE GENERATOR BEARING HI VIBRATION ALARM (AR–105–E05) alarms.

Bearing #7 rotor and casing vibration are at 12 mils, rising at 1 mil/minute.

(1) What actions are required now?

(2) What actions would be required if the trend continues after 8 minutes?

A. (1) Scram the reactor
Manually trip the Main Turbine and enter ON–193–002, Main Turbine Trip
(2) SELECT ALL VALVES CLOSED
Break condenser vacuum immediately

B. (1) Scram the reactor
Manually trip the Main Turbine and enter ON–193–002, Main Turbine Trip
(2) SELECT ALL VALVES CLOSED
Break condenser vacuum when main turbine is less than 1200 rpm

C. (1) Manually trip the Main Turbine and enter ON–193–002, Main Turbine Trip
(2) SELECT ALL VALVES CLOSED
Scram the reactor
Break condenser vacuum immediately

D. (1) Manually trip the Main Turbine and enter ON–193–002, Main Turbine Trip
(2) SELECT ALL VALVES CLOSED
Scram the reactor
Break condenser vacuum when main turbine is less than 1200 rpm

Answer Explanation

A. Incorrect – Scram is not required with reactor power below 26%

B. Incorrect – Scram is not required with reactor power below 26%

C. Incorrect – Vacuum should be broken when below 1200 rpm

D. Correct. required for vibration exceeding 20 mils. (IAW OP–193–001 Step 2.6.3.g(4)– IF a Turbine Rub develops as evidenced by a steady vibration level then an rising trend of 1 Mil/Min for 3 minutes, SELECT ALL VALVES CLOSED

AND IF vibration continues to go up to >20 mils, vacuum should be broken when below 1200 rpm.

Examination Analysis

Six of the seven SRO applicants selected an incorrect answer to the question. All selected Distractor C. No applicant asked the proctor for clarification of the question.

Recommended Change

Accept Distractor C as a second correct answer to the question, in addition to the original keyed answer B.

Justification For Change

The keyed correct answer for this question is Distractor D. The question is a two part question, requiring the SRO applicant to first evaluate present unit conditions as specified in the stem and determine a course of actions necessary to mitigate the turbine vibration levels presented in the stem. With reactor power at 22 percent, the automatic reactor scram on a Main Turbine trip is automatically bypassed. As bypass valve capability is approximately 25 percent as described in TM-OP-093, unit operation at this power level can therefore continue following a turbine trip. The same information is provided in ON-193-002, *Main Turbine Trip*:

> *1.3 Reactor Scram if Main Turbine trip occurred with Reactor power > 26%.*

The SRO applicant must therefore conclude that an anticipatory reactor scram is not required before initiating a manual turbine trip. The first part of Distractors C and D remain correct as justified in the original submittal and Distractors A and B are incorrect.

The second part of the question requires the applicant to evaluate unit conditions eight minutes after the actions in the first part of the distractors have been taken. After eight minutes, the rising vibration trend has resulted in bearing vibration levels exceeding 20 mils.

The Main Turbine startup procedure in OP-193-001, *Main Turbine Operation*. Step 2.6.3.g states in part:

> *g. IF undesirable thermal or vibration condition (1 mil/min. rise for 3 minutes) develops during Turbine startup, Evaluate AND Perform any of following:*
>
> *(1) Depress SPEED SET RPM ALL VALVES CLOSED pushbutton.*
>
> ...

CAUTION
Do Not exceed vibration limits in this procedure. Refer to Attachment I and AR-105-001(D05)(E05). *IF a turbine rub develops as evidenced by a steady vibration level then an rising trend of 1 Mil/Min. for 3 minutes, SELECT ALL VALVES CLOSED AND IF vibration continues to go up to > 20 mils, vacuum should be broken when below 1200 rpm.*

(4) Break vacuum using HV-10742A,B,C CDSR VAC BKR to reduce speed as quickly as possible IF bearing vibration rises to >20 mils.

With bearing vibration rising at the rate identified in the procedure, and continuing for greater than 8 minutes, the contingency actions described in the CAUTION and performed per step (4) require condenser vacuum to be broken when Main Turbine speed has coasted down below 1200 rpm.

The first two actions specified in the C and D distractors, to close all Main Turbine steam admission valves and then scram the reactor, are identical. The direction to close all Main Turbine steam admission valves comes from step (1). A reactor scram should be performed in anticipation of closure of MSIVs and the loss of the normal heat sink when condenser vacuum is broken. The determination required of the applicant to select between the two distractors is when condenser vacuum can be broken. As noted above step (4) requires condenser vacuum to be broken. The CAUTION before step (4) provides guidance that vacuum should not be broken until after Main Turbine speed has coasted down below 1200 rpm.

During the examination review, the applicants identified that alternative procedure guidance exists that can be applied in response to the turbine high vibration condition eight minutes after the turbine trip. The manual turbine trip initiated in response to current unit conditions results in meeting the symptoms of ON-193-002, *Main Turbine Trip*:

1. SYMPTOMS AND OBSERVATIONS

1.1 Any of following alarms at Unit Operating Benchboard 1C651:

1.1.1 MAIN TURB MASTER TRIP
1.1.2 GEN LOCKOUT RELAYS TRIP
1.1.3 EXCITER FIELD BKR TRIP

1.2 One or more annunciators associated with condition causing Main Turbine/Main Generator trip at Unit Operating Benchboard 1C651.

OP-AD-055, *Operations Procedure Program* Step 8.11.2 contains the guidance for when to enter an Off-Normal procedure when symptoms are observed:

> *8.11.2 ... Plant conditions must be evaluated to determine if entry is required. ... The decision not to enter an Off Normal should be made only after reviewing the actions of the procedure to ensure no actions are applicable. If it is unclear, the Off Normal procedure should be entered. ...*

Review of this guidance shows that judgment may be exercised when making the decision to apply an Off Normal procedure. In this instance, the normal operations procedure contains adequate guidance to address the turbine vibration condition. Entry into the Off Normal is not required. However, if the applicant knows that actions in the Off Normal procedure may be or are judged applicable to the observed unit conditions, entry into the Off Normal is justified.

Applicant comments received during the examination review identified the following steps from ON-193-002 as applicable to Main Turbine operation eight minutes after the manual trip:

CAUTION
Breaking vacuum when turbine speed is greater than 1200 rpm will cause severe stress on last stage turbine buckets.

3.4 IF reduced coastdown time is required due to extremely high bearing vibration, Break vacuum as follows:

...

3.4.1 At 1C668, Open CDSR VAC BKR HV 10742A, B, C by depressing common OPEN push button.

The guidance provided in the Off Normal procedures differs from the guidance in the turbine startup procedure in two distinct ways. First, the CAUTION to Step 3.4 only identifies the equipment concern with breaking vacuum with Main Turbine speed above 1200 rpm, but does not provide or impose specific restrictions on when vacuum may be broken unlike OP-193-001 Step 2.6.3.g. Second, the wording of Step 3.4 establishes a criteria of *extremely high bearing vibration* for breaking condenser vacuum. In this question the SRO applicant must determine a course of action for bearing vibrations exceeding 20 mils. This vibration is at least 8 mils above the turbine trip setpoint identified in AR-105-001 (D05). The bearing vibration has continued to worsen even though a manual turbine trip and subsequent coastdown would be expected to lower vibration. The determination that this level of bearing vibration is extremely high, particularly since all mitigating actions initiated have failed, is supported.

With the determination of extremely high vibration, the applicant must determine how to apply the CAUTION to Step 3.4. As this CAUTION does not impose a specific restriction on breaking vacuum, the applicant must weigh the potential for the stress caused by windage on the last stage turbine buckets against a variety of potential but unspecified causes of the elevated bearing vibration presented by the question. The judgment of the applicant to break condenser vacuum immediately based on the available guidance of the Off Normal procedure is appropriate. This makes Distractor C a second correct answer to the question.

C. (1) Manually trip the Main Turbine and enter ON–193–002, Main Turbine Trip
(2) SELECT ALL VALVES CLOSED
Scram the reactor
Break condenser vacuum immediately

It is the recommendation of SSES to accept C as a second correct answer to this question. Choice D remains a correct answer as justified in the original submittal. Choices A and B remain incorrect as explained in the original submittal.

<u>References</u>

TM-OP-093, *Main Turbine Construction*

OP-193-001, *Main Turbine Operation*

ON-193-002, *Main Turbine Trip*

OP-AD-055, *Operations Procedure Program*

SRO QUESTION 87

Question

Unit 1 is in Mode 4 following a scram 2 days ago.

RHR Loop B is operating in Shutdown Cooling.

Current conditions are as follows:

Reactor level	+90 inches, steady
Reactor coolant temperature	170 °F, steady

A reactor coolant leak occurs in the RPV bottom head drain line.

Reactor level lowers to +10 inches, and is still lowering slowly.

Which of the following actions are adequate to satisfy Technical Specification requirements?

A. Raise reactor level to ≥ +45 inches using Core Spray per OP–151–001, Core Spray System
Confirm two additional alternate methods capable of decay heat removal by performing Attachment B, System/Equipment Availability Determination, of OP–149–001, Loss of RHR Shutdown Cooling Mode

B. Raise reactor level to ≥ +13 inches using Core Spray per OP–151–001
Restart RHR Loop B in Shutdown Cooling in accordance with ON–149–001, Loss of RHR Shutdown Cooling Mode

C. Raise reactor level to ≥ +45 inches using Core Spray per OP–151–001
Perform a system status file check AND log these systems in the eSOMS log confirming one additional alternate method capable of decay heat removal

D. Raise reactor level to ≥ +13 inches using Core Spray per OP–151–001
Start RHR Loop A in Shutdown Cooling in accordance with ON–149–001, Loss of RHR Shutdown Cooling Mode

Answer Explanation

A. Incorrect – IAW ON–149–001 Section 3.3.6. Raising level restores core circulation. With Both Loops unavailable TS 3.4.9. Action A.1 applies – Verify an alternate decay heat removal method is available for EACH inoperable RHR SDC loop. As both RHR SDC loops are inoperable until the isolation is reset, 2 alternate methods of decay heat removal are required. Att B is performed to identify unit status and available equipment when choosing which alternate method of decay heat removal to implement and is not the procedurally specified method to satisfy TS 3.4.9 Action A.1.

B. Correct – With level raised above the RHR SDC common suction isolation setpoint, RHR Loop B can be restored to service. Restoring RHR B to service satisfies the LCO for TS 3.4.9 and no further action is required.

C. Incorrect – 2 alternate methods of decay heat removal are required. This is the correct method to identify and document the additional alternate methods.

D. Incorrect – The ON only provides for restarting a tripped RHR SDC loop, not placing a RHR SDC loop in service. OP–149–002 should instead be used to ensure required flushes, warming, and fill/vent is performed.

Examination Analysis

Six of the seven SRO applicants selected an incorrect answer to the question. All selected Distractor A. No applicant asked the proctor for clarification of the question.

Recommended Change

Delete the question from the examination. Review of the question after applicant feedback indicates that Distractors A and D are both additional correct answers to the question, in addition to the original keyed answer B.

Justification For Change

Distractor B

The keyed correct answer to this question was B and was justified by reference to TS 3.4.9, *RHR Shutdown Cooling System – Cold Shutdown*, for which the Limiting Condition for Operation states

> *Two RHR shutdown cooling subsystems shall be OPERABLE, and, with no recirculation pump in operation, at least one RHR shutdown cooling subsystem shall be in operation.*

The transient described in the stem of the question results in isolation of the RHR common suction pathway when RPV level falls below +13 inches, rendering both loops of RHR SDC inoperable. ON-149-001, *Loss of RHR Shutdown Cooling Mode*, Step 3.2.1, provides the following guidance

> *3.2.1 IF conditions permit restoring the previously in service loop of RHR to Shutdown Cooling, Perform Attachment C, Quick Recovery of Previously Inservice Shutdown Cooling Loop.*

Distractor B specifies the action of first raising level above +13 inches with the Core Spray system. There are no conditions in the stem which preclude the availability or operation of Core Spray to raise RPV level. This satisfies the requirement to perform Attachment C of ON-149-001 to restart the previously in-service SDC loop. Again there are no conditions in the stem which preclude taking the action specified in the Distractor to restart RHR B in SDC. With RHR B restored to operation in the SDC mode, TS 3.4.9 LCO requirements for one RHR SDC subsystem OPERABLE and in operation are satisfied. However, RHR A was inoperable only due to the loss of the common suction pathway resulting from RPV level below +13". When RHR B is restored to SDC, RHR A is returned to operability, as manual actions to complete aligning RHR A to SDC are allowed by the TS Bases for TS 3.4.9:

> *Additionally, each shutdown cooling subsystem is considered OPERABLE if it can be manually aligned (remote or local) in the shutdown cooling mode for removal of decay heat.*

Per LCO 3.0.2, any Required Actions in TS 3.4.9 are no longer required to be performed once the TS 3.4.9 LCO is met:

> *LCO 3.0.2* *Upon discovery of a failure to meet an LCO, the Required Actions of the associated Conditions shall be met, except as provided in LCO 3.0.5 and LCO 3.0.6.*
>
> *If the LCO is met or is no longer applicable prior to expiration of the specified Completion Time(s), completion of the Required Action(s) is not required, unless otherwise stated.*

No Notes are specified in TS 3.4.9 requiring completion of any Required Action once initiated.

With the LCO for TS 3.4.9 fully met following completion of the actions specified in Distractor B, and with no requirement to complete any Required Actions initiated upon Condition entry in TS 3.4.9, the original answer justification is fully supported. Distractor B is still a correct answer.

Distractor B

To demonstrate the correctness of Distractor A the following four issues must be addressed:

1. What are the relevant action(s) necessary to correctly determine the actions ***adequate to satisfy*** *Technical Specification requirements* [emphasis added] as stated in the question?

2. What are the applicable Technical Specification requirements in effect during the RPV level transient?

3. Does the question stem specify all unit conditions necessary to evaluate compliance with TS 3.4.9 and any applicable Required Action?

4. Do the mitigating actions specified by Distractor A, once complete, satisfy all Required Actions resulting from entry into all of the applicable Conditions of TS 3.4.9, given unit conditions?

The stem specifies that the unit is operating in Mode 4 with the RHR B system operating in the Shutdown Cooling mode. As mentioned earlier, the transient described in the stem of the question results in isolation of the RHR common suction pathway when RPV level falls below +13 inches, rendering both loops of RHR SDC inoperable. Technical Specification requirements for one or more inoperable RHR SDC loops in Mode 4 are provided by TS 3.4.9 Condition A:

---NOTE---
Separate Condition entry is allowed for each shutdown cooling subsystem.

CONDITION		*REQUIRED ACTION*		*COMPLETION TIME*
A.	*One or two required RHR shutdown cooling subsystems inoperable.*	*A.1*	*Verify an alternate method of decay heat removal is available for each inoperable RHR shutdown cooling subsystem.*	*1 hour* *AND* *Once per 24 hours thereafter*

Condition A applies to RHR A and B separately, per the Note. As a result, two alternate decay heat removal methods must be demonstrated, one each for RHR A and RHR B. Distractor A specifies the mitigating action of confirming two additional alternate methods capable of decay heat removal, which is adequate to fully satisfy Required Action A.1.

The fact that Distractor A specifies two alternate decay heat removal methods is alone not adequate to demonstrate that Required Action A.1 is satisfied. The determination of what is *adequate to satisfy* the Required Action must also be demonstrated. *Adequate to satisfy* implies that any mitigating action that results in an end state that ensures the unit is operating in compliance with the Technical Specifications, and can be accomplished by plant procedure, is an acceptable correct answer.

Distractor A identified performing Attachment B, *System/Equipment Availability Determination*, of ON-149-001 [typo corrected] to confirm that two alternate decay heat removal methods were available. In the question explanation, this was described as being incorrect as it was not the procedurally specified method to satisfy TS 3.4.9 Required Action A.1. The only procedure referenced in the question is ON-149-001, implying that the procedural guidance being cited is Step 3.3.6.c

> *WITHIN 1 hour, Verify functionality of TWO alternate methods capable of decay heat removal from Attachment A by Performing a system status file check AND Logging these systems in the eSOMS log.*

Performance of step 3.3.6.c of ON-149-001 will satisfy TS 3.4.9 Required Action A.1, but performance of this step is not the method that could be taken that is *adequate to satisfy* the Required Action. For example, GO-100-010, *ECCS/Decay Heat Removal in Mode 4, 5, or Defueled*, is directed to be performed by GO-100-005, *Plant Shutdown To Hot/Cold Shutdown*, step 5.39.2, on entry into Mode 4:

> *5.39 WHEN reactor temperature is < 200°F, Perform following:*
>
> *5.39.2 Commence GO-100-010.*

The purpose of GO-100-010 is to *provide instructions to ensure adequate ECCS and decay heat removal available* and is to be performed *at all times when in Mode 4, 5 or Defueled.* The Plant Status Log Board maintained by GO-100-010 is required to be updated as described in Step 5.1.2:

> *5.1.2 Any time operability status is changed on equipment listed on Outage Plant Status Log (Attachment A).*

Updating of the Plant Status Log Board would be required during the transient loss of SDC described in the stem of the question. The information about alternate decay heat removal methods, if impacted by the transient, would similarly be updated and could be used to confirm that two alternate decay heat removal methods were available.

In Distractor A, the alternate method specified to confirm that two alternate decay heat removal methods were available is by performing Attachment B of ON-149-001. This attachment provides a list of methods to makeup and letdown from the reactor vessel. On the list of makeup methods are RHR and Core Spray. On the list of letdown methods is SRVs to the Suppression Pool. To perform the attachment, a determination of the availability or unavailability of each method is required.

Attachment A of ON-149-001 provides the list of alternate methods of decay heat removal that may be used to satisfy TS 3.4.9 Required Action A.1. The following methods are provided for Modes 3 and 4:

> *Core Spray injection from suppression pool and return path through 2 SRV's (PSV 141 F013C,E,F,L,M or R preferred). One loop of Suppression pool cooling available.*
>
> *RHR injection from suppression pool via operable heat exchanger and return path through 2 SRV's (PSV 141 F013C,E,F,L,M or R preferred).*
>
> *RHR injection from suppression pool bypassing heat exchanger and return path through 2 SRV's (PSV 141 F013C,E,F,L,M or R preferred). Suppression pool cooling available on other RHR loop.*

The assumption by the applicant that all ECCS equipment is operable is reasonable, as the stem does not identify any conditions affecting the operability of safety-related systems other than the RPV level transient. This assumption, when combined with the performance of available/unavailability checks on reactor vessel makeup and letdown methods by performance of Attachment B of ON-149-001, allows the applicant to make a correct determination of the availability of two alternate decay heat removal methods and therefore is *adequate to satisfy* TS 3.4.9 Required Action A.1.

An additional Condition in TS 3.4.9 must be evaluated for applicability due to the loss of the in-service RHR SDC system during the RPV level transient. The loss of coolant circulation required by the TS 3.4.9 LCO is addressed by Condition B:

CONDITION	*REQUIRED ACTION*	*COMPLETION TIME*
B. No RHR shutdown cooling subsystem in operation. *AND* *No recirculation pump in operation.*	*B.1 Verify reactor coolant circulating by an alternate method.*	*1 hour from discovery of no reactor coolant circulation* *AND* *Once per 12 hours thereafter*
	AND	
	B.2 Monitor reactor coolant temperature.	*Once per hour*

The first part of Condition B, that no RHR SDC system is in operation, is readily determined by the applicant from the stem of the question and knowledge of the RHR SDC common suction isolation setpoint on low RPV level. The second part of Condition B, the determination that no recirculation pumps are in operation, is not as readily determined.

The explanation for the question does not address Recirc pump status, as it was not relevant to supporting the keyed correct answer. The status of the Reactor Recirculation pumps is not clearly specified as part of the initial unit conditions provided by the stem. With one RHR SDC system in operation, one Recirc pump would definitively have been secured, as part of the procedure for placing the first loop of RHR in SDC per OP-149-002 Step 2.19.28:

CAUTION
Do Not secure both recirc pumps until SDC in service.

2.19.28 Ensure Reactor Recirc Pump A(B) SECURED per OP-164-001.

As noted in the Caution, OP-149-002 requires that the other Recirc pump, if running, be left in service. Guidance for Recirc pump operation is provided in GO-100-005:

5.34 WHEN RPV pressure is < 98 psig AND the Shutdown Cooling Isolation Signal is cleared; Place RHR System in Shutdown Cooling in accordance with OP-149-002.

5.36 Shut Down second Reactor Recirculation Pump in accordance with OP-164-001 **unless directed otherwise by Shift Supervision.** [emphasis added]

Distractor A appears to be written from the perspective that forced circulation of the reactor coolant has been lost, due to the loss of RHR SDC and the implicit assumption that both Recirc pumps have been secured. The first part of Distractor A therefore specifies the mitigating action to meet TS 3.4.9 Required Action B.1, of raising reactor level to establish coolant circulation by natural convection per ON-149-001:

3.3.6 IF all RHR Shutdown Cooling lost:

a. Promptly Establish reactor coolant circulation using ONE of following alternate methods:

(1) Maintain water level ≥ 45 inches.

(2) Ensure Reactor Recirculation System in service.

Left unaddressed by Distractor A, any other distractor, or the question explanation, is any action to satisfy TS 3.4.9 Required Action B.2, to monitor reactor coolant temperature.

A review of procedural guidance for Recirc pump operation in Mode 4 found 2 citations that address the issue. GO-100-005 states as part of a listing of the nominal final conditions of the unit when Mode 4 is achieved that the Recirc system will be shutdown. As seen from Step 5.36 of the GO, shutdown of the Recirc system is not specifically required. The second citation is from the OP-164-001, *Reactor Recirculation System*, Step 2.4.2.i:

i. During the start up of a Rx Recirc Pump, the pump is operated at 25 psig or lower (No. 1 Seal Pressure) for a period of time. To ensure adequate seal lubrication and cooling avoid low pressure operation as much as possible and minimize the time of operation below 200 psig to 48 hours or less where practical. (12)

This provides guidance for nominal operation of the recirc pumps during low-pressure conditions. Applying this guidance to the question, the stem states that the reactor was scrammed 2 days ago. Assuming that is was a scram from power, there exists some margin to the 48 hour guidance for low-pressure Recirc pump operation, and supports an assumption that a Recirc pump could still be running.

The RPV level transient described in the stem of the question does not specify a minimum level, only a current level and trend. The current level is +10 inches, well above the -38 inch Recirc pump trip setpoint of the ATWS-RPT logic. The trend specified is a slow downward trend with no specific rate. All four distractors are written specifying level restoration with Core Spray to a specified value. No information regarding the timeliness of operator action is provided. It is therefore reasonable to assume that the mitigating actions described in the distractors is to be taken promptly and without delay. Manual alignment of the Core Spray system to inject is a simple operation that only requires starting one or more Core Spray pumps in the loop, enabling the injection valve manual open permissive, and throttling open the injection valve. It is reasonable to assume that these efforts could be accomplished before RPV level falls below -38 inches.

Determining the actions *adequate to satisfy* Technical Specification 3.4.9 requirements to identify a correct answer to the question requires the applicant to evaluate two Conditions and the associated Required Actions. The first condition addressed is the inoperability of both RHR SDC loops. As has been shown, the second part of Distractor A is an action that will result in correctly identifying two alternate decay heat removal methods to complete TS 3.4.9 Required Action A.1. The second condition to address is the loss of forced coolant circulation due to no RHR SDC loops in operation. If the applicant makes the reasonable assumption that a Recirc pump is still in operation, Condition B of TS 3.4.9 does not apply and no specific action is therefore required. This makes Distractor A a second correct answer to the question.

Distractor D

During the examination review, and after consultation with the Chief Examiner, it was discovered that Distractor D is also a correct answer to the question. Distractor D is symmetric to Distractor B, the keyed correct answer to the question. The only difference is that Distractor D specifies starting RHR Loop A in SDC mode versus RHR Loop B.

Review of the question explanation suggests the intention of Distractor D was to use Attachment C of ON-149-001, *Quick Recovery of Previously Inservice Shutdown Cooling Loop*, to place RHR Loop A in service in SDC. The explanation then identifies the normal operating procedure OP-149-002 as the correct procedure reference for placing RHR Loop A in SDC.

Regardless of the intent of the question, the approach to evaluating the correctness of Distractor D is to review ON-149-001 to see if it contains procedural guidance for placing another RHR SDC subsystem in service in response to the transient, once the low-level condition is corrected. Review of ON-149-001 shows the applicable guidance in the section of the procedure for one loop of RHR SDC lost in Mode 4, at step 3.3.5.a(3):

> *(3) Place one of the remaining available subsystems of RHR in SDC mode.*

With this procedure guidance contained in ON-149-001, Distractor D becomes an additional correct answer to the question.

Conclusion

It is the recommendation of SSES to delete this question from the examination. The original answer justification is fully supported and Distractor B is still a correct answer. It was shown how Distractors A and D are both additional correct answers to the question. With three correct answers identified, the question must be deleted from the examination.

References

TS 3.4.9, *Residual Heat Removal (RHR) Shutdown Cooling System — Cold Shutdown*

ON-149-001, *Loss of RHR Shutdown Cooling Mode*

TS 3.0, *Limiting Condition For Operation (LCO) Applicability*

GO-100-010, *ECCS/Decay Heat Removal in Mode 4, 5, or Defueled*

GO-100-005, *Plant Shutdown To Hot/Cold Shutdown*

OP-149-002, *RHR Shutdown Cooling*

OP-164-001, *Reactor Recirculation System*

2.3 RETURNING INVERTER TO SERVICE (REMOVING ALTERNATE AC FROM SERVICE)

NOTE:	For Vital, and Security UPS, placing the Manual Bypass Switch to the Normal Mode position should cause the Inverter to capture the load (after a time delay of 5 to 30 seconds) due to the Auto Retransfer feature. This is normal and depressing the Inverter to Load push button PB1 can be eliminated if this should occur.

2.3.1 Prerequisites

☐ a. Alternate Power Source supplying UPS loads.

☐ b. Battery Input Breaker to Inverter **OPEN**.

2.3.2 Precautions

a. Do not close battery input breaker (CB-1) if incoming DC voltage $\leq$ 250 volts as observed in step 2.3.3.

b. Never close Battery Input Breaker (CB-1) without Precharge light illuminated or equipment damage may occur.

☐

CAUTION

DC Bus Voltage must be > 250 Volts and stable before Battery Input Breaker CB-1 can be CLOSED in Step 2.2.3.c below.

2.3.3 **Depress** and **Hold** the Precharge push button **UNTIL**:

☐ a. Precharge light **ILLUMINATES**.

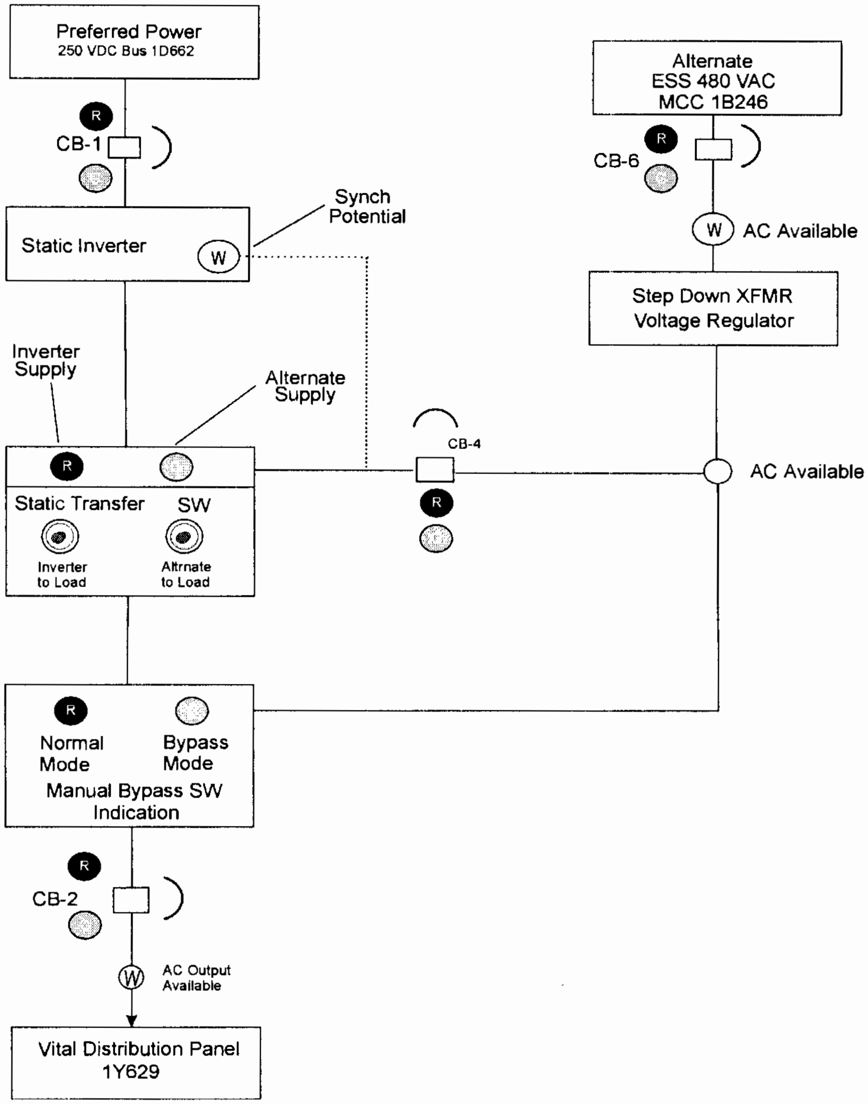
☐ b. Voltage indicated on Voltmeter V2 rises to >250 VDC.

THEN

☐ c. **Close** Battery Input Breaker CB-1.

☐ 2.3.4 **Release** Precharge push button.

☐ 2.3.5 **Observe** DC bus voltage on V2 ~ 268 VDC.



The following discusses the sub components, controls, indications, circuit breakers, input power transfers, and annunciators for the UPS.

- PRECHARGE pushbutton and indicating light (Not shown on Figure): On the Static Inverter Panel is provided for status indication for the UPS Circuit Cards. If the PRECHARGE light is not on, the pushbutton must be depressed prior to closing CB-1. This is required in order to power up the printed circuit cards inside the UPS. This prevents damage to the UPS internal circuit capacitors.

- CIRCUIT BREAKER CB-1: Isolates the UPS from the preferred 250 VDC power supply. CB-1 will automatically trip open if the supply voltage decreases below 210 VDC.

ARCHIVING - AR/EWR #1728861 - A request was made from the learning center to provide technical documentation to verify equipment response to a proposed situation. The

WMAMMAN@NIMS

Item Identification | Related Work | Action Taken | Trend Codes | Add On Data | Groups & Requirements | Schedule | Affected Objects | References | Trackers

Item # 1728861 Type/Subtype AR EWR Category ID By ROBINSON*MITCHELL

Event Date 07/23/2013 10:10 Source Type/ID System N/A ID Date 07/23/2013 10:22

CAQ Item ☐ CARB Rvw ☐ PORC Rvw ☐ Quality Related ☐ Commitment ☐

Title A REQUEST WAS MADE FROM THE LEARNING CENTER TO PROVIDE TECHNICAL DOCUMENTATION TO VERIFY EQUIPMENT RESPONS

Description A request was made from the learning center to provide technical documentation to verify equipment response to a proposed situation. The purpose of this action is to document the reference material for the conclusion.

Workflow Status

Status ARCHIVING

Sub Status

Comment

Responsibility

Group 312GL-RMB-NSE ELEC LEAD

Org Electrical/I&C Systems

Assigned To ROBINSON*MITCHELL

Affected Objects Summary

Category	ID	Description	Criticality
Design Component	NONE	NO COMPONENT AFFECTED	6
Unit/System	N/A	NO SSES SYSTEM RELATIONSHIP	

Priority

Significance

Priority 4

Needed By

Due Date 07/26/2013 Update

Work Period

Window ID/Start

MHRS Est / Act 4 8

Commitment Date

Attachments Y View

Action Taken Summary

Equipment response conclusion attached in references.

Action Taken By / Date: ROBINSON*MITCHELL 07/23/2013 14:05

Req	Workflow Step Checkoff List Description	Complete	Completed By
☑	All media attachments converted to PDF files.	✔	
☐	All hard copy documentation scanned and attached as PDFs.	✔	

Background

Documentation was requested to determine Computer UPS response to situation where the Battery input breaker is closed without precharging the unit.

Investigation

Several different Ametek SCI personnel were contacted for information since the IOM does not contain specific information about a situation where the precharge light is not illuminated before closing the breaker. The design purpose documentation of the precharge circuit was supplied by one vendor contact and is titled "SECTION 4" of this document. The documentation states "The purpose of the precharge is to limit the DC current inrush on energization of the input breakers." A different Ametek SCI contact elaborated on the design purpose of the precharge and the proposed situation of closing the breaker without the precharge. The response is included in the correspondence along with the referenced breaker curve. Maintenance personnel stated that the internal capacitors have been damaged in the past in addition to tripping the input breaker. However, a review of work orders for 1D656 found no examples of internal UPS damage.

Conclusion

In conclusion, it is clear that the design purpose of the precharge circuit is to limit the DC inrush. Consequently, this prevents tripping of the Battery Input Breaker. There is concurrence among three different SCI contacts that, during the proposed situation, the Battery Input Breaker would trip. SE also concurs with this conclusion.

Although the SCI contacts wouldn't expect internal damage during the proposed situation, it is possible that electrolytic capacitors could be damaged by the high inrush current. If damage has occurred in the past as stated by maintenance, it may have been the result of their age before the routine replacement of the electrolytic capacitors was implemented.

Therefore, a battery input breaker trip and internal capacitor damage are both plausible consequences of the proposed situation.

(See attached documentation)

SECTION 4

Section 4 - General Circuit Description and Theory of Operation

4.0 Introduction

4.1 Inverter General Circuit Description & Theory of Operation

The UPS can be considered as seven blocks (see Figure 4.1): rectifier, input and output filters, controls, power switching circuit (inverter), static and manual bypass switches.

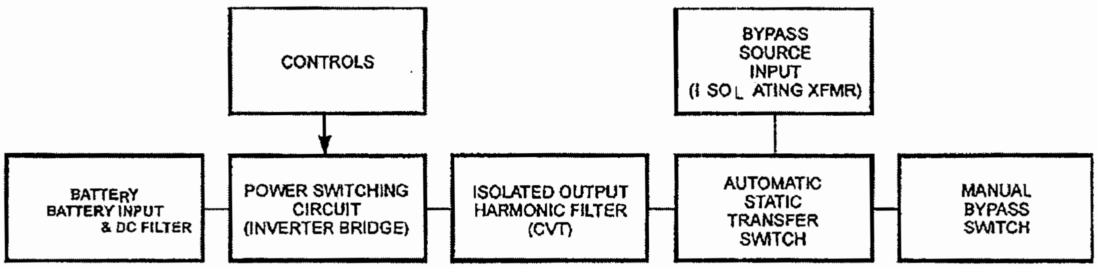


Figure 4.1

Each block is discussed in more detail below.

4.1.1 Battery Inputs and DC Filters

The battery input, rectifier input (if equipped), and DC filter serve to supply the basic building block for the inverter input block. The circuit consists of one or more input circuit breakers and a pre-charge circuit (on user specified units and units of 20KVA and larger).

The circuit breaker(s) serves as the basic isolation, input fault protection, and circuit energization device.

The DC filter is designed to limit reflected ripple to the source to a minimum as well as filter incoming ripple, spikes and surges from effecting the inverter operation. This filter is of a standard L-C design with size varying by KVA size.

A pre-charge circuit is provided on units of 20KVA and larger and on units as a user specified option on smaller systems. The purpose of the pre-charge is to limit the DC current inrush on energization of the input breakers.

The pre-charge circuit consists of a momentary push button switch, current limiting resistor and fuses. The circuit, when the switch is activated, bypasses the input circuit breaker and allows the DC input filters to charge to a predetermined level thus keeping inrush surges to an acceptable level. The circuit is fuse protected in the event a capacitor is shorted, in order to prevent circuit damage.

The typical pre-charge time is five to ten seconds.

All DC filters are equipped with a bleeder resistor to discharge the circuit to a safe level within 60 seconds.

4.1.2 Power Switching Circuit (Inverter Bridge)

By reviewing the least complex bridge, the parallel commutated square wave inverter bridge, it will become apparent that bridge design and circuit simplicity is of utmost importance in system reliability.

Figure 4.2 illustrates a parallel commutated square wave inverter bridge. The output wave is a square wave with a peak-to-peak amplitude of twice the DC supply voltage, having a period which is determined by the rate at which SCRs 1 through 4 are gated on. The SCRs are turned on, in pairs, by simultaneously applying signals to the gate terminals of SCRs 1 and 4, or SCRs 2 and 3. When SCRs 1 and 4 are switched on, a current will flow from the positive terminal of the source through choke 1, SCR 1, the load circuit, SCR 4, choke 2 and back to the negative terminal of the source. This will establish a left-to-right, plus-to-minus voltage relationship across the load and capacitor C1.

The steady state load current through the various components is virtually determined by the impedance of the load. Chokes 1 and 2 and SCRs 1 and 4 present very low steady state voltage drop and, therefore, virtually all the source voltage appears across the load. Conduction of SCRs 1 and 4 will continue to the end of the half cycle, at which time, their gate signals are removed and applied to SCRs 2 and 3. SCRs 2 and 3 will conduct, causing capacitor C1 to discharge through SCRs 1 and 4 in the reverse direction. This action, which occurs in less than 50 microseconds, commutates SCRs 1 and 4 off.

The short circuit current that results from all four SCRs being turned on during this brief period is limited by the action of chokes 1 and 2. Diodes 1, 2, 3 and 4 clamp any high transient voltage generated immediately after commutation by chokes 1 and 2. SCRs 2 and 3 remain conductive until the end of the half cycle, at which time SCRs 1 and 4 are gated on to repeat the entire process.

The resulting waveform is regulated and filtered by a harmonic filter consisting of a constant voltage transformer (CVT) in the output block.

Susquehanna Steam Station
PPL Susquehanna, LLC
Berwick, PA 18601

Attn: Mr Mitch Robinson mrobinson@pplweb.com 570-542-1970

Ref: Conversation with Bob Lintelman on 7-19-13 concerning precharge circuit.

The precharge circuit in the inverter is used to charge the DC capacitor bank in the unit prior to closing the input breaker. This precharge sequence reduces the inrush current to the capacitor bank preventing the input breaker from clearing during start up. There is an input choke in series with the capacitor bank, to act as a filter for the inverter, but its impedance is very low (about .001655 ohms). Closing the input breaker without precharging the capacitor bank will result in the input breaker tripping. The breaker is a GE THKMA826500, (reference the attached breaker curve). This is a 500 amp breaker. Assuming a battery bank capable of supplying 5 kAIC or more, it can be seen that you are in the 25 msec trip range of the breaker curve. There will be some charge placed on the capacitor bank. This low voltage may be sufficient to cause the inverter bridge fuses to also clear. I would not expect any damage to the unit.

Bob Lintelman
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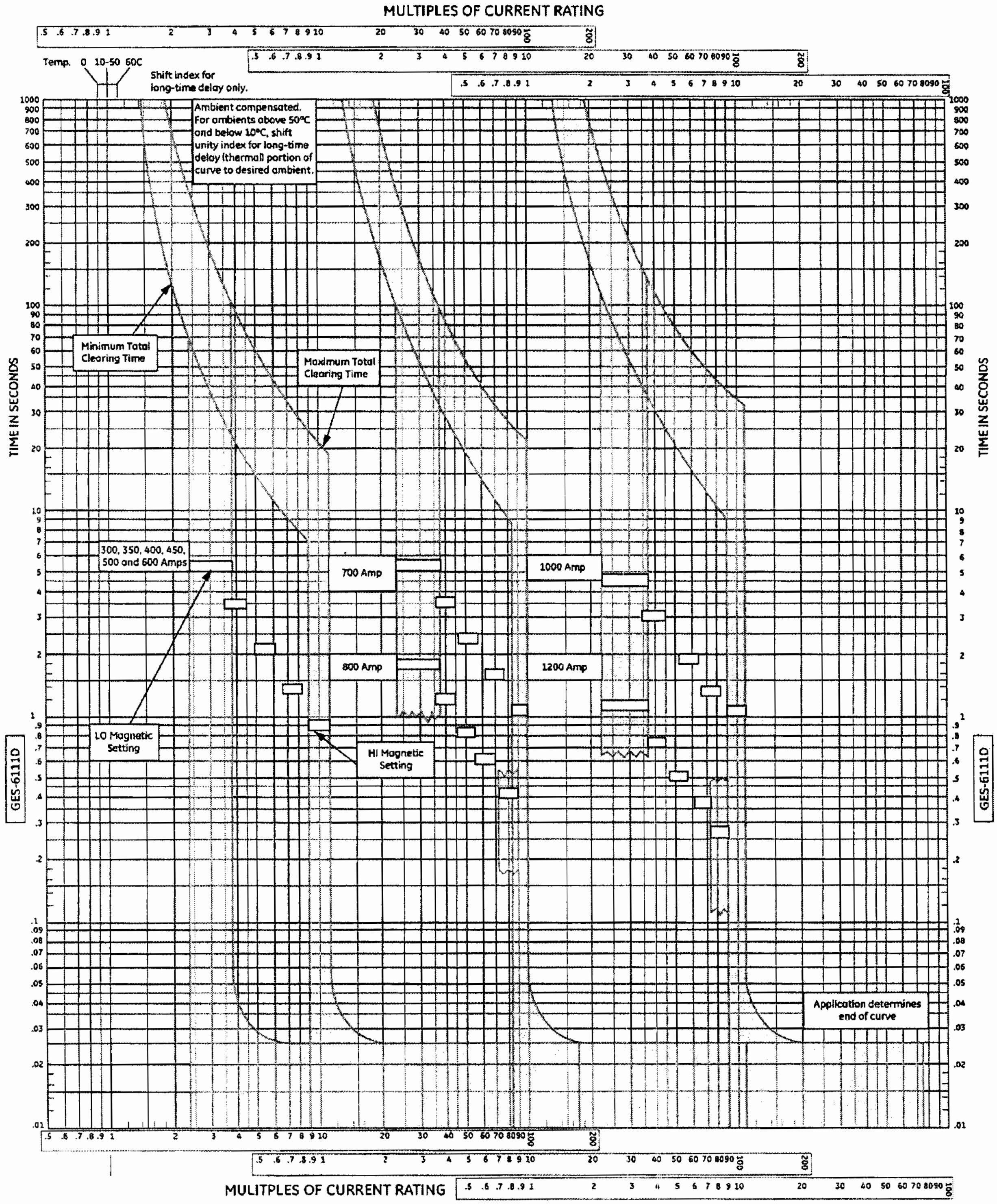


GE Consumer & Industrial - Electrical Distribution

Current Ratings
300, 350, 400, 450, 500, 600, 700, 800
1000 and 1200 Amperes

Voltage Ratings
600 Vac, 250 Vdc

Frequency Ratings
Dc or 60 Hertz for 300-800 Amperes
60 Hertz for 1000-1200 Amperes

Molded-Case Circuit Breaker K 1200 Line

Types TKMA & THKMA
(300-1200 Amperes)

Long-Time Delay and Instantaneous Time-Current Curves

Curves show ambient-compensated circuit breaker in open air, 10-50°C, wired with conductors of corresponding rating, no prior load. For all other ambients, use rating shift index at top of sheet.

GES-6111D

Adjustments

Long-time delay thermal trip: not adjustable.

Instantaneous magnetic trip: continuously adjustable, factory set on HI.

Dc magnetic trip level approximately 40% higher than ac values.

Blocks show trip range at marked points on instantaneous dials.

C3.97 BM

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.9 Residual Heat Removal (RHR) Shutdown Cooling System — Cold Shutdown

LCO 3.4.9 Two RHR shutdown cooling subsystems shall be OPERABLE, and, with no recirculation pump in operation, at least one RHR shutdown cooling subsystem shall be in operation.

-----NOTES-----

1. Both RHR shutdown cooling subsystems and recirculation pumps may be removed from operation for up to 2 hours per 8 hour period.

2. One RHR shutdown cooling subsystem may be inoperable for up to 2 hours for the performance of Surveillances.

APPLICABILITY: Mode 4.

ACTIONS

-----NOTE-----

Separate Condition entry is allowed for each shutdown cooling subsystem.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or two required RHR shutdown cooling subsystems inoperable.	A.1 Verify an alternate method of decay heat removal is available for each inoperable RHR shutdown cooling subsystem.	1 hour <u>AND</u> Once per 24 hours thereafter

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. No RHR shutdown cooling subsystem in operation. AND No recirculation pump in operation.	B.1 Verify reactor coolant circulating by an alternate method.	1 hour from discovery of no reactor coolant circulation AND Once per 12 hours thereafter
	AND	
	B.2 Monitor reactor coolant temperature.	Once per hour

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.9.1	Verify one RHR shutdown cooling subsystem or recirculation pump is operating.	12 hours

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.9 Residual Heat Removal (RHR) Shutdown Cooling System—Cold Shutdown

BASES

BACKGROUND

Irradiated fuel in the shutdown reactor core generates heat during the decay of fission products and increases the temperature of the reactor coolant. This decay heat must be removed to maintain the temperature of the reactor coolant ≤ 200°F. This decay heat removal is in preparation for performing refueling or maintenance operations, or for keeping the reactor in the Cold Shutdown condition.

The shutdown cooling function of the RHR System provides decay heat removal and is manually controlled. Each RHR loop consists of two motor driven pumps, a heat exchanger, and associated piping and valves. Both loops have a common suction from the same recirculation loop. Each pump discharges the reactor coolant, after circulation through the respective heat exchanger, to the reactor via the associated recirculation loop. The RHR heat exchangers transfer heat to the RHR Service Water System.

APPLICABLE SAFETY ANALYSES

Decay heat removal by operation of the RHR System in the shutdown cooling mode is not required for mitigation of any event or accident evaluated in the safety analyses. Decay heat removal is, however, an important safety function that must be accomplished or core damage could result. Although the RHR Shutdown Cooling System does not meet a specific criterion of the NRC Policy Statement (Ref. 1), it was identified in the NRC Policy Statement as a significant contributor to risk reduction. Therefore, the RHR Shutdown Cooling System is retained as a Technical Specification.

LCO

Two RHR shutdown cooling subsystems are required to be OPERABLE, and when no recirculation pump is in operation, one RHR shutdown cooling subsystem must be in operation. An OPERABLE RHR shutdown cooling subsystem consists of an RHR pump with an associated RHRSW pump, a heat exchanger, valves, piping, instruments, and controls to ensure the corresponding flow paths are OPERABLE. On the primary side, the two subsystems have a common suction source and are

(continued)

BASES

LCO (continued)

allowed to have a common heat exchanger and common discharge piping. Thus, to meet the LCO, both pumps in one loop or one pump in each of the two loops must be OPERABLE. Since the piping and heat exchangers are passive components that are assumed not to fail, they are allowed to be common to both subsystems. For each pump required to be OPERABLE on the primary (RHR) side, an associated RHRSW pump must be OPERABLE on the secondary side to transport decay heat to the UHS. Therefore, if two RHR pumps (and one heat exchanger) in the same loop are being used to comprise two shutdown cooling subsystems, the two RHRSW pumps (one from Unit 1 and one from Unit 2) which are capable of servicing the subject heat exchanger must be OPERABLE.

In MODE 4, the RHR cross tie valves (HV-151-F010A and B) may be opened to allow pumps in one loop to discharge through the opposite recirculation loop to make a complete subsystem. Additionally, each shutdown cooling subsystem is considered OPERABLE if it can be manually aligned (remote or local) in the shutdown cooling mode for removal of decay heat. In MODE 4, one RHR shutdown cooling subsystem can provide the required cooling, but two subsystems are required to be OPERABLE to provide redundancy. Operation of one subsystem can maintain or reduce the reactor coolant temperature as required. However, to ensure adequate core flow to allow for accurate average reactor coolant temperature monitoring, nearly continuous operation is required.

Note 1 permits both RHR shutdown cooling subsystems to be shut down for a period of 2 hours in an 8 hour period. Note 2 allows one RHR shutdown cooling subsystem to be inoperable for up to 2 hours for the performance of Surveillance tests. These tests may be on the affected RHR System or on some other plant system or component that necessitates placing the RHR System in an inoperable status during the performance. This is permitted because the core heat generation can be low enough and the heatup rate slow enough to allow some changes to the RHR subsystems or other operations requiring RHR flow interruption and loss of redundancy.

APPLICABILITY

In MODE 4, the RHR Shutdown Cooling System may be operated in the shutdown cooling mode to remove decay heat to

(continued)

BASES

APPLICABILITY (continued)

maintain coolant temperature below 200°F. Otherwise, a recirculation pump is required to be in operation.

In MODES 1 and 2, and in MODE 3 with reactor steam dome pressure greater than or equal to the RHR cut in permissive pressure, this LCO is not applicable. Operation of the RHR System in the shutdown cooling mode is not allowed above this pressure because the RCS pressure may exceed the design pressure of the shutdown cooling piping. Decay heat removal at reactor pressures greater than or equal to the RHR cut in permissive pressure is typically accomplished by condensing the steam in the main condenser. Additionally, in MODE 2 below this pressure, the OPERABILITY requirements for the Emergency Core Cooling Systems (ECCS) (LCO 3.5.1, "ECCS—Operating") do not allow placing the RHR shutdown cooling subsystem into operation.

The requirements for decay heat removal in MODE 3 below the cut in permissive pressure and in MODE 5 are discussed in LCO 3.4.8, "Residual Heat Removal (RHR) Shutdown Cooling System—Hot Shutdown"; LCO 3.9.8, "Residual Heat Removal (RHR)—High Water Level"; and LCO 3.9.9, "Residual Heat Removal (RHR)—Low Water Level."

ACTIONS

A Note has been provided to modify the ACTIONS related to RHR shutdown cooling subsystems. Section 1.3, Completion Times, specifies once a Condition has been entered, subsequent divisions, subsystems, components or variables expressed in the Condition, discovered to be inoperable or not within limits, will not result in separate entry into the Condition. Section 1.3 also specifies Required Actions of the Condition continue to apply for each additional failure, with Completion Times based on initial entry into the Condition. However, the Required Actions for inoperable shutdown cooling subsystems provide appropriate compensatory measures for separate inoperable shutdown cooling subsystems. As such, a Note has been provided that allows separate Condition entry for each inoperable RHR shutdown cooling subsystem.

(continued)

BASES

ACTIONS (continued)

A.1

With one of the two required RHR shutdown cooling subsystems inoperable, except as permitted by LCO Note 2, the remaining subsystem is capable of providing the required decay heat removal. However, the overall reliability is reduced. Therefore, an alternate method of decay heat removal must be provided. With both RHR shutdown cooling subsystems inoperable, an alternate method of decay heat removal must be provided in addition to that provided for the initial RHR shutdown cooling subsystem inoperability. This re-establishes backup decay heat removal capabilities, similar to the requirements of the LCO. The 1 hour Completion Time is based on the decay heat removal function and the probability of a loss of the available decay heat removal capabilities. Furthermore, verification of the functional availability of these alternate method(s) must be reconfirmed every 24 hours thereafter. This will provide assurance of continued heat removal capability.

The required cooling capacity of the alternate method must be ensured by verifying (by calculation or demonstration) its capability to maintain or reduce temperature. Decay heat removal by ambient losses can be considered as, or contributing to, the alternate method capability. Alternate methods that can be used include (but are not limited to) the Reactor Water Cleanup System.

B.1 and B.2

With no RHR shutdown cooling subsystem and no recirculation pump in operation, except as permitted by LCO Note 1, and until RHR or recirculation pump operation is re-established, an alternate method of reactor coolant circulation must be placed into service. The alternate method may use forced or natural circulation. This will provide the necessary circulation for monitoring coolant temperature. The 1 hour Completion Time is based on the coolant circulation function and is modified such that the 1 hour is applicable separately for each occurrence involving a loss of coolant circulation. Furthermore, verification of the functioning of the alternate method must be reconfirmed every 12 hours thereafter. This will provide assurance of continued temperature monitoring capability.

(continued)

BASES

ACTIONS

B.1 and B.2 (continued)

During the period when the reactor coolant is being circulated by an alternate method (other than by the required RHR Shutdown Cooling System or recirculation pump), the reactor coolant temperature and pressure must be periodically monitored to ensure proper function of the alternate method. The once per hour Completion Time is deemed appropriate.

SURVEILLANCE REQUIREMENTS

SR 3.4.9.1

This Surveillance verifies that one RHR shutdown cooling subsystem or recirculation pump is in operation and circulating reactor coolant. The required flow rate is determined by the flow rate necessary to provide sufficient decay heat removal capability. The Frequency of 12 hours is sufficient in view of other visual and audible indications available to the operator for monitoring the RHR subsystem in the control room.

REFERENCES

1. Final Policy Statement on Technical Specifications Improvements, July 22, 1993 (58 FR 39132).

1. SYMPTOMS AND OBSERVATIONS

1.1 Loss of shutdown cooling flow

1.2 Loss of RHR Service Water System flow

1.3 NSSSS Isolation signal to SHUTDOWN CLG SUCT OB ISO HV-151-F008 and/or SHUTDOWN CLG SUCT IB ISO HV-151-F009 from any of following:

1.3.1 High RPV pressure (98 psig)

1.3.2 High Suction Flow (25,000 gpm)

1.3.3 RPV Low Level 3 (13 inches)

1.3.4 Loss of RPS Bus A and/or RPS Bus B

2. AUTOMATIC ACTIONS

None

3. OPERATOR ACTIONS

☐ NOTE: Subsections within Section 3 may be performed in any order as determined by Shift Supervision based on the nature of the event and the priority of required operator actions. Steps within each subsection must be performed in the order written.

3.1 As time permits, **Record** date and time of event.

____________________ __________ / __________
Shift Supervision Date Time

3.2 **Determine** cause of loss of RHR Shutdown Cooling, **AND Perform** the following:

☐ 3.2.1 IF conditions permit restoring the previously in-service loop of RHR to Shutdown Cooling, **Perform** Attachment C, Quick Recovery of Previously Inservice Shutdown Cooling Loop.

AND

☐ 3.2.2 IF loss occurred in Mode 3 or Mode 4, **Perform** Section 3.3 of this procedure.

☐ 3.2.3 IF loss occurred in Mode 5 **AND** level < 22 feet above flange, **Perform** Section 3.4 of this procedure.

☐ 3.2.4 IF loss occurred in Mode 5 **AND** level > 22 feet above flange, **Perform** Section 3.5 of this procedure.

3.3 IF RHR Shutdown Cooling lost in Mode 3 or Mode 4:

☐ 3.3.1 IF in Mode 3, **Comply** with TS 3.4.8.

☐ 3.3.2 IF in Mode 4, **Comply** with TS 3.4.9.

☐ 3.3.3 IF in Mode 4, **Review** Attachment G to determine estimated "Time to 200 F."

☐ 3.3.4 IF SDC lost due to Loss of RHRSW, **Restart** RHRSW IAW OP-116/216-001, else N/A.

3.3.5 IF one loop of RHR Shutdown Cooling lost:

a. **Promptly Establish** reactor coolant circulation using **ONE** of the following alternate methods:

☐ (1) **Maintain** water level ≥ 45 inches.

☐

NOTE:	Placing Reactor Recirculation System in service will provide accurate indication of Coolant Temperature but will also add heat to the coolant over time.

☐ (2) **Ensure** Reactor Recirculation System in service IAW OP-164-001.

☐ (3) **Place** one of the remaining available subsystems of RHR in SDC mode.

☐ b. **WITHIN** 1 hour, **Verify** functionality of **ONE** alternate method capable of decay heat removal from Attachment A by **Performing** a system status file check **AND** **Logging** this system in the eSOMS log.

3.3.6 **IF** all RHR Shutdown Cooling lost:

a. **Promptly Establish** reactor coolant circulation using **ONE** of following alternate methods:

☐ (1) **Maintain** water level ≥ 45 inches.

☐ (2) **Ensure** Reactor Recirculation System in service.

b. **Determine** heatup rate from SO-100-011, Reactor Vessel Temperature and Pressure Recording using: (3)

☐ (1) **Notify** the STA to **Perform** OI-TA-009 using Historical Computer Data.

OR

☐ (2) SRV Tailpipe Temperature from recorder TRS-B21-1R614 at Panel 1C614, **IF** Reactor Vessel is flooded to Main Steam lines **AND AT LEAST** one SRV is opened.

OR

☐ (3) Bottom Head Drain Temperature, if RWCU in service, CRD out of service and there is not forced core flow (A) NLT01 or (B) TR-B21-1R006 at Panel 1C007.

OR

☐ (4) Bottom Head Drain Temperature, if RWCU in service, and there is forced core flow (A) NLT01, (B) TR-B21-1R006 at Panel 1C007.

OR

☐

NOTE:	Reactor Vessel Skin Temperatures are not the most accurate indication of Coolant Temperature due to the lag time in heat transfer from the coolant to the vessel wall.

☐ (5) Reactor vessel skin temperature from TE-B21-1N030E on recorder TR-B21-1R006 at Panel 1C007, **IF ALL** RHR Shutdown Cooling is lost **AND NO** Reactor Recirculation Pumps are in service.

☐ c. **<u>WITHIN</u>** 1 hour, **Verify** functionality of **<u>TWO</u>** alternate methods capable of decay heat removal from Attachment A by **Performing** a system status file check **<u>AND</u> Logging** these systems in the eSOMS log.

☐ d. **Classify** plant status in accordance with EP-PS-100, Emergency Director, Control Room.

☐ 3.3.7 **Determine/Evaluate** status of systems/equipment on Attachment B for use of Attachments D, E or F.

☐ 3.3.8 Using determination from Attachment B, **Place** any available alternate Decay Heat Removal System in service using Attachment D, E, or F.

☐ 3.3.9 **Maintain** reactor coolant temperature as low as practical but ≥ 80°F with available letdown/makeup systems.

3.3.10 <u>IF</u> reactor coolant temperature continues to rise **Perform** following as applicable on direction of Shift Manager: (3)

a. <u>IF</u> Primary **<u>AND</u>** Secondary containment **ESTABLISHED**, **Perform** following:

☐

NOTE:	Reactor Head Vents HV-141-F001 and HV-141-F002 MUST be **CLOSED** to Raise Reactor Pressure

(1) <u>IF</u> Reactor Head Vents are **OPEN**:

☐ (a) **Close** HV-141-F001.

☐ (b) **Close** HV-141-F002.

☐ (2) **Allow** reactor temperature and pressure to rise until reactor pressure ~ 20 psig,

ON-149/249-001 LOSS OF SHUTDOWN COOLING MODE
ALTERNATE METHODS OF DECAY HEAT REMOVAL

☐ NOTE: Functionality determination is based on associated system status file.

MODE	ALTERNATE METHOD
3, 4	Core Spray injection from suppression pool and return path through 2 SRV's (PSV-141-F013C,E,F,L,M or R preferred). One loop of Suppression pool cooling available.
	RHR injection from suppression pool via operable heat exchanger and return path through 2 SRV's (PSV-141-F013C,E,F,L,M or R preferred).
	RHR injection from suppression pool bypassing heat exchanger and return path through 2 SRV's (PSV-141-F013C,E,F,L,M or R preferred). Suppression pool cooling available on other RHR loop.
5 (<22' above flange)	Core Spray injection from suppression pool and return path through 2 SRV's (PSV-141-F013C,E,F,L,M or R preferred). One loop of Suppression pool cooling available.
	RHR injection from suppression pool and return path through 2 SRV's (PSV-141-F013C,E,F,L,M or R preferred). Suppression pool cooling available on other RHR loop.
	<u>IF</u> determined by STA (OI-TA-009) to have sufficient heat removal capabilities, Reactor Water Cleanup letdown with CRD makeup.
	<u>IF</u> determined by STA (OI-TA-009) to have sufficient heat removal capabilities, Reactor Water Cleanup in recirculation.

3.0 LIMITING CONDITION FOR OPERATION (LCO) APPLICABILITY

LCO 3.0.1	LCOs shall be met during the MODES or other specified conditions in the Applicability, except as provided in LCO 3.0.2, LCO 3.0.7 and LCO 3.0.8.
LCO 3.0.2	Upon discovery of a failure to meet an LCO, the Required Actions of the associated Conditions shall be met, except as provided in LCO 3.0.5 and LCO 3.0.6. If the LCO is met or is no longer applicable prior to expiration of the specified Completion Time(s), completion of the Required Action(s) is not required, unless otherwise stated.
LCO 3.0.3	When an LCO is not met and the associated ACTIONS are not met, an associated ACTION is not provided, or if directed by the associated ACTIONS, the unit shall be placed in a MODE or other specified condition in which the LCO is not applicable. Action shall be initiated within 1 hour to place the unit, as applicable, in: a. MODE 2 within 7 hours; b. MODE 3 within 13 hours; and c. MODE 4 within 37 hours. Exceptions to this Specification are stated in the individual Specifications. Where corrective measures are completed that permit operation in accordance with the LCO or ACTIONS, completion of the actions required by LCO 3.0.3 is not required. LCO 3.0.3 is only applicable in MODES 1, 2, and 3.

(continued)

1. PURPOSE

To provide instructions to ensure adequate ECCS and decay heat removal available. This procedure is used in conjunction with other General Operating Procedures.

2. PREREQUISITES

None

3. PRECAUTIONS

3.1 Ensure Technical Specifications and Surveillance Requirements are met for the operational Mode of the Unit. Attachment D lists references to applicable Technical Specifications and Surveillances for the various Mode 5 configurations.

3.2 Notes on Attachment B, Inoperable Equipment/System Cross-Reference, are provided as a guide only.

3.3 Minimize the time at lowered inventory and potential delays while at lowered inventory.

4. INITIAL CONDITIONS

This procedure is to be performed at all times when in Mode 4, 5 or Defueled.

☐ NOTE: Steps in this procedure are written in the general order in which they should be performed; however, steps may be performed out of order or in parallel based on plant conditions at the discretion of Shift Supervision.

5. PROCEDURE

5.1 **Hang** Outage Plant Status Log Board in Control Room. **Circle** appropriate requirement on Outage Plant Status Log, section 1 as follows:

☐ 5.1.1 Once per shift when in Mode 4, 5 or Defueled.

☐ 5.1.2 Any time operability status is changed on equipment listed on Outage Plant Status Log (Attachment A).

☐ NOTE: Attachment B contains individual notes for some items (e.g., (NOTE 1)). If a particular item is inoperable, evaluate the associated note to help determine operability status of other equipment which may be affected.

5.1.3 Every time a configuration change is made between the following plant conditions:

4 <----> 5, refueling gates closed

5, refueling gates closed <----> 5, refueling gates open

5, refueling gates open <----> 5, core alterations

5, refueling gates open <----> 5, OPDRV

5, core alterations <----> DEFUELED, refueling gates open

DEFUELED, refueling gates open <----> DEFUELED, refueling gates closed

☐ NOTE: Operational Mode 5 configurations may be combined, but each change in status of one of the combined configurations is still considered a configuration change. Attachment C describes all the possible operational Modes and the procedure used to make the change.

☐ 5.1.4 **Circle** present unit status.

☐ 5.1.5 **Circle** status of refueling gates and cask storage pit gates.

5.2 **Circle** appropriate ECCS requirements on Outage Plant Status Log, section 2 as follows:

☐ 5.2.1 ECCS not required if no fuel in vessel and refueling gates closed.

☐ 5.2.2 One (1) functional ECCS (capable of injecting water into the RPV), if RPV head removed, reactor cavity flooded to 22 feet, and fuel storage pool gates removed.

☐ 5.2.3 Two low pressure operable ECCS injection/spray subsystems in Mode 4 and Mode 5, except with spent fuel storage pool gates removed and water level ≥ 22 feet over the top of the RPV flange as required by TS 3.5.2.

☐ 5.3 When applicable, **Record** the evolution that is an OPDRV on Outage Plant Status Log, section 3. Otherwise, **Record** 'None.'

☐ 5.4 When applicable, **Record** current Fuel Pool Cooling letdown alignment on Outage Plant Status Log, section 4. Otherwise, **Record** 'None.'

5.5 **Record** status of ECCS/Decay Heat Removal Support Systems on Outage Plant Status Log, section 5 as follows:

☐ 5.5.1 **Circle** items Operable/Operating.

☐ 5.5.2 'X' items inoperable.

5.6 **Record** status of Inventory Control on Outage Plant Status Log, section 6 as follows:

☐ 5.6.1 **Circle** items Operable.

☐ 5.6.2 'X' items inoperable.

5.7 **Record** status of Decay Heat Removal/Forced Circulation methods on Outage Plant Status Log, section 7. Use the following guidelines to identify alternate methods of decay heat removal:

5.7.1 In Operational Mode 4:

☐ a. Two (2) subsystems of RHR Shutdown Cooling are required.

b. If applicable, **Record** the Alternate method(s) of Decay Heat Removal. Otherwise, **Record** 'N/A'. The following are the alternates:

☐

NOTE:	Options (1) & (2) are only available after the unit has been shutdown for at least a month.

☐ (1) RWCU system letdown with CRD makeup. This requires STA evaluation.

☐ (2) RWCU system in recirc mode. This requires STA evaluation.

(3) With primary <u>and</u> secondary containment established, allow reactor to steam to

☐ (a) condenser

<u>OR</u>

☐ (b) through SRVs with one loop of suppression pool cooling available.

☐ (4) Core Spray injection, suction from suppression pool, return path via 2 SRVs (preferred PSV-141-F013C, E, F, L, M, R), one loop of Suppression pool cooling available.

☐ (5) RHR in LPCI mode, companion HX in service, return path via 2 SRVs (preferred PSV-141-F013C, E, F, L, M, R).

☐ (6) RHR in LPCI mode, companion HX not available, return path via 2 SRVs (preferred PSV-141-F013C, E, F, L, M, R), Suppression pool cooling available on other RHR loop.

OUTAGE PLANT STATUS LOG

PLANT MODE ________ UNIT 1

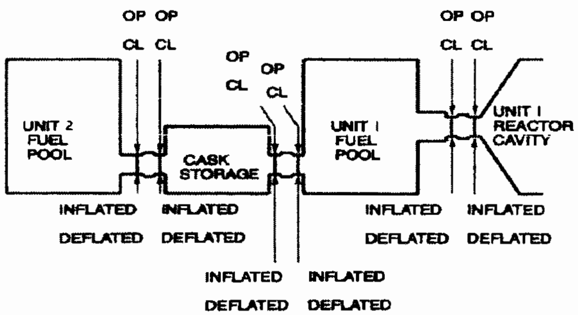
INSTRUCTIONS:
A. CIRCLE ITEMS OPERABLE / OPERATING
B. "X" ITEMS INOP

CAUTION: INDIVIDUAL NOTES ARE PROVIDED AS A GUIDE FOR OPERABILITY DETERMINATION.

1. REQUIREMENTS FOR COMPLETING THIS ATTACHMENT:
(CIRCLE PRESENT UNIT STATUS BELOW)

- SHIFTLY
- EQUIPMENT OPERABILITY STATUS CHANGE
- CONFIGURATION CHANGE BETWEEN THE FOLLOWING:

4,	<------->	5, REFUELING GATES CLOSED	GO-100-006
5, REFUELING GATES CLOSED	<------->	5, REFUELING GATES OPEN	GO-100-006
5, REFUELING GATES OPEN	<------->	5, CORE ALTERATIONS	GO-100-006
5, REFUELING GATES OPEN	<------->	5, OPDRV	NDAP-QA-0326
5, CORE ALTERATION	<------->	5, DEFUELED, REFUELING GATES OPEN	GO-100-006
5, DEFUELED, REFUELING GATES OPEN	<------->	5, DEFUELED, REFUELING GATES CLOSED	GO-100-006



CIRCLE APPROPRIATE GATE STATUS

2. ECCS REQUIREMENTS:

- ECCS NOT REQUIRED IF NO FUEL IN VESSEL AND REFUELING GATES ARE CLOSED.
- ONE ECCS CAPABLE ON INJECTION, IF VESSEL HEAD REMOVED, REACTOR CAVITY FLOODED TO 22 FEET, AND REFUELING GATES OPEN. THIS IS AN ADMINISTRATIVE REQUIREMENT.
- TWO OPERABLE ECCS, AS DEFINED IN TS 3.5.2, ALL OTHER TIMES

3. OPDRV IN PROGRESS NDAP-QA-0326

____

4. FUEL POOL COOLING LETDOWN ALIGNMENT OP-135-001

____

____

5. ECCS/DECAY HEAT REMOVAL SUPPORT SYSTEMS:

		DIVISION 1			DIVISION 2		
EMERGENCY SERVICE WATER		LOOP A (NOTE 1)	0P504A	0P504C	LOOP B (NOTE 2)	0P504B	0P504D
RESIDUAL HEAT REMOVAL SERVICE WATER		LOOP A (NOTE 3)	1P506A	2P506A	LOOP B (NOTE 4)	1P506B	2P506B
OFFSITE A.C. SOURCE			T10			T20	
DIESEL GENERATORS	0G501E		0G501A	0G501C		0G501B	0G501D
DIESEL GENERATORS SUBSTITUTED			YES/NO	YES/NO		YES/NO	YES/NO
A.C. BUSES			1A201 (NOTE5)	1A203 (NOTE7)		1A202 (NOTE6)	1A204 (NOTE8)
D.C. SOURCES		A 125VDC (NOTE9)	C 125VDC (NOTE9)		B 125VDC (NOTE9)	D 125VDC (NOTE9)	
		A 250VDC	A ±24VDC		B 250VDC (NOTE10)	B ±24VDC	

6. INVENTORY CONTROL:

CORE SPRAY	LOOP A	1P206A	1P206C	LOOP B	1P206B	1P206D
RESIDUAL HEAT REMOVAL (LPCI)	LOOP A	1P202A	1P202C	LOOP B	1P202B	1P202D

7. DECAY HEAT REMOVAL/FORCED CIRCULATION METHODS:

NORMAL							
RESIDUAL HEAT REMOVAL (SHUTDOWN COOLING)	AVAILABLE	LOOP A	1P202A	1P202C	LOOP B	1P202B	1P202D
	IN-SERVICE	LOOP A	1P202A	1P202C	LOOP B	1P202B	1P202D

TS	OPERATIONAL MODE	LOOPS REQUIRED
3.4.9	4	2
3.9.8	5, CAVITY DRAINED	2
3.9.7	5, CAVITY FLOODED 22'	1

ALTERNATES (S)

AVAILABLE ______________________________

IN-SERVICE ______________________________

FUEL POOL COOLING STATUS — UNIT 1 IN-SERVICE / SHUT DOWN — UNIT 2 IN-SERVICE / SHUT DOWN — SDHR IN-SERVICE / SHUT DOWN

HEAT EXCHANGERS IN-SERVICE — A/B/C — A/B/C

TIME TO 200° F ______________ RECORD ONCE/DAY.

8. REACTIVITY CONTROL: REACTIVITY CONTROL: ALL RODS IN YES/NO ONE ROD OUT INTERLOCK: OP/INOP

9. SECONDARY CONTAINMENT: ZONE 1 IN-SERVICE / SHUT DOWN / BYPASS — ZONE 2 IN-SERVICE / SHUT DOWN / BYPASS — U1 ZONE 3 IN-SERVICE / SHUT DOWN — U2 ZONE 3 IN-SERVICE / SHUT DOWN

10. PCO ____________ US____________ SM ____________ TIME________ DATE___/___/___

CONFIRM

b. RCIC DIV 1 MOV OL BYPS HS-E51-1S33 ________

c. RCIC DIV 2 MOV OL BYPS HS-E51-1S34 ________

5.33.2 **Confirm** RCIC isolates on low steam supply pressure at ≥ 53 psig indicated at PPC Point NFP02 Rx Press Wide Range, as follows:

a. **AFTER** STM SUPPLY IB ISO HV-149-F007 closes, **Place** STM SUPPLY IB ISO HV-149-F007 Keyswitch to **CLOSE**. ________

b. **AFTER** STM SUPPLY OB ISO HV-149-F008 closes, **Place** STM SUPPLY OB ISO HV-149-F008 Keyswitch to **CLOSE**. ________

5.33.3 **AFTER** waiting two (2) minutes, **Return** following keylock switches to **NORM**:

a. RCIC DIV 1 MOV OL BYPS HS-E51-1S33 ________

b. RCIC DIV 2 MOV OL BYPS HS-E51-1S34 ________

c. **Clear** TRO 3.8.2.1. ________

5.33.4 **Ensure** turbine steam seals have been shifted to **AUXILIARY STEAM** in accordance with OP-192-001. ________

☐ NOTE: The loop of RHR to be placed in SDC is determined based on any or all of the following:

- Outage Schedule
- Surveillances Requirements
- Equipment Availability
- Divisional Work Week
- Risk
- As Directed by Shift Supervision

5.34 **WHEN** RPV pressure is < 98 psig **AND** the Shutdown Cooling Isolation Signal is cleared; **Place** RHR System in Shutdown Cooling in accordance with OP-149-002. ________

CONFIRM

5.35 **WHEN** Rx Coolant Temp is ≤ 330 Deg, **Place** RWCU Pump in service IAW OP-161-001. ________

5.36 **Shut Down** second Reactor Recirculation Pump in accordance with OP-164-001 unless directed otherwise by Shift Supervision. ________

☐

CAUTION

RPV flange and head flange temperature must be maintained ≥ 70°F to comply with SR 3.4.10.8 while cooling the vessel shell, flange and head.

5.37 **IF** RPV head to be removed, **Commence** cooling RPV Shell and Flange Area using RHR Head Spray in accordance with OP-149-002. ________

5.38 **IF** RPV head is to be removed, **OR** to isolate the MSLs, **Complete** this step concurrently with subsequent steps as time permits.

5.38.1 **Ensure** MSIVs and Steam Line Drains isolated per Attachment F. ________

5.38.2 **Maintain** RPV level at 90"-100" using the following systems: ________

a. Reactor Water Cleanup system in a Letdown alignment in accordance with OP-161-001.

☐

NOTE: Based on the minimum amount of cooling water flow recommended for the Control Rod Drives and CRD Pump Curve limitations, a minimum CRD System flow > 37 gpm should be maintained. When CRD is being utilized for Reactor Vessel makeup following Reactor/Plant Shutdown, < 37 gpm may be maintained for short periods of time when level control is limited by the ability to letdown.

b. CRD in accordance with OP-155-001 up to and including removing CRD System from service **IF NECESSARY**.

CONFIRM

g. **IF** Reactor temperature **< 200°F**, **Perform** following:

(1) **Bypass** Main Condenser Low Vacuum Trip per Attachment A. ________

(2) **Break** Main Condenser Vacuum in accordance with OP-143-001. ________

h. **WHEN** Main Condenser Vacuum has decayed to atmospheric pressure, **Shut Down** Seal Steam System in accordance with OP-192-001. ________

☐ NOTE: Status control tags can be removed during the performance of Attachment H.

5.38.8 **IF** applicable, **Direct** Electrical Maintenance to **Perform** Attachment H, Restoration of the Alarm Reflash From Feedwater Heater Panels 1C101, 1C102, And 1C103 To Control Room Panel 1C668. ________

☐ NOTE: Shutdown Range Level Instrumentation is calibrated cold and will provide accurate indication for the remainder of this procedure.

5.39 **WHEN** reactor temperature is < 200°F, **Perform** following:

5.39.1 **Record** entering Mode 4. ________

________ / ________
Date Time

5.39.2 **Commence** GO-100-010. ________

5.39.3 **Make** page announcement when Condition 4, Cold shutdown has been established. ________

☐

NOTE:	ESW supplies cooling to the following RHR components:

NOTE: ESW supplies cooling to the following RHR components:

- Division I ESW (Loop A)
  - "A" RHR Pump Motor Oil Cooler and "A" RHR Pump Room Unit Cooler
  - "D" RHR Pump Motor Oil Cooler and "D" RHR Pump Room Unit Cooler
  - "C" RHR Pump Motor Oil Cooler
- In the event of a failure of Div 1 of ESW/RHRSW, RHR pump 1P202D should be selected.
- Division II ESW (Loop B)
  - "B" RHR Pump Motor Oil Cooler and "B" RHR Pump Room Unit Cooler
  - "C" RHR Pump Motor Oil Cooler and "C" RHR Pump Room Unit Cooler
  - "D" RHR Pump Motor Oil Cooler
- In the event of a failure of Div 2 of ESW/RHRSW, RHR pump 1P202A should be selected.
- Only RHR Room Cooler 1V210B will Auto Start on High Room Temperature.

☐ 2.19.25 **Place** ESW supplying RHR Room Cooler and RHR Pump A(B)(C)(D) in operation per OP-054-001.

☐ 2.19.26 As time permits, **Place** RHRSW A(B) in operation in accordance with OP-116-001.

☐ 2.19.27 **Confirm** Reactor Vessel level ≥ 90 inches to ensure natural recirculation flow for Core Cooling and prevent thermal stratification. [1]

☐

CAUTION

Do Not secure both recirc pumps until SDC in service.

☐ 2.19.28 **Ensure** Reactor Recirc Pump A(B) **SECURED** per OP-164-001.

☐ a. At 1C651, **Ensure** HV-143-F031A(B) RECIRC PUMP A(B) DSCH **CLOSED**.

☐ 2.19.29 **Close** HV-151-F017A(B) RHR INJ FLOW CTL.

☐ 2.19.30 **IF** required, **Perform** applicable section of SO-149-014 to stroke time HV-151-F015A(B).

☐ 2.19.31 **Open** HV-151-F015A(B) RHR INJ OB ISO.

2.19.32 **Ensure** following temperature limits met: (11)

☐ a. Differential temperature between RPV bulk coolant temperature and bottom head drain ≤ 145°F.

☐ b. Differential temperature between Reactor coolant within idle Recirc Loop A(B) and RPV bulk temperature ≤ 100°F.

☐ 2.19.33 **Notify** Refuel Floor HP contact of impending RHR Pump start.

☐ 2.19.34 **Closely Monitor** cooldown rate while manipulating RHR and RHRSW flow.

☐ a. **IF** necessary to lower cooldown rate: **Lower** RHRSW flow.

☐

CAUTION

Ensure the next two steps are performed in rapid succession to avoid pump damage.

☐ 2.19.35 **Start** RHR PUMP 1P202A(B) or C(D).

☐ a. **Ensure** Annunciator RHR/CORE SPRAY LOOP A(B) OPERATING ADS PERMISSIVE **ALARMS**.

CS ☐ 2.19.36 **Throttle** HV-151-F017A(B) OPEN RHR INJ FLOW CTL to establish flow approximately 5,000 gpm.

☐ 2.19.37 **Ensure** 1V210A(B) or C(D) RHR RM UNIT CLR **STARTED**.

i. During the start-up of a Rx Recirc Pump, the pump is operated at 25 psig or lower (No. 1 Seal Pressure) for a period of time. To ensure adequate seal lubrication and cooling avoid low pressure operation as much as possible and minimize the time of operation below 200 psig to 48 hours or less where practical. (12)

j. During normal operations the pump specific MG SET A(B) Controller Output & MG SET A(B) Scoop Tube Position indications should be within 1% of each other. If the indications indicate > 1%, then initiate an AR to have the Scoop Tube Position circuit calibrated.

k. Lock Scoop Tube for any uncontrolled change in Reactor Recirc Flow.

l. In single loop operation, maintain operating Reactor Recirculation Flow Rate less than or equal to 54.0 Mlbm/hr.

m. Instantaneous Total Core Flow is limited to 110 Mlb/hr and can be monitored using computer point NJF01 <u>or</u> on recorder XR14301 at 1C652 panel. A CR **shall** be initiated and notification made to Nuclear Fuels if this limit is exceeded. (14)

☐ NOTE: Only one fan needs to be placed in service since each are 100% capacity. If one MG set is to be placed in service with one set of slide dampers installed, Bypass Damper HD-17405 must be open.

If starting an idle Recirculation loop that has slide dampers installed, the MG Set Ventilation System can be shutdown to allow removal of slide dampers provided operating Recirc MG set is at minimum speed of ~ 20% (~ 0% Controller output). Duration of fan shutdown should be as short as possible.

☐ 2.4.3 **Place** MG Set Ventilation System in operation in accordance with OP-133-002.

2.4.4 <u>**IF**</u> starting Rx Recirc Pump '**A**':

☐ a. **Ensure** RRP A CLG WTR OB ISO VALVES HV-18791A1/A2 **OPEN**.

The function of chest-warming is to heat the valve chest. In chest-warming MSVs 1, 3, and 4 are closed, MSV 2 Pilot Valve open, CVs 1, 2, 3, and 4 are closed, Intercept Valves are closed, and the Intermediate Stop Valves are open. In Chest warming, steam will pressurize through MSV 2 Pilot Valve into the steam chest up to CVs 1, 2, 3, and 4. Once the chest is pressurized, maintain the pressure to bring temperature to main steam temperature while assuring the Allowable Temperature Difference Graph in OP-193-001is not exceeded. Remain in chest warming until ready to roll the main turbine.

OFF-NORMAL OPERATION

(P&ID M-101 and ON-193-002, Main Turbine Trip)

If an automatic or manual turbine trip is initiated, the Stop Valves, Control Valves, and Combined Intermediate Valves will rapidly close. The abrupt termination of steam flow causes a large pressure increase at the turbine inlet (and reactor vessel). The pressure regulator senses this increase and directs the Bypass Valves to open, limiting system pressure. If the reactor power level, at the time of the trip, was within the capacity of the Bypass Valves, power operation of the reactor may be continued with pressure being controlled on the Bypass Valves.

If reactor power level is above 26 percent at the time of the turbine trip (as sensed by turbine first stage pressure), a reactor scram will be initiated. This is caused by the 94.5 (93 by TS) percent open position limit switches on the Stop Valves, or low Emergency Trip Supply (ETS) pressure of (≥460 psig per TS, ≥ 500 psig TRM setpoint) to the Control Valves. In this, reactor pressure may rise to the setpoint of the Safety Relief Valves (SRVs), causing them to open and discharge steam to the Suppression Pool. When the SRVs have reduced reactor pressure to below their setpoint, pressure control is again resumed by the EHC System via the Bypass Valves.

MAIN TURBINE TRIPS

Thrust Bearing Wear detector - 8 psig

The thrust bearing wear detector consists of an oil-operated relay and six pressure switches. If the turbine shaft moves approximately 0.040 inches, the pressure switches will see 8 psig oil pressure and generate a trip signal.

f. IF Main Turb Lube Oil Temp does not rise with supervision permission, **Perform** the following:

☐ (1) **Close** 109115 MN TURB L-O CLR SW TEMP CTL VLV OUTLET ISO VLV.

☐ (2) **Monitor** MN TURB L-O Temp, IF Temp goes up to ≥ **115°F**, **Open** 109115

☐

NOTE:	There is a time delay between speed selection and opening of Control Valves. Startup rate of speed set can be changed at any time. Since Breakaway Torque is substantially larger than Low Speed Running Torque, after Turbine rolls on steam Control Valves will close completely before resuming acceleration control. On a Fast Startup Rate, it is possible for Intercept Valves to partially close for a short time.

☐

CAUTION

Do Not exceed VIBRATION LIMITS in this procedure. Refer to Attachment I and AR-105-001(D05)(E05).

IF a turbine rub develops as evidenced by a rising trend of 1 Mil/Min. for 3 minutes, SELECT ALL VALVES CLOSED IF vibration continues to go up to greater than 20 mils, vacuum should be broken when Turbine Speed is below 1200 rpm.

Breaking vacuum when Turbine Speed is greater than 1200 rpm will cause severe stress on last stage turbine buckets.

g. IF undesirable thermal or vibration condition (1 mil/min. rise for 3 minutes) develops during Turbine startup, **Evaluate AND Perform** any of following:

☐ (1) **Depress** SPEED SET RPM ALL VALVES CLOSED pushbutton.

☐ (2) IF bearing vibration lowers, **Depress** SPEED SET RPM 100 pushbutton.

☐ (a) **WHEN** directed by Shift Supervision **Restart** procedure at Step 2.6.3.

(3) **IF** bearing vibration rises to greater than 20 mils, **Perform** following:

☐ (a) **SCRAM** Reactor per ON-100-101, SCRAM, SCRAM IMMINENT.

☐ (b) **Trip** Main Turbine by **Depressing** Master TRIP pushbutton.

(c) **WHEN** Turbine Speed less than 1,200 rpm, **Perform** following:

☐ 1) **Close** MSIVs and MSL drains.

☐ 2) At 1C668, **Depress** HV-10742A,B,C Cdsr Vac Bkr OPEN pushbutton to break Main Condenser vacuum.

(d) **WHEN** Main Turbine reaches zero speed, **Perform** following:

☐ 1) **Ensure** Turning Gear 1S103 automatically **STARTS AND ENGAGES**.

OR

☐ 2) **Perform** "Alternate Method For Placing Main Turbine On Turning Gear (Air Motor)" section of OP-193-001, Main Turbine Operation.

☐ **CAUTION (1)**

Maintain temperature differentials between inner and outer surfaces of control valve casing within limits of Attachment B.

☐ **CAUTION (2)**

Do Not exceed 175°F exhaust hood temperature.

☐ h. **Depress** START UP RATE FAST pushbutton.

1. SYMPTOMS AND OBSERVATIONS

1.1 Any of following alarms at Unit Operating Benchboard 1C651:

1.1.1 MAIN TURB MASTER TRIP

1.1.2 GEN LOCKOUT RELAYS TRIP

1.1.3 EXCITER FIELD BKR TRIP

1.2 One or more annunciators associated with condition causing Main Turbine/Main Generator trip at Unit Operating Benchboard 1C651.

1.3 Reactor Scram if Main Turbine trip occurred with Reactor power > 26%.

2. AUTOMATIC ACTIONS

2.1 Main Turbine Stop Valves SV-1,2,3 and 4 close.

2.2 Main Turbine Control Valves CV-1,2,3 and 4 close.

2.3 Main Turbine Combined Intermediate Valves CIV-1,2,3,4,5 and 6 close.

2.4 Bypass Valves BPV-1, 2, 3, 4 and 5 open to maintain set pressure.

2.5 Auxiliary Busses 11A (1A101) and 11B (1A102) transfer to Startup Bus 10 (0A103).

2.6 As Main Turbine coasts down, following pumps start:

2.6.1 Motor Suction Pump 1P108.

2.6.2 Turning Gear Oil Pump 1P111.

2.6.3 Turbine Lift Pumps 1P109A,B,C,D,E,F,G,H & J

2.7 Reactor Recirc Pumps 1P401A and B trip caused by EOC-RPT if thermal power > 26%.

2.8 Stator Cooling Pumps 1P116A and B trip if Main Turbine Tripped on Main Generator Lockout due to Generator Differential or Generator Neutral Overvoltage conditions.

☐ 3.2.9 MN STM LINE IB DRAIN HV-141-F016

☐ 3.2.10 MN STM LINE OB DRAIN HV-141-F019

3.3 **Monitor** Main Turbine coastdown.

☐

CAUTION

Breaking vacuum when turbine speed is greater than 1200 rpm will cause severe stress on last stage turbine buckets.

3.4 **IF** reduced coastdown time is required due to extremely high bearing vibration, **Break** vacuum as follows:

☐

NOTE: MSIV's will close at 10.2 inches Hg Vacuum (19.0 inches Hg Absolute) unless low vacuum trip bypassed. Turbine Bypass Valves will close at 7 inches Hg Vacuum (22.2 inches Absolute).

☐ 3.4.1 At 1C668, **Open** CDSR VAC BKR HV-10742A, B, C by depressing common **OPEN** push button.

☐ 3.4.2 **Observe** Main Condenser Vacuum decays to atmospheric pressure.

☐ 3.4.3 **Remove** Sealing Steam from turbine Seals in accordance with OP-192-001.

3.5 **Evaluate** need to enter following ON's:

☐ 3.5.1 ON-100-101, Scram

☐ 3.5.2 ON-164-002, Loss of Reactor Recirculation Flow

☐ 3.5.3 ON-197-001, Loss of Stator Cooling

3.6 At Generator and Transformers Protection Relays Vertical Board 1C654, **Circle** as found position **AND Reset** the following Primary and Backup Lockout Relays if tripped:

☐

NOTE: Primary Lockout Relays 86GA and 86GC cannot be reset until Gen Sync BKR Low Gas Lockout conditions are cleared at 1R101.

☐ 3.6.1 86GA TRIPPED/RESET

8.10.3 Operators are expected to confirm the specified automatic actions have occurred.

8.10.4 Operators shall perform the specified manual actions based on the source/cause of the alarm. Manual actions based on other sources/causes can be marked N/A.

8.11 Off Normal Procedures (ON)

8.11.1 Provide guidance for abnormal conditions which:

a. Require more detailed instructions than can be provided in an AR/LA,

b. Do not have the potential to result in core damage or uncontrolled release to the environment, and

c. Are similar in complexity to operator actions and serious consequences as the significant events listed in paragraph 6 of Regulatory Guide 1.33, Quality Assurance Program Requirements.

8.11.2 A single alarm or symptom may not warrant entry into an Off Normal procedure. Plant conditions must be evaluated to determine if entry is required. Shift Supervision may elect not to enter an Off Normal procedure provided the "Symptom or Observation" is due to normal system operation and not a transient of off normal condition of the power plant. The decision not to enter an Off Normal should be made only after reviewing the actions of the procedure to ensure no actions are applicable. If it is unclear, the Off Normal procedure should be entered. If the Off Normal procedure is not entered, a log entry shall be made listing the "Symptom or Observation" and the justification for not entering the Off Normal procedure.

8.11.3 If a conflict exists between Off Normal procedures and symptom based EOPs, symptom based EOPs take precedence.

8.11.4 The procedure shall only be entered if forced by plant conditions; they shall not be entered of own accord.

8.11.5 ON's shall be exited when it can be determined positively that the condition requiring entry into the ON no longer exists (i.e., problem is known and under plant control). After an ON has been entered, subsequent clearing of all entry conditions is <u>not</u>, by itself, conclusive that a condition no longer exists.

TURB GEN BRG HI VIBRATION TRIP (D05)

SETPOINT:
11.5 Mils (Rotor) Bearings 1-8
6.5 Mils (Casing) Bearings 1-8
12 Mils (Rotor) Bearings 9-10
5 Mils (Casing) Bearings 9-10
10 Mils (Rotor) Bearings 11-12
7.5 Mils (Casing) Bearings 11-12

ORIGIN:
XKT1222-1
(1C6100 TSI)

1. PROBABLE CAUSE:

1.1 A high vibration seen at any of 12 Main Turbine bearings caused by any of following:
- 1.1.1 Improper lube oil temperatures.
- 1.1.2 Improper lube oil supply flow to bearings.
- 1.1.3 A wiped bearing.
- 1.1.4 Turbine packing rubbing.
- 1.1.5 Rotor imbalance.

1.2 TSI system (BENTLY NEVADA) malfunction.

1.3 Trip Logic is a 1 out of 2 taken twice (x or y Rotor and x or y Casing on same Bearing).

2. OPERATOR ACTION:

☐ 2.1 **Ensure** Automatic Actions.
☐ 2.2 **Perform** ON-193-002, Main Turbine Trip.

3. AUTOMATIC ACTION:

3.1 Main Turbine Trips **AND IF** Rx Power greater than 26% RTP:
- ☐ 3.1.1 Reactor Scrams.
- ☐ 3.1.2 Rx Recirc Pumps trip on EOC-RPT.

4. REFERENCE:

4.1 M2-J-39(3)
4.2 E-323 Sh. 2
4.3 IOM 119
4.4 FF62115 sheets 60-61

TURB GEN BRG HI VIBRATION (E05)	SETPOINT:	7.5 Mils on 1,2,3,4,5,6,7,8 (Rotor) 4.0 Mils on 1,2,3,4,5,6,7,8 (Casing) 7 Mils on 9,10,11,12 (Rotor) 4.5 Mills on 9, 10 (Casing) 7 Mils on 11,12 (Casing)
	ORIGIN:	1C6100B (TSI)

1. PROBABLE CAUSE:

A high vibration seen at any of 12 Main Turbine bearings caused by any of following:

- 1.1 Improper lube oil temperatures
- 1.2 Improper lube oil supply flow to bearings
- 1.3 A wiped bearing
- 1.4 Turbine packing rubbing
- 1.5 Rotor imbalance
- 1.6 Coupling misalignment
- 1.7 Hi Var Loading
- 1.8 Turbine Startup
- 1.9 Turbine Coastdown
- 1.10 Valve Testing

2. <u>OPERATOR ACTION</u>:

☐ 2.1 **Determine** which bearing(s) is in alarm and the magnitude of the vibrations from PPC TBCASE **<u>OR</u>** TBVIB display **<u>OR</u>** VR10106, Turbine Vibration.

☐ 2.2 <u>IF</u> any of the following limits (Rotor **<u>OR</u>** Casing) are exceeded during Turbine Startup, **Trip** the Main Turbine **<u>AND</u> Perform** ON-193-002, Main Turbine Trip **<u>AND</u> Perform** action per OP-193-001.

BEARING 1 THRU 8		
SPEED		INSTANTANEOUS LIMIT
0-1800 RPM		11.5 MILS (ROTOR) 6.5 MILS (CASING)

BEARING 9 AND 10		
SPEED	TIMED LIMIT	INSTANTANEOUS LIMIT
0 - 1400 RPM	10 MILS FOR 2 MIN (ROTOR)	12 MILS (ROTOR)
> 1400 RPM	10 MILS FOR 15 MIN (ROTOR)	12 MILS (ROTOR)
0-1800 RPM	N/A (CASING)	5.0 MILS (CASING)

BEARINGS 11 AND 12		
SPEED	TIMED LIMIT	INSTANTANEOUS LIMIT
0-1400 RPM	8 MILS FOR 2 MIN (ROTOR)	10 MILS (ROTOR)
> 1400 RPM	8 MILS FOR 15 MIN (ROTOR)	10 MILS (ROTOR)
0-1800 RPM	N/A (CASING)	7.5 MILS (CASING)

☐ 2.3 PPC formats TBAMPL and TBPHASE were added to support additional monitoring, **Reference** ODM 1404634 for additional information and requirements.

☐ 2.4 **Contact** Station Engineering or Maintenance.

☐ 2.5 <u>IF</u> actual vibration cannot be validated, **Consider** disable Turbine Vibration Trip.

3. <u>AUTOMATIC ACTION</u>:

☐ (Rotor) Turbine will trip <u>IF</u> 11.5 Mils is exceeded on Bearings 1 thru 8, 12 Mils on bearing 9 and 10 and 10 Mils on bearing 11 and 12. (Casing) Trip 6.5 Mils bearing 1-8, 5 Mils on bearings 9 and 10, and 7.5 mils on bearing 11 and 12. Trip requires X or Y Rotor <u>and</u> X or Y Casing on same bearing.

4. <u>REFERENCE</u>:

- 4.1 M2J-101(3)
- 4.2 E-323 Sh. 2
- 4.3 IOM 1198
- 4.4 EC-093-1033
- 4.5 EWR-1398217
- 4.6 FF62115 sheets 60-61