SAFETY RELATED

FARLEY NUCLEAR PLANT

SPECIFIC BACKGROUND DOCUMENT

FOR

FNP-1/2-ESP-0.3

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITH RVLIS)

PROCEDURE USAGE REQUIREMENTS PER FNP-0-AP-6	SECTIONS
Continuous Use	
Reference Use	
Information Use	**ALL**

Approved:

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Unit 1 ERP Step:	**Unit 2 ERP Step:**	***ERG Step No:***

ERP StepText: NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITH RVLIS)

ERG StepText: *NATURAL CIRCULATION COOLDOWN WITH STEAM VOID IN VESSEL (WITH RVLIS)*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Changed to make plant specific. It is not absolute that a void will be formed in the vessel depending on the cooldown conditions. However this procedure makes provisions for this eventuality.

Section: **Purpose**

Unit 1 ERP Step:	**Unit 2 ERP Step:**	***ERG Step No:***

ERP StepText: This procedure provides actions to continue plant cooldown and depressurization to cold shutdown, with no accident in progress, under conditions that allow for the potential formation of a void in the upper head region with a vessel level system available to monitor void growth.

ERG StepText: *This guideline provides actions to continue plant cooldown and depressurization to cold shutdown, with no accident in progress, under conditions that allow for the potential formation of a void in the upper head region with a vessel level system available to monitor void growth.*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Changed to make plant specific.

Section: Symptoms

Unit 1 ERP Step: **Unit 2 ERP Step:** ***ERG Step No:***

ERP StepText: This procedure is entered after completing the first ten steps of FNP-1-ESP-0.2 when the limits of FNP-1-ESP-0.2 must be exceeded; from the following:

ERG StepText: *This guideline is entered from ES-0.2, NATURAL CIRCULATION COOLDOWN, after completing the first twelve steps.*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Changed to make plant specific.

Section: **Procedure**

Unit 1 ERP Step: 1 CAUTION-1 **Unit 2 ERP Step:** 1 CAUTION-1 ***ERG Step No:*** *1 CAUTION-1*

ERP StepText: To ensure proper plant response, FNP-1-EEP-0, REACTOR TRIP OR SAFETY INJECTION, must be entered upon any SI actuation.

ERG StepText: *If SI actuation occurs during this guideline, E-0, REACTOR TRIP OR SAFETY INJECTION, should be performed.*

Purpose: To alert the operator that if SI occurs during this guideline he should transfer to the appropriate procedure

Basis: When SI actuates, plant conditions exist which require actions not covered in this guideline. Therefore, a transition to E-0, REACTOR TRIP OR SAFETY INJECTION, should be made.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

Section: **Procedure**

Unit 1 ERP Step: 1 CAUTION-2 **Unit 2 ERP Step:** 1 CAUTION-2 ***ERG Step No:*** *1 CAUTION-2*

ERP StepText: The first 10 steps of FNP-1-ESP-0.2, NATURAL CIRCULATION COOLDOWN TO PREVENT REACTOR VESSEL HEAD STEAM VOIDING must be performed before continuing with this procedure.

ERG StepText: *The first eleven steps of ES-0.2, NATURAL CIRCULATION COOLDOWN, should be performed before continuing with this guideline.*

Purpose: To alert the operator that he must start the natural circulation cooldown in ES-0.2, where several important preliminary steps are taken

Basis: This guideline is intended to supplement ES-0.2, which is the preferred guideline for a natural circulation cooldown. The initial steps in ES-0.2 must be performed prior to this guideline to ensure such things as adequate shutdown margin, upper head cooling, blocking of SI signals and initial cooldown/depressurization.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

Section: **Procedure**

Unit 1 ERP Step: 1 CAUTION-3 **Unit 2 ERP Step:** 1 CAUTION-3 ***ERG Step No:*** *1 CAUTION-3*

ERP StepText: If RCP seal cooling had previously been lost, the affected RCP should not be started prior to a status evaluation.

ERG StepText: *If RCP seal cooling had previously been lost, the affected RCP should not be started prior to a status evaluation.*

Purpose: To alert the operator that RCP seal damage may have occurred if RCP cooling had previously been lost. In that case, starting the affected RCP may further damage the seal and RCP.

Basis: The potential for degradation in RCP seal performance and seal life increases with increasing temperature above 300°F. Hence, if seal cooling is lost for a significant period of time, seal or bearing damage may occur. The potential non-uniform sealing surfaces and seal crud blockage that may exist prior to RCP start can aggravate bearing and seal damage if the RCP is started. Following restoration of seal cooling, the RCP should not be started prior to a complete RCP status evaluation in order to minimize potential RCP damage on restart. Refer to Subsection 2.1 of the background document for guideline ECA-0.0, LOSS OF ALL AC POWER, for additional information.

Knowledge: 1. If RCP seal cooling is lost for only a few minutes, the inventory of cold water in the seal area should prevent excessive seal heat up. For longer periods of time, seal and bearing temperatures may increase greater than 300°F. If excessive temperatures develop, the affected RCP should not be restarted prior to a complete RCP evaluation. 2. RCPs should not be started prior to a status evaluation unless an extreme (red) or severe (orange) CSF challenge is diagnosed. Under such a CSF challenge, the "rules of usage" apply and an RCP should be started if so instructed in the associated FRG. Under a CSF challenge, potential RCP damage is an acceptable consequence if RCP start is required to address a CSF challenge (e.g., to mitigate an inadequate core cooling condition). This is consistent with the intent of these FRGs which attempt to first establish support conditions to start an RCP, but then start an RCP whether or not the support conditions are established.

References:

Justification of Differences:

1 None

Section: **Procedure**

Unit 1 ERP Step: 1 NOTE-1 **Unit 2 ERP Step:** 1 NOTE-1 ***ERG Step No:*** *1 NOTE-1*

ERP StepText: FOLDOUT PAGE should be monitored continuously.

ERG StepText: *Foldout page should be open.*

Purpose: To remind the operator that the foldout page for ES-0.3 should be open

Basis: The foldout page provides a list of important items that should be continuously monitored. If any of the parameters exceed their limits, the appropriate operations should be initiated. Refer to the section FOLDOUT PAGE in this background document and the document FOLDOUT PAGE ITEMS in the Generic Issues section of the EXECUTIVE VOLUME for additional information on which foldout page items apply to this guideline and sample wording of those items.

Knowledge: The operator should know what items comprise each foldout page.

References:

Justification of Differences:

1 Changed "open" to "monitored continuously". The foldout page does not open in the FNP format.

Section: **Procedure**

Unit 1 ERP Step: 1 NOTE-2 **Unit 2 ERP Step:** 1 NOTE-2 ***ERG Step No:*** *1 NOTE-2*

ERP StepText: To ensure adequate pressurizer spray, the priority for establishing RCP support conditions is 1B, 1A and then 1C.

ERG StepText: *RCPs should be run in order of priority to provide normal PRZR spray.*

Purpose: To inform the operator of a preferred order for starting RCPs

Basis: For the reference plant there are PRZR connections to one RCS hot leg via the surge line and to two RCS cold legs via the spray lines. Single pump operation in the loop that provides the best spray is preferred to obtain normal PRZR spray capability. If the RCP in the loop with the pressurizer surge line can be started, then it alone should be sufficient to provide normal pressurizer spray. However, if that RCP is unavailable, it will likely be necessary to start more than one RCP to provide normal pressurizer spray. Refer to the document RCP TRIP/RESTART in the Generic Issues section of the Executive Volume.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to plant specific order of priority.

Section: **Procedure**

Unit 1 ERP Step: 1 **Unit 2 ERP Step:** 1 ***ERG Step No:*** *1*

ERP StepText: Establish RCP support conditions.

ERG StepText: *Try To Restart An RCP*

Purpose: To establish forced convection cooling by starting an RCP

Basis: Cooling down under forced convection conditions allows faster plant cooldown with less potential for upper head voiding than under natural circulation conditions. This step outlines the conditions necessary for starting an RCP, and thereby establishing forced convection cooling. If the RVLIS upper range indicates less than (J.01), then additional requirements on PRZR level and RCS subcooling must be met prior to starting an RCP in order to accommodate any void collapse. Refer to the document titled RCP TRIP/RESTART in the Generic Issues section of the Executive Volume for a discussion of the RCP restart criteria. To limit the pressure decrease upon RCP restart, saturated conditions should first be established in the PRZR. If the PRZR is not saturated, starting an RCP will cause the PRZR level and pressure to decrease faster than if the PRZR were saturated. The PRZR pressure and level will still decrease when an RCP is started under saturated conditions, but the rate of decrease is slower since vapor is created as the pressure drops. If all seal cooling has been lost long enough that the maximum RCP seal parameters identified in the RCP Vendor Manual have been exceeded, seal injection and CCW thermal barrier cooling should not be established to the affected RCP(s). Both of these methods of seal cooling could have unintended consequences that result in additional pump damage or the failure of plant safety systems. Seal cooling should instead be restored by cooling the RCS, which will reduce the temperature of the water flowing through the pump seals.

Knowledge: 1. This step is a continuous action step as indicated by NOTE preceding it. 2. Pressurizer level and subcooling requirements for starting an RCP with a void in the upper head are designed to accommodate a collapse of the void. Starting an RCP will preclude the use of a pressurizer PORV during subsequent recovery, however, the operator should anticipate a decrease in pressurizer level and RCS subcooling when the RCP is started with upper head voiding. Charging flow should be increased as necessary to maintain pressurizer level on span and adequate RCS subcooling. It may also be necessary to isolate letdown in order to maintain pressurizer level. If pressurizer level or RCS subcooling is lost, SI actuation will be required per the foldout page. o If a pressurizer spray valve is failed open, RCP(s) previously stopped to prevent RCS depressurization should not be restarted.

IF a DG is already operating above its continuous load rating, THEN additional manual loads should not be added. Unanticipated plant emergency conditions may dictate the need to load the emergency diesel generators above the continuous load rating limit (i.e. 2.85 MW for small DGs, 4.075 MW for large DGs). Under these circumstances, diesel generator loading may be raised not to exceed the 2000 hour load rating limit (i.e. 3.1 MW for small DGs, 4.353 MW for large DGs). Diesel loading should be reduced within the diesel generator continuous load rating limit as soon as plant conditions allow.

Section: **Procedure**

References:

Justification of Differences:

1 Changed to make plant specific.

Section: **Procedure**

Unit 1 ERP Step: **Unit 2 ERP Step:** ***ERG Step No:*** *1 NOTE-3*

ERP StepText: N/A Step Deletion

ERG StepText: *If conditions can be established for starting an RCP during this guideline, Step 1 should be repeated.*

Purpose: To inform the operator that an RCP should be started whenever possible during the course of this guideline, and the guidance in Step 1 should be used

Basis: Since forced convection cooling permits a faster plant cooldown with less potential for upper head voiding, an attempt to restart an RCP should be made when under natural circulation conditions. If the proper conditions can be established for starting an RCP, Step 1 should be repeated. Step 1 provides conditions necessary for starting an RCP and should be used when attempting a restart. This step also directs the operator to the appropriate procedure if restart is successful.

Knowledge: N/A

References:

Justification of Differences:

1 This guidance is built into the step and a separate note is not needed.

Section: **Procedure**

Unit 1 ERP Step: 1.1 CAUTION-1 **Unit 2 ERP Step:** 1.1 CAUTION-1 ***ERG Step No:***

ERP StepText: To prevent heat exchanger damage, do not attempt restoration of RCP seal return flow unless the CCW miscellaneous header is aligned to an operating CCW loop.

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Plant specific information provided to user. This information identifies the potential for damage if seal return flow is established without cooling provided to the seal return heat exchanger.

Section: **Procedure**

Unit 1 ERP Step: 1.11 CAUTION-1 **Unit 2 ERP Step:** 1.11 CAUTION-1 ***ERG Step No:***

ERP StepText: Step 1.10 must be complete before starting an RCP.

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Added Caution to ensure sufficient inventory to accommodate any vessel void collapse is provided prior to starting a RCP.

Section: **Procedure**

Unit 1 ERP Step: 1.11 NOTE-1 **Unit 2 ERP Step:** 1.11 NOTE-1 ***ERG Step No:***

ERP StepText: Changes in RCP configuration may affect pressurizer spray flow.

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Reinforced selection of RCP operation should consider pressurizer spray performance. This information has been placed immediately prior to the step for starting RCPs in accordance with the writers guide.

Section: **Procedure**

Unit 1 ERP Step: 2 NOTE-1 **Unit 2 ERP Step:** 2 NOTE-1 ***ERG Step No:*** *2 NOTE-1*

ERP StepText: To prevent excessive pressure variations, saturated conditions should be established in the pressurizer prior to lowering pressurizer level.

ERG StepText: *Saturated conditions in the PRZR should be established before trying to decrease PRZR level.*

Purpose: To remind the operator that he should have a saturated PRZR before he attempts to reduce PRZR level

Basis: To reduce the PRZR level in a controlled manner, saturated conditions should first be established. If the PRZR is not saturated, decreasing PRZR level (using charging and letdown) will cause the PRZR pressure to decrease faster than if the PRZR were saturated. Though the PRZR pressure still decreases when level is reduced under saturated conditions, the rate of decrease is slower since vapor is created as the pressure drops.

Knowledge: N/A

References:

Justification of Differences:

1 Plant specific wording, includes reason for establishing saturated conditions.

Section: **Procedure**

Unit 1 ERP Step: 2 **Unit 2 ERP Step:** 2 ***ERG Step No:*** *2*

ERP StepText: Establish pressurizer level to accommodate void growth.

ERG StepText: *Establish PRZR Level To Accommodate Void Growth*

Purpose: To ensure that there is adequate space in the PRZR to allow the displacement of fluid from the primary system due to the formation of a void in the vessel

Basis: In this guideline as the primary system is cooled and depressurized under natural circulation conditions, a potential for void formation in the upper head region exists. If a void does form, it will displace primary fluid from the vessel into the PRZR as it grows. Therefore, before any further cooldown/depressurization is performed, the PRZR level must be low enough to accommodate this void growth and high enough to cover the PRZR heaters and prevent letdown from isolating. A level between (D.06)% and (D.12)% satisfies these requirements. In addition, PRZR level controls are placed in manual to allow any increase in PRZR level due to void growth.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

Section: **Procedure**

Unit 1 ERP Step: 3 **Unit 2 ERP Step:** 3 ***ERG Step No:*** *3*

ERP StepText: Continue RCS cooldown.

ERG StepText: *Continue RCS Cooldown And Initiate Depressurization*

Purpose: To continue the RCS cooldown and begin depressurization

Basis: This guideline is intended to provide a faster cooldown/depressurization than that outlined in ES-0.2. For this reason a maximum cooldown rate of 100°F/hr is allowed, along with a minimal subcooling requirement (i.e., instrument errors plus 20°F to ensure subcooling in hot legs). At the same time, however, the primary system pressure and temperature should be maintained within the Technical Specification limits. Deviation from the required cooldown rate could lead to excessive heat removal rates during the RCS cooldown. Since the intent of this guideline is to perform a controlled RCS cooldown and stay within Technical Specification limits, the requirement to maintain RCS temperature and pressure within these limits is explicitly emphasized in this step. Though this is not a pressurized thermal shock concern, emphasis is needed on maintaining RCS temperature and pressure within certain limits. The utility should be aware that a faster natural circulation cooldown/ depressurization, which allows upper head void growth, poses an additional concern. A high temperature differential may exist between the vessel proper and the vessel head that could cause differential contraction between the vessel head and vessel body at the flange, thereby stressing the studs beyond the allowable code limits. A review of this potential thermal stress safety concern indicated that the best-estimate maximum differential temperature that could occur is 250°F, with 300°F being an enveloping maximum differential temperature. Westinghouse performed work for a number of near term operating license plants to address the safety grade cold shutdown requirements of draft Regulatory Guide 1.139, Guidance for Residual Heat Removal. The Diablo Canyon Natural Circulation Cooldown Pretest report included a review of the thermal stress concern in the reactor vessel during the natural circulation cooldown. Since the best-estimate maximum differential temperatures exceeded those analyzed for Diablo Canyon, the analysis results were extrapolated to determine the affect of the increased differential temperature. This extrapolation indicated that although thermal stresses will be increased for the greater differential temperatures, total stress in the reactor vessel closure studs is well within the allowable limits. STEP DESCRIPTION TABLE FOR ES-0.3Step3 Based on this evaluation, it is concluded that a safety concern does not exist in implementing the guidance contained in the WOG natural circulation cooldown guidelines. Consequently, a plant specific evaluation of the natural circulation cooldown thermal stress concern is not needed prior to implementing the ERGs. Although not required prior to guideline implementation, utilities may still desire to analyze this concern to better quantify the consequences in terms of potential margin reduction. Plant-specific evaluation/analysis of the reactor vessel thermal stress concern requires an assessment of actual cooldown rates of the fluid in the reactor vessel upper head and actual reactor vessel metal temperature during a natural circulation cooldown utilizing the recovery strategies in the ERGs. This information can then be utilized in a finite element stress analysis of the reactor vessel flange area.

Section: Procedure

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

2 Split guideline step into two steps to eliminate multi-action step IAW Writer's Guide.

3 Changed "100°F/hr" to "100°F in any 60 minute period". This change complies with the FNP PTLR and is consistent with the basis for the integrity status tree which states that no thermal shock concern exists as long as the RCS cold leg temperature decrease has not exceeded 100°F in the previous 60 minutes. It also ensures any initial cooldown is considered in the 100 degree/hr cooldown.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITH RVLIS)

Plant Specific Background Information

Section: **Procedure**

Unit 1 ERP Step: 4 NOTE-1 **Unit 2 ERP Step:** 4 NOTE-1 ***ERG Step No:***

ERP StepText: Reactor vessel steam voiding may occur during RCS pressure reduction. This will cause a rapid rise in pressurizer level.

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 The information deals with the potential for forming a void in the reactor vessel. It is intended to inform the operator of a condition which may occur that will effect RCS inventory indications.

Section: **Procedure**

Unit 1 ERP Step: 4 **Unit 2 ERP Step:** 4 ***ERG Step No:*** *3*

ERP StepText: Begin RCS pressure reduction.

ERG StepText: *Continue RCS Cooldown And Initiate Depressurization*

Purpose: To continue the RCS cooldown and begin depressurization

Basis: This guideline is intended to provide a faster cooldown/depressurization than that outlined in ES-0.2. For this reason a maximum cooldown rate of 100°F/hr is allowed, along with a minimal subcooling requirement (i.e., instrument errors plus 20°F to ensure subcooling in hot legs). At the same time, however, the primary system pressure and temperature should be maintained within the Technical Specification limits. Deviation from the required cooldown rate could lead to excessive heat removal rates during the RCS cooldown. Since the intent of this guideline is to perform a controlled RCS cooldown and stay within Technical Specification limits, the requirement to maintain RCS temperature and pressure within these limits is explicitly emphasized in this step. Though this is not a pressurized thermal shock concern, emphasis is needed on maintaining RCS temperature and pressure within certain limits. The utility should be aware that a faster natural circulation cooldown/ depressurization, which allows upper head void growth, poses an additional concern. A high temperature differential may exist between the vessel proper and the vessel head that could cause differential contraction between the vessel head and vessel body at the flange, thereby stressing the studs beyond the allowable code limits. A review of this potential thermal stress safety concern indicated that the best-estimate maximum differential temperature that could occur is 250°F, with 300°F being an enveloping maximum differential temperature. Westinghouse performed work for a number of near term operating license plants to address the safety grade cold shutdown requirements of draft Regulatory Guide 1.139, Guidance for Residual Heat Removal. The Diablo Canyon Natural Circulation Cooldown Pretest report included a review of the thermal stress concern in the reactor vessel during the natural circulation cooldown. Since the best-estimate maximum differential temperatures exceeded those analyzed for Diablo Canyon, the analysis results were extrapolated to determine the affect of the increased differential temperature. This extrapolation indicated that although thermal stresses will be increased for the greater differential temperatures, total stress in the reactor vessel closure studs is well within the allowable limits. STEP DESCRIPTION TABLE FOR ES-0.3Step3 Based on this evaluation, it is concluded that a safety concern does not exist in implementing the guidance contained in the WOG natural circulation cooldown guidelines. Consequently, a plant specific evaluation of the natural circulation cooldown thermal stress concern is not needed prior to implementing the ERGs. Although not required prior to guideline implementation, utilities may still desire to analyze this concern to better quantify the consequences in terms of potential margin reduction. Plant-specific evaluation/analysis of the reactor vessel thermal stress concern requires an assessment of actual cooldown rates of the fluid in the reactor vessel upper head and actual reactor vessel metal temperature during a natural circulation cooldown utilizing the recovery strategies in the ERGs. This information can then be utilized in a finite element stress analysis of the reactor vessel flange area.

Section: **Procedure**

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

2 Split guideline step into two steps to eliminate multi-action step IAW Writer's Guide.

Section: **Procedure**

Unit 1 ERP Step: 5 **Unit 2 ERP Step:** 5 ***ERG Step No:*** *4*

ERP StepText: Maintain pressurizer level 25%-90%.

ERG StepText: *Control PRZR Level*

Purpose: To keep the PRZR level on the normal span between (D.06)% and 90% (i.e., to prevent losing PRZR level, high or low)

Basis: As the void grows in the vessel the PRZR level will increase (PRZR controls are in manual). It is important to prevent a water solid PRZR and the resultant loss of pressure control. In the same way the PRZR should not be allowed to drain and uncover the heaters. Though this is less likely to occur, a void redistribution could cause this situation. Normal charging and letdown (with a saturated PRZR) is used to either increase or decrease level. The PRZR level can also be decreased by continuing RCS cooldown to shrink inventory. Before performing any level decrease, however, the PRZR heaters should be energized to maintain PRZR pressure stable. Drain and fill cooling of the reactor vessel upper head assists the operator-controlled RCS cooldown and depressurization. As the RCS is depressurized using auxiliary spray or a PRZR PORV, the upper head void grows and displaces hot upper head water into the RCS to mix with the cooler RCS water. The water forced out of the upper head will cause a corresponding surge of water from the RCS into the PRZR, raising the PRZR level and pressure. If the upper head void growth is sufficient to contact water circulating from the core outlet into the hot legs, the interfacing steam will be condensed by the subcooled water. The rate of condensation will depend on the amount of subcooling and mixing in the circulating water. As the upper head steam condenses, cooler water will enter the upper head region causing an outsurge of water from the PRZR. This drain and fill process may be continued until the upper head temperature is sufficiently reduced and the upper head becomes water solid. The operator should be aware that the PRZR will not respond in the normal manner if a void is present. If letdown is greater than charging, the PRZR pressure will decrease, the vessel void will grow and the PRZR level will increase. In the same way when charging is greater than letdown, the PRZR pressure will increase, the vessel void will shrink, and the level will decrease. If inventory shrink is used to reduce PRZR level, careful attention should be paid to the Technical Specification pressure-temperature limits. STEP DESCRIPTION TABLE FOR ES-0.3Step4

Knowledge: 1. Relationship between charging/letdown control and PRZR level/void changes 2. Relationship between inventory shrink and PRZR level. 3. This is a continuous action step.

References:

Section: **Procedure**

Justification of Differences:

1 Changed to make plant specific.

Section: **Procedure**

Unit 1 ERP Step: 5.2.1 NOTE-1 **Unit 2 ERP Step:** 5.2.1 NOTE-1 ***ERG Step No:***

ERP StepText: The intent of step 5.2.1 is to maintain the pressurizer liquid at saturation temperature.

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Added note to emphasize turning heaters on to maintain pressurizer at saturation temperature.

Section: **Procedure**

Unit 1 ERP Step: 6 **Unit 2 ERP Step:** 6 ***ERG Step No:*** *5*

ERP StepText: Check REACTOR VESSEL LEVEL indication - GREATER THAN 44% UPPER PLENUM.

ERG StepText: *Check RVLIS Full Range Indication - GREATER THAN (K.04)*

Purpose: To allow the void to reach the hot legs without disrupting natural circulation.

Basis: If steam enters the hot legs, it would most likely be condensed by the subcooled hot leg water well before the relatively slow natural circulation flow can carry it to the SG U-tubes, therefore some voiding into the RCS hot legs should not impede the natural circulation cooling process. Even if steam were to reach the SG U-tubes, the condensation rate of steam in the U-tubes is more rapid than in the subcooled loop so significant degradation of the natural circulation process should not occur. By monitoring RVLIS and limiting the void growth to the top of the hot legs (re-pressurizing the RCS if necessary), the potential for introducing voids into the SG U-tubes is minimized. No uncertainty is applied to the nominal value to preclude a bias toward either preventing void growth to the top of the hot legs, or allowing excessive steam to enter the hot legs. This is considered a reasonable balance between the benefit of enabling effective upper head drain and fill cooling and the potential consequence of allowing steam to enter the hot legs.

Knowledge: 1. Understanding of RVLIS function, configuration, and interpretation. 2. Understanding of re-pressurization and void collapse. 3. This step is a continuous action step.

References: DW-08-001

Justification of Differences:

1 Changed to plant specific wording and included specific parameter to meet.

Section: **Procedure**

Unit 1 ERP Step: 7 **Unit 2 ERP Step:** 7 ***ERG Step No:*** *6*

ERP StepText: Check when to isolate SI accumulators.

ERG StepText: *Check If SI System Should Be Locked Out*

Purpose: To determine if appropriate plant conditions exist for locking out SI

Basis: The safety injection accumulator isolation valves should be closed (by whatever plant specific means necessary) and their power supplies locked out to prevent the dumping of the accumulator borated water into the RCS when RCS pressure drops below accumulator pressure. The high-head safety injection pumps and the non-operating charging/SI pumps should be locked out to prevent any spurious startings. The pressure and temperature criteria from the appropriate Technical Specification for the plant should be used to lock out SI.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to plant specific wording, accumulators only SI system this is applicable to at this time.

Section: **Procedure**

Unit 1 ERP Step: 8 **Unit 2 ERP Step:** 8 ***ERG Step No:*** *7*

ERP StepText: Maintain letdown flow.

ERG StepText: *Maintain Letdown Flow*

Purpose: To maintain required letdown flow so RCS inventory remains constant

Basis: As reactor coolant pressure decreases, the delta P across the letdown orifice will drop and result in decreased letdown flow. Action should be taken to increase letdown flow to maintain a constant RCS inventory

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

Section: **Procedure**

Unit 1 ERP Step: 9 **Unit 2 ERP Step:** 9 ***ERG Step No:*** *8*

ERP StepText: Maintain seal injection flow to each RCP - 6-13 gpm.

ERG StepText: *Maintain Required RCP Seal Injection Flow*

Purpose: To control the amount of RCP seal injection flow within specified limits

Basis: Reactor coolant pump seal injection flow will vary as RCS cooldown/ depressurization continues. The hand controlled throttle valve in the charging line (or other plant specific valves) should be adjusted as necessary to maintain the seal injection flow within the required limits for RCP support.

Knowledge: If all seal cooling has been lost long enough that the maximum RCP seal parameters identified in the RCP Vendor Manual have been exceeded, seal injection and CCW thermal barrier cooling should not be established to the affected RCP(s). Both of these methods of seal cooling could have unintended consequences that result in additional pump damage or the failure of plant safety systems. Seal cooling should instead be restored by cooling the RCS, which will reduce the temperature of the water flowing through the pump seals.

References:

Justification of Differences:

1 Changed to make plant specific.

Section: **Procedure**

Unit 1 ERP Step: 10 **Unit 2 ERP Step:** 10 ***ERG Step No:*** *9*

ERP StepText: Check if RHR system can be placed in service.

ERG StepText: *Check If RHR System Can Be Placed In Service*

Purpose: To check for required conditions and then place RHR System in service

Basis: The RHR System is designed to operate below specific RCS pressure and temperature conditions. If previous actions to establish conditions were not complete, this step directs the operator to return to those steps for completion of the actions. The RHR System is placed in service according to plant specific procedures when the required conditions are established.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

Section: **Procedure**

Unit 1 ERP Step: 11 **Unit 2 ERP Step:** 11 ***ERG Step No:*** *10*

ERP StepText: Continue RCS cooldown to cold shutdown with RHR.

ERG StepText: *Continue RCS Cooldown To Cold Shutdown*

Purpose: To use RHR System to cool down the RCS to cold shutdown conditions

Basis: The RCS must be cooled down to less than 200°F to attain cold shutdown. The RHR System is used to achieve this temperature in the RCS.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITH RVLIS)

Plant Specific Background Information

Section: **Procedure**

Unit 1 ERP Step: 12 CAUTION-1 **Unit 2 ERP Step:** 12 CAUTION-1 ***ERG Step No:*** *11 CAUTION-1*

ERP StepText: Reactor vessel steam voiding may occur if the RCS is depressurized before the entire RCS is cooled to less than 200`F.

ERG StepText: *Depressurizing the RCS before the entire RCS is less than 200°F may result in additional void formation in the RCS.*

Purpose: To warn the operator that depressurizing the RCS before the entire RCS is less than 200°F could allow additional voids to form

Basis: The caution warns that depressurizing the RCS before the entire RCS (including the upper head region and steam generator U-tubes) is less than 200°F could result in additional void formation. Therefore, while using the RHR System to cool down the RCS, steps to cool down the inactive portions of the RCS should also be performed to further limit void formation.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

Section: **Procedure**

Unit 1 ERP Step: 12 **Unit 2 ERP Step:** 12 ***ERG Step No:*** *11*

ERP StepText: Continue cooldown of inactive portion of RCS.

ERG StepText: *Continue Cooldown Of Inactive Portion Of RCS*

Purpose: To ensure that heat is being removed from the vessel head and SG U-tubes so potential void formation during depressurization is minimized

Basis: The total core flow during RHR System operation is approximately 2 percent of full flow. The RHR System flow is even less than the natural circulation flow, and the upper head will, therefore, remain relatively stagnant compared to the rest of the RCS (i.e., the RHR System will force minimal cooling flow into the upper head). Two options are then available: 1) Run CRDM fans during RHR System operation to cool the upper head; or 2) Without CRDM fans running, wait for the upper head to cool by conduction before depressurizing the RCS with the RHR System in service. For the second option, plants with inverted top hat upper support plates (USP) should wait 3.7 days (88 hours) to allow the upper head region to cool off to 200°F. For top hat USP plants and flat USP plants, the waiting periods are 1.1 days (27 hours) and 1.2 days (29 hours), respectively. It should be noted that these waiting periods have been determined for a water solid upper head, i.e., the RVLIS upper range indicates greater than (J.01). Since it is expected at this time that the void in the vessel has been condensed from the RCS cooldown, these waiting periods can be used to give a general idea of how long it will take to cool the upper head below 200°F. It is difficult to determine exact waiting periods if a void is still present in the upper head because the size of void will influence heat transfer and subsequent cooldown. However, with CRDM fans on, the cooldown rate of the upper region would be at least as great as the rate with a water solid head for the following reasons: 1) Since steam in the upper head region would be at a higher temperature than the liquid, the delta T between the upper head region and the region above the hot legs is increased; 2) Since the cool-off rate is effectively proportional to this delta T, it would be increased; and 3) Condensation of steam onto the inside wall of the upper head would also increase the cooldown rate of the upper head region. When the plant is being cooled by the RHR System, the injection from the RHR System is into the cold legs and the return line to the RHR System is from the hot leg. Thus the steam generators are not being cooled by the RHR System. Steam dump should, therefore, be used to cool the steam generators from 350°F to less than or equal to 212°F. The steam dumping from all steam generators must be continued until they have stopped steaming. This will reduce the potential for steam bubble formation in the steam generator U-tubes upon depressurization of the RCS. STEP DESCRIPTION TABLE FOR ES-0.3Step11

Knowledge: 1. Understanding of RVLIS function, configuration, and interpretation. 2. It is important to keep SG chemistry within the required specifications throughout the final cooldown/depressurization to cold shutdown. The operator should be aware that chemistry requirements should be met at all times.

Section: **Procedure**

References:

Justification of Differences:

1 Changed to make plant specific.

2 Added RCS pressure control band.

Section: **Procedure**

Unit 1 ERP Step: 13 **Unit 2 ERP Step:** 13 ***ERG Step No:*** *12*

ERP StepText: Check if RCS depressurization is permitted.

ERG StepText: *Determine If RCS Depressurization Is Permitted*

Purpose: To ensure that the entire RCS is below 200°F before final depressurization

Basis: As long as the entire RCS is below 200°F, depressurization to atmospheric pressure will not cause any void formation in the system. With CRDM fans running, the upper head should be cooled to below 200°F. Without CRDM fans, waiting the length of time discussed in the BASIS section of Step 11 should allow a water-solid upper head to cool down below 200°F. Other methods can be used to help determine upper head fluid temperature. If upper head TCs are available, they can give a good indication of upper head fluid temperature. A full RVLIS vessel indication will imply at least saturated conditions (temperature based on system pressure, corrected for differences between measurement point and the vessel head). Any PRZR level increase and/or RVLIS indication less than full, following an RCS depressurization at this time, would indicate that the upper head fluid temperature is not below 200°F, and the RCS should be pressurized to collapse the void. In this case, when it is appropriate to depressurize would be determined by trial and error. The method for determining SG U-tube temperature conditions consists of steaming the SGs until they stop steaming. This then implies that no delta T exists and the primary/secondary temperatures are approximately equal.

Knowledge: Determination of upper head and SG U-tube temperatures from direct or indirect means (upper head TCs, RVLIS, steam pressure, etc.)

References:

Justification of Differences:

1 Changed to make plant specific.

2 Added detailed guidance for shutting down a diesel when an auto start signal is present. Included for situation where diesel has to be shutdown quickly due to unusual conditions such as no SW for cooling.

3 Per background document the way to determine that the entire RCS is below 200°F is by upper head thermocouple being below 200°F and no steam generation in the S/G's. Therefore guidance has be specified.

Section: **Procedure**

Unit 1 ERP Step: 13.1 NOTE-1 **Unit 2 ERP Step:** 13.1 NOTE-1 ***ERG Step No:***

ERP StepText: FNP-2-SOP-68 INADEQUATE CORE COOLING MONITORING SYSTEM provides detailed operating instructions for the core exit T/C monitor.

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Added note to provide the operator with a procedure reference for operating the core exit T/C monitor.

Section: **Continous Action Summary**

Unit 1 ERP Step: **Unit 2 ERP Step:** ***ERG Step No:***

ERP StepText: Continuing action summary pages

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 The Continuous Action Summary was added to aide the operator in addressing actions which are of a continuing nature. This page can be removed from the procedure and used as a reminder of on going actions during the event.

Section: **Figure 1**

Unit 1 ERP Step: **Unit 2 ERP Step:** ***ERG Step No:***

ERP StepText: Figure 1 - NUMBER 1 SEAL OPERATING RANGE

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References: Westinghouse product update number s-009

Justification of Differences:

1 Added figure to provide additional operator guidance. Obtained from Westinghouse product update number s-009.

Section: **Figure 2**

Unit 1 ERP Step: **Unit 2 ERP Step:** ***ERG Step No:***

ERP StepText: Figure 2 - RCS PRESSURE - TEMPERATURE OPERATING LIMITS

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Added figure to provide additional operator guidance. Obtained from UOP-1.1.

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Plant Specific Background Information

Section: Figure 3

Unit 1 ERP Step: **Unit 2 ERP Step:** ***ERG Step No:***

ERP StepText: Figure 3 -UNIT 1/2 100°F/HR TECH. SPEC. LIMIT RCS COOLDOWN

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Provided applicable Technical Specification cooldown limit curve for use during cooldown.

Section: **Attachment 1**

Unit 1 ERP Step: **Unit 2 ERP Step:** ***ERG Step No:***

ERP StepText: Attachment 1 - ACCUMULATOR MOV DISCONNECTS (POWER RESTORATION)

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Added attachment to provide detailed guidance for the restoration of power to the accumulator discharge valves.

Section: Attachment 2

Unit 1 ERP Step: **Unit 2 ERP Step:** ***ERG Step No:***

ERP StepText: Attachment 2 - ACCUMULATOR MOV DISCONNECT (POWER REMOVAL)

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Added attachment to provide detailed guidance for the removal of power to the accumulator discharge valves.

Section: **FOLDOUT Page**

Unit 1 ERP Step: 1 **Unit 2 ERP Step:** 1 ***ERG Step No:*** *1*

ERP StepText: Monitor SI criteria.

ERG StepText: *SI ACTUATION CRITERIA*

Purpose:

Basis: Although the criteria are identical to the ones found in the SI Reinitiation criteria, the actions are different. The operator is instructed to actuate safety injection rather than start SI pumps as necessary. The criteria selected for SI actuation are either loss of RCS subcooling or the inability to maintain pressurizer level with charging. Each of these limits indicate that control of the plant is lost and that SI actuation is necessary.

Knowledge:

References:

Justification of Differences:

1 Changed to make plant specific.

2 Changed to dual column format IAW Writer's Guide.

Section: **FOLDOUT Page**

Unit 1 ERP Step: 2 **Unit 2 ERP Step:** 2 ***ERG Step No:*** *2*

ERP StepText: Monitor switchover criteria.

ERG StepText: *AFW SUPPLY SWITCHOVER CRITERION*

Purpose:

Basis: This criterion is on the FOLDOUT PAGE to remind the operator that the supply of water from the condensate storage tank to the suction of the AFW pumps is limited and, if it is depleted, an alternate suction supply of water to the AFW pumps is necessary.

Knowledge:

References:

Justification of Differences:

1 Changed to make plant specific.

2 Changed to dual column format IAW Writer's Guide.