FNP-0-ESB-0.4
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SAFETY RELATED

FARLEY NUCLEAR PLANT

SPECIFIC BACKGROUND DOCUMENT

FOR

FNP-1/2-ESP-0.4

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

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

Approved:

David L Reed (for)
Operations Manager

Date Issued: January 11, 2011

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NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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 eleven steps.*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: **Title**

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

ERP StepText: NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

ERG StepText: *NATURAL CIRCULATION COOLDOWN WITH STEAM VOID IN VESSEL (WITHOUT RVLIS)*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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 without 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 without a vessel level system available to monitor void growth.*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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 ten 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 twelve 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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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 Changed to plant specific wording and requirement.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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-0.4 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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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 delineate FNP's RCP priority for running pumps.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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. Adequate PRZR level and RCS subcooling criteria 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. 3. 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. 2.85ÿMW for small DGs, 4.075ÿMW for large DGs). Under these circumstances, diesel generator loading may be raised not to exceed the 2000 hour load rating limit (i.e. 3.1ÿMW for small DGs, 4.353ÿMW for large DGs). Diesel loading should be reduced within the diesel generator continuous load rating limit as soon as plant conditions allow.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

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

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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 this step, therefore a separate note is not required.

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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: **Procedure**

Unit 1 ERP Step: 1.13 NOTE-1 **Unit 2 ERP Step:** 1.13 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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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. In addition, strict limits are placed on the PRZR level since it will be used to monitor void growth. A level between (D.06)% and (D.12)% satisfies all these requirements. In order to allow an increase in PRZR level due to void growth, PRZR level controls are placed in manual.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

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

ERP StepText: Reduce RCS hot leg temperature to 500`F.

ERG StepText: *Decrease RCS Hot Leg Temperatures To 500°F*

Purpose: To initiate the cooldown sequence with a temperature decrease to 500°F

Basis: The entire guideline is accomplished in a step-wise fashion to decrease temperature and pressure. This is the first temperature decrease and 500°F is chosen in order that the initial depressurization (to 1600 psig) does not cause a void to form (or increase further) in the upper head and does not violate the Technical Specification cooldown curve (see Figure 1). Since it is not intended to draw a void at this time in the guideline, the pressure is maintained constant and the cooldown rate is maintained at a maximum of 50°F/hr which was the maximum rate used in the natural circulation cooldown analysis where no void was formed (see Reference 1). In addition, the PRZR level is maintained constant using charging to make up for system volumetric shrink. 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 and subsequent steps (Steps 5, 11 and 15). Though this is not a pressurized thermal shock concern, emphasis is needed on maintaining RCS temperature and pressure within certain limits.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

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

ERP StepText: Reduce RCS pressure to 1600 psig.

ERG StepText: *Depressurize RCS To 1600 PSIG*

Purpose: To depressurize the RCS to the Technical Specification limiting pressure at 450°F

Basis: This is the first depressurization step (See Figure 1) and stops at 1600 psig which is the limiting pressure at 450°F for the Technical Specification cooldown curve of the most limiting plant. It is unlikely that upper head voiding will occur or continue at this time as indicated in Figure 1 by the location of the upper head saturation limit curve (for conservatism the curve used is for a THOT plant with 25°F/hr cooldown; see the background document for ES-0.2, NATURAL CIRCULATION COOLDOWN).

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 5 NOTE-1 **Unit 2 ERP Step:** 5 NOTE-1 ***ERG Step No:*** *5 NOTE-1*

ERP StepText: After cooldown is stopped, RCS hot leg temperatures will fall due to reduction in heat transfer rate.

ERG StepText: *After cooldown is stopped, RCS hot leg temperatures will decrease due to decrease in heat transfer rate.*

Purpose: To remind the operator to expect the hot leg temperatures to decrease further after cooldown is stopped.

Basis: When in a steady state natural circulation condition, RCS cold leg temperatures are at or slightly above the saturation temperature corresponding to the steam generator pressure and the delta T between the RCS hot legs and cold legs is approximately equal to the full power forced convection delta T. Refer to the Natural Circulation Generic Issues Background Document for additional information regarding system conditions under natural circulation. The response of RCS temperatures under natural circulation conditions are effected by operator actions to cooldown the plant (short term response) and by the decrease in core decay heat generation with time (long term response). These short term and long term effects are discussed below: Cooldown: Natural circulation cooldown of the RCS from no_load temperature to RHRS initiation temperature is achieved by controlling steam release from the main steam system using the condenser steam dump or atmospheric steam dump valves in the pressure control mode. Cooldown is initiated by opening the dump valves to reduce the pressure in the steam generators. Since the steam generators are at saturated conditions, reducing steam pressure reduces steam temperature. As the temperature in the steam generators is reduced below the temperature of the coolant in the RCS, the heat transfer to the steam generators from the reactor coolant increases. RCS cold leg temperature will decrease with steam generator temperature and the differential temperature (delta T) between the RCS hot legs and cold legs increases. When the RCS is being cooled down, a delta T exists between the primary and secondary systems as well as between the RCS hot legs and cold legs. Under cooldown conditions heat is being removed at a greater rate than under equilibrium conditions when temperature is being held constant. Thus, the delta T between the primary and secondary systems increases as the heat removal rate increases. STEP DESCRIPTION TABLE FOR ES-0.4Step 5 - NOTE As cooldown progresses, the secondary pressure (and temperature) decreases. This causes the cold leg temperature to decrease with steam temperature. The hot leg temperature also decreases after a time lag that is established based on the primary system delta T. To slow or terminate the cooldown, the steam dump valves are used to reduce the steam release, thus stabilizing and possibly increasing secondary pressure (and temperature) slightly. When the cooldown is slowed or terminated, the heat being removed from the primary system decreases to an equilibrium (constant temperature) level. The decrease in heat removal will result in a reduction in primary system delta T, the cold leg temperature will stabilize and possibly increase slightly and the hot leg temperature will decrease slightly. This short term response of system temperatures to the initiation and termination of plant cooldown must be accounted for by the operator in performing cooldown steps to better control system temperature at the desired values. Since the operator is instructed to stop the cooldown in the step that follows

Section: Procedure

this note, the purpose of this note is to address the short term response of RCS hot leg temperature when cooldown is stopped. It reminds the operator to expect hot leg temperature to decrease further after the cooldown is stopped. The operator should stop the cooldown with sufficient temperature margin that the expected decrease does not exceed the temperature limit in the step. Decrease in Core Decay Heat Generation: In the long term, the primary system delta T will gradually decrease as core decay heat generation gradually decreases. As the primary system delta T gradually decreases, the cold leg temperature will gradually increase and the hot leg temperature will gradually decrease. This long term response of system temperatures to the decrease in decay heat generation should be accounted for by the operator in performing steps that maintain system temperatures to better control system temperature at the desired values. Since this is a long term response consideration, it is not specifically addressed in the note. With respect to the long term effect of decreasing core decay heat generation rates on the behavior of system temperatures, the ERGs rely on operator knowledge and training to properly perform steps that initiate and terminate cooldown and maintain system temperatures.

Knowledge: 1. Expected THOT decrease (short term response) after cooldown is stopped due to decrease in loop delta Ts. See BASIS section above. 2. Expected THOT decrease (long term response) due to decrease in core decay heat generation rates. See BASIS section above.

References:

Justification of Differences:

1 Changed to make plant specific. Eliminated use of term 'decrease' per writers guide.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

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

ERP StepText: Reduce RCS hot leg temperature to 450`F.

ERG StepText: *Decrease RCS Hot Leg Temperatures To 450°F*

Purpose: To continue the step-wise cooldown

Basis: At 1600 psig a decrease in primary temperature to 450°F is just short of reaching the limiting Technical Specification cooldown curve (see Figure 1). Here it is important that the operator consider the preceding NOTE so as not to violate the Technical Specification cooldown curve when stopping the cooldown at the specified temperature. The cooldown is now accomplished at the maximum rate of 100°F/hr, pressure is held constant at 1600 psig, and inventory is added to make up for system shrink. As explained in Step 3, RCS temperature and pressure should be maintained within limits of the Technical Specification cooldown curve and the limits imposed by this guideline. It is still unlikely that void formation will start or continue under these conditions as indicated in Figure 1.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

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

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.

2 Revised order to establish seal flow before establishing a flow balance. Adjusting seal injection after establishing a flow balance will invalidate the flow balance adjustment.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 7 NOTE-1 **Unit 2 ERP Step:** 7 NOTE-1 ***ERG Step No:***

ERP StepText: With an RCS flow balance established, the magnitude of PZR level rise during any subsequent RCS depressurization is indicative of the degree of reactor vessel steam voiding.

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Note added to explain the intent of step. With RCS inlet and outlet flows matched any change in pressurizer level must be a result of void changes.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

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

ERP StepText: Establish RCS flow balance.

ERG StepText: *Equalize Charging And Letdown Flows*

Purpose: To balance primary inventory gains and losses

Basis: Conditions must be established so that any change in the PRZR level will occur solely due to void formation in the vessel. It is necessary to balance inventory gains and losses so that when void formation occurs letdown will not be increased to make up for increasing PRZR level. A strict control of inventory is needed so accurate tracking of void growth can be maintained.

Knowledge: During subsequent RCS depressurization steps, charging flow should be maintained equal to letdown flow.

References:

Justification of Differences:

1 Changed to make plant specific.

2 Revised order to establish seal flow before establishing a flow balance. Adjusting seal injection after establishing a flow balance will invalidate the flow balance adjustment.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 8 **Unit 2 ERP Step:** 8 ***ERG Step No:*** *10*

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 Specifications for the plant should be used to lock out SI.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

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

3 Change sequence to place instructions of isolating the accumulators prior to RCS pressure reduction below a 1000 PSIG. This ensures that an accidental accumulator discharge will not occur.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

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

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

ERG StepText: *The upper head region may void during RCS depressurization. This will result in a rapidly increasing PRZR level.*

Purpose: To remind the operator that a rapidly increasing PRZR level during the RCS depressurization in the next step is a sign that voids are forming in the primary system

Basis: As the primary pressure drops the fluid in the upper head, which is hotter than the rest of the system, will flash into steam. Since the primary system additions and losses are being maintained equal, the expanding steam will displace fluid into the PRZR, causing its level to increase. Without RCPs running, there is very little flow into the upper head region. Liquid in that region remains relatively hot even though the liquid temperature in the active regions of the RCS has been significantly reduced during the RCS cooldown. As the RCS is subsequently depressurized, the hotter liquid in the upper head may flash to steam, forming an upper head void. Steam formation in the upper head will displace water into the PRZR, causing rapidly increasing PRZR level with the potential for water relief through the PRZR PORVs. The PRZR may fill with water within a few minutes. This note informs the operator of the potential for this condition, so that RCS depressurization can be stopped quickly to avoid a water solid PRZR.

Knowledge: N/A

References: DW-99-032

Justification of Differences:

1 Changed to make plant specific. This is presented as a Note (reference DW-99-032).

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

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

ERP StepText: Reduce RCS pressure.

ERG StepText: *Depressurize RCS*

Purpose: To continue RCS depressurization with void formation in the vessel expected

Basis: The decrease in system pressure to less than 800 psig will cross the upper head saturation limit curve (Figure 1) and void formation can be expected. Both RCS pressure and PRZR level are monitored at this time. If the desired pressure is reached without overfilling the PRZR (i.e., PRZR level less than 90%), then the depressurization is terminated and the operator can continue with the cooldown. However, if the PRZR level increases above 90% during the depressurization, then further actions are taken as specified in the next step.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

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

ERP StepText: To continue RCS pressure reduction, it may be necessary to cycle pressurizer level several times by raising and then lowering RCS pressure (in accordance with steps 9 and 10). This will enhance reactor vessel upper head cooling.

ERG StepText: *In order to continue overall system depressurization, it may be necessary to cycle PRZR level (cycle pressure) to enhance upper head cooling.*

Purpose: To inform the operator that it may be necessary to cycle PRZR level by cycling pressure in order to allow additional cooling of the upper head

Basis: If the PRZR level is greater than 90% the depressurization must be stopped and the primary side repressurized to partially or wholly collapse the vessel void. This action should cause the PRZR level to drop and force liquid into the upper head, cooling the upper head internals structure. Depressurization can then continue while monitoring PRZR level. If PRZR level increases to greater than 90% again, the RCS is repressurized, PRZR level drops and cool liquid is forced into the upper head. This cycling of PRZR level should continue until RCS can be depressurized to the desired pressure without PRZR level increasing to greater than 90%.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

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

ERP StepText: Check pressurizer level - LESS THAN 90%.

ERG StepText: *Check PRZR Level - LESS THAN 90%*

Purpose: To ensure the PRZR level has not exceed 90% before continuing the RCS cooldown and depressurization

Basis: The PRZR is being allowed to fill with primary fluid displaced by the growing vessel void. However, the size of the void is being limited by only allowing the PRZR to fill to a maximum of 90% (starting at a level above the top of the heaters). This will ensure continued PRZR pressure control. The document RCP TRIP/RESTART in the Generic Issues section of the Executive Volume provides a discussion of the plant specific PRZR level necessary to accommodate upper head void collapse in relation to RCP restart conditions. In addition, information is provided on the percentage of PRZR volume displaced by vessel voiding (limited to above the top of the hot leg nozzles) for various types of plants. This information can be used to approximate the expected increase in PRZR level from upper head void growth when the RCS is cooled down and depressurized as outlined in this guideline. If the PRZR level increases to greater than 90% during the depressurization, the RCS is repressurized to enhance upper head cooling (Refer to BASIS section of previous NOTE) before any further depressurization can be performed.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 11 NOTE-1 **Unit 2 ERP Step:** 11 NOTE-1 ***ERG Step No:***

ERP StepText: After cooldown is stopped, RCS hot leg temperatures will fall due to reduction in heat transfer rate.

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Added Note similar to note provided prior to previous cooldown step. This information is applicable any time a cooldown sequence is directed.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

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

ERP StepText: Reduce RCS hot leg temperatures to 400`F.

ERG StepText: *Decrease RCS Hot Leg Temperatures To 400°F*

Purpose: To continue the step-wise cooldown

Basis: At 800 psig a decrease in primary temperature to 400°F is within the limiting Technical Specification cooldown curve (Figure 1). Here it is important that the operator consider the NOTE preceding Step 5 so as not to violate the Technical Specification cooldown curve when stopping the cooldown at the specified temperature. The cooldown is still accomplished at the maximum rate of 100°F/hr, pressure is held constant at 800 psig, and inventory is added to make up for system shrink. As explained in Step 3, RCS temperature and pressure should be maintained within limits of the Technical Specification cooldown curve and the limits imposed by this guideline.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

2 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.

Section: Procedure

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

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

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Changed to make plant specific

2 Added guidance to ensure seal injection flow is maintained and to be consistent with previous similar step.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

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

ERP StepText: Establish RCS flow balance.

ERG StepText: *Equalize Charging And Letdown Flows*

Purpose: To balance primary inventory gains and losses

Basis: Conditions must be established so that any change in the PRZR level will occur solely due to void formation in the vessel. It is necessary to balance inventory gains and losses so that when void formation occurs letdown will not be increased to make up for increasing PRZR level. A strict control of inventory is needed so accurate tracking of void growth can be maintained. Careful attention must also be paid to maintaining the required RCP seal injection and return flows.

Knowledge: During subsequent RCS depressurization steps, charging flow should be maintained equal to letdown flow.

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: **Procedure**

Unit 1 ERP Step: 14 NOTE-1 **Unit 2 ERP Step:** 14 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: DW-99-032

Justification of Differences:

1 Added Note to alert for pressurizer level changes and to be consistent with previous similar step. Presented as a Note (reference DW-99-032).

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 14 **Unit 2 ERP Step:** 14 ***ERG Step No:*** *13*

ERP StepText: Reduce RCS pressure.

ERG StepText: *Depressurize RCS*

Purpose: To continue RCS depressurization with void formation in the vessel expected

Basis: This decrease in system pressure to less than 600 psig will remain below the upper head saturation limit curve (Figure 1) and void formation can be expected. Both RCS pressure and PRZR level are monitored. If the desired PRZR pressure is reached without overfilling the PRZR (i.e., PRZR level less than 90%), then the depressurization is terminated and the operator can continue with the cooldown. However, if the PRZR level increases above 90% during the depressurization, then further actions are taken as specified in the next step.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

Section: Procedure

Unit 1 ERP Step: 15 NOTE-1 **Unit 2 ERP Step:** 15 NOTE-1 ***ERG Step No:***

ERP StepText: To continue RCS pressure reduction, it may be necessary to cycle pressurizer level several times by raising and then lowering RCS pressure (in accordance with steps 14 and 15). This will enhance reactor vessel upper head cooling.

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Added note to identify the potential need to perform the associated steps repeatedly and to be consistent with previous similar step.

Section: Procedure

Unit 1 ERP Step: 15 **Unit 2 ERP Step:** 15 ***ERG Step No:*** *14*

ERP StepText: Check pressurizer level - LESS THAN 90%.

ERG StepText: *Check PRZR Level - LESS THAN 90%*

Purpose: To ensure the PRZR level has not exceeded 90% before continuing the RCS cooldown and depressurization

Basis: The PRZR is being allowed to fill with primary fluid displaced by the growing vessel void. However, the size of the void is being limited by only allowing the PRZR to fill to a maximum of 90% (starting at a level above the top of the heaters). This will ensure continued PRZR pressure control (refer to BASIS section of Step 9). If the PRZR level increases to greater than 90% during the depressurization the RCS is repressurized to enhance upper head cooling (refer to BASIS section of NOTE preceding Step 9) before any further depressurization can be performed.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 16 NOTE-1 **Unit 2 ERP Step:** 16 NOTE-1 ***ERG Step No:***

ERP StepText: After cooldown is stopped, RCS hot leg temperatures will fall due to reduction in heat transfer rate.

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Added Note similar to note provided prior to previous cooldown step. This information is applicable any time a cooldown sequence is directed.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: **Procedure**

Unit 1 ERP Step: 16 **Unit 2 ERP Step:** 16 ***ERG Step No:*** *15*

ERP StepText: Reduce RCS hot leg temperatures to 350°F.

ERG StepText: *Decrease RCS Hot Leg Temperatures To (F.06)°F*

Purpose: To continue the step-wise cooldown to RHR System entry conditions.

Basis: At 600 psig a decrease in primary temperature to (F.06)°F is within the RHR System entry condition temperature and the limiting Technical Specification cooldown curve (Figure 1). Here again it is important that the operator consider the NOTE preceding Step 5 so as not to violate the Technical Specification cooldown curve when stopping the cooldown at the specified temperature. The cooldown is still accomplished at the maximum rate of 100°F/hr, pressure is held constant at 600 psig, and inventory is added to make up for system shrink. As explained in Step 3, RCS temperature and pressure should be maintained within limits of the Technical Specification cooldown curve and the limits imposed by this guideline.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

2 Changed "100°F/Hr to "100°F in any 60 minute period". Ensures any initial cooldown is considered in the 100 degree/hr cooldown.

Section: Procedure

Unit 1 ERP Step: 17 **Unit 2 ERP Step:** 17 ***ERG Step No:***

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

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Changed to make plant specific.

2 Added guidance to ensure seal injection flow is maintained and to be consistent with similar previous step.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 18 **Unit 2 ERP Step:** 18 ***ERG Step No:*** *16*

ERP StepText: Establish RCS flow balance.

ERG StepText: *Equalize Charging And Letdown Flows*

Purpose: To balance primary inventory gains and losses

Basis: Conditions must be established so that any change in the PRZR level will occur solely due to void formation in the vessel. It is necessary to balance inventory gains and losses so that when void formation occurs letdown will not be increased to make up for increasing PRZR level. A strict control of inventory is needed so accurate tracking of void growth can be maintained. Careful attention must also be paid to maintaining the required RCP seal injection and return flows.

Knowledge: During subsequent RCS depressurization steps, charging flow should be maintained equal to letdown flow.

References:

Justification of Differences:

1 Changed to make plant specific.

2 Revised order of steps to establish seal injection prior to establishing a flow balance.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 19 NOTE-1 **Unit 2 ERP Step:** 19 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: DW-99-032

Justification of Differences:

1 Added Note to alert for pressurizer level changes and to be consistent with previous similar step. Presented as a Note (reference DW-99-032).

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 19 **Unit 2 ERP Step:** 19 ***ERG Step No:*** *17*

ERP StepText: Reduce RCS pressure.

ERG StepText: *Depressurize RCS*

Purpose: To continue RCS depressurization to RHR System entry conditions with void formation in the vessel expected

Basis: This decrease in system pressure to less than (B.01) psig is within the RHR System entry condition pressure and remains below the upper head saturation limit curve (Figure 1) so that void formation can be expected. Both RCS pressure and PRZR level are monitored. If the desired pressure is reached without overfilling the PRZR (i.e., PRZR level less than 90%), then the depressurization is terminated and the operator can continue with the cooldown. However, if the PRZR level increases above 90% during the depressurization, then further actions are taken as specified in the next step.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

Section: Procedure

Unit 1 ERP Step: 20 NOTE-1 **Unit 2 ERP Step:** 20 NOTE-1 ***ERG Step No:***

ERP StepText: To continue RCS pressure reduction, it may be necessary to cycle pressurizer level several times by raising and then lowering RCS pressure (in accordance with steps 19 and 20). This will enhance reactor vessel upper head cooling.

ERG StepText: *N/A Step Addition*

Purpose:

Basis:

Knowledge:

References:

Justification of Differences:

1 Added note to identify the potential need to perform the associated steps repeatedly and to be consistent with previous similar step.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 20 **Unit 2 ERP Step:** 20 ***ERG Step No:*** *18*

ERP StepText: Check pressurizer level - LESS THAN 90%.

ERG StepText: *Check PRZR Level - LESS THAN 90%*

Purpose: To ensure the PRZR level has not exceeded 90% before continuing the RCS cooldown and depressurization

Basis: The PRZR is being allowed to fill with primary fluid displaced by the growing vessel void. However, the size of the void is being limited by only allowing the PRZR to fill to a maximum of 90% (starting at a level above the top of the heaters). This will ensure continued PRZR pressure control (refer to BASIS section of Step 9). If the PRZR level increases to greater than 90% during the depressurization, the RCS is repressurized to enhance upper head cooling (refer to BASIS section of NOTE preceding Step 9) before any further depressurization can be performed.

Knowledge: N/A

References:

Justification of Differences:

1 Changed to make plant specific.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 21 **Unit 2 ERP Step:** 21 ***ERG Step No:*** *19*

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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 22 **Unit 2 ERP Step:** 22 ***ERG Step No:*** *20*

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 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 Change to make plant specific. Since cooldown subsequent to this step is expected to be done with RHR, this is explicitly stated.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: **Procedure**

Unit 1 ERP Step: 23 CAUTION-1 **Unit 2 ERP Step:** 23 CAUTION-1 ***ERG Step No:*** *21 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: DW-99-032

Justification of Differences:

1 Changed to make plant specific. Presented as a Note (reference DW-99-032).

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 23 **Unit 2 ERP Step:** 23 ***ERG Step No:*** *21*

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. 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 the void will influence heat transfer and subsequent cooldown. However, with CRDM fans on, the cooldown rate of the upper head 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-0.4Step21

Knowledge: 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 substep to provide user with an RCS pressure control band.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Procedure

Unit 1 ERP Step: 24 **Unit 2 ERP Step:** 24 ***ERG Step No:*** *22*

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 21 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. Any PRZR level increase, 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 repressurized 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, steam pressure, etc.)

References:

Justification of Differences:

1 Changed to make plant specific.

2 Per the background document, the method of determining entire RCS to be below 200°F is by upper head thermocouples, if available, and no steam generation in the SGs. Therefore, this guidance has been specified.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: Continuous 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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: FOLDOUT Page

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

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.

NATURAL CIRCULATION COOLDOWN WITH ALLOWANCE FOR REACTOR VESSEL HEAD STEAM VOIDING (WITHOUT RVLIS)

Plant Specific Background Information

Section: FOLDOUT Page

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

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.