October 25, 2005 TSTF-05-19

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUBJECT: TSTF-492, Revision 0, "Modify RHR - High Water Level Bases to Address Decay Heat Removal with Upper Internals Installed"

Dear Sir or Madam:

Enclosed for NRC review is Revision 0 of TSTF-492, "Modify RHR - High Water Level Bases to Address Decay Heat Removal with Upper Internals Installed." This Traveler modifies the Residual Heat Removal (RHR) Bases to provide additional information regarding decay heat removal with the reactor vessel upper internals installed.

Any NRC review fees associated with the review of TSTF-492, Revision 0 should be billed to the Westinghouse Owners Group.

Should you have any questions, please do not hesitate to contact us.

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Enclosure

cc: Thomas H. Boyce, Technical Specifications Section, NRC
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Technical Specification Task Force
Improved Standard Technical Specifications Change Traveler

Modify RHR - High Water Level Bases to Address Decay Heat Removal with Upper Internals Installed

NUREGs Affected: ☐ 1430 ☑ 1431 ☐ 1432 ☐ 1433 ☐ 1434

Classification: 2) Bases Only Change

Recommended for CLIIP?: No

Correction or Improvement: Correction

NRC Fee Status: Not Exempt

Benefit: Improves Bases

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See attached.

Revision History

OG Revision 0 Revision Status: Active

Revision Proposed by: Commanche Peak

Revision Description:
Original Issue

Owners Group Review Information

Date Originated by OG: 23-Jun-04

Owners Group Comments:
(No Comments)

Owners Group Resolution: Approved Date: 27-Jul-04

TSTF Review Information

TSTF Received Date: 15-Oct-04 Date Distributed for Review: 02-Nov-04

OG Review Completed: ☑ BWOG ☑ WOG ☑ CEOG ☑ BWROG

TSTF Comments:
(No Comments)

TSTF Resolution: Approved Date: 25-Oct-05

NRC Review Information

NRC Received Date: 25-Oct-05

OG Revision 0 **Revision Status: Active**

Affected Technical Specifications

LCO 3.9.5 Bases	RHR and Coolant Circulation - High Water Level

1.0 Description

The Bases of LCO 3.9.5, "RHR and Coolant Circulation - High Water level," are modified to address the condition of one OPERABLE RHR train and the upper internals installed in the reactor vessel. The Bases addition recognizes that additional requirements beyond those in the Specification may be required by the outage risk management program required by NUMARC 91-06.

2.0 Proposed Change

The Bases of LCO 3.9.5, "RHR and Coolant Circulation - High Water level," are modified. A clarification, a Reviewer's Note, and the following paragraph are added:

> The acceptability of the LCO and the LCO Note is based on preventing boiling in the core in the event of the loss of RHR cooling. It has been determined, however, that when the upper internals package is in place in the reactor vessel there may not be sufficient communication with the water above the core for adequate decay heat removal by natural convection to the water in the refueling cavity. As a result, boiling could occur in a relatively short period of time if a loss of RHR cooling occurs. As a compensatory measure, temporary administrative processes are implemented to reduce the risk of core boiling should a loss of RHR cooling occur. Maintaining the second train of RHR available or the availability of additional cooling equipment, including equipment not required to be OPERABLE (e.g. a centrifugal charging pump or a safety injection pump), contributes to this risk reduction. This strategy is consistent with NUMARC 91-06, "Guidelines for Industry Actions to Assess Shutdown Management," for management of shutdown tasks to maintain risk at an acceptably low level. This may require the availability of additional equipment beyond that required by the Technical Specifications which can be used to provide the required cooling. An outage risk assessment of these cooling methods is performed to assure that the desired level of minimal risk is maintained (frequently referred to as maintaining a desired defense in depth). The level of detail involved in the assessment will be commensurate with the equipment affected.

3.0 Background

During a self assessment at a Westinghouse NSSS plant, representatives noted a difference in outage execution between the plant being visited and the representative's plant. The plant being visited did not consider the cavity flooded (to enter the Applicability of Specification 3.9.5) until the reactor vessel upper internals had been removed. This prevents starting an electrical/RHR train outage until the upper internals have been removed. The explanation given by the plant was that this created a RED condition for Decay Heat Removal in the Outage Risk Assessment due to insufficient flow area for thermal communication between the core and the Refueling Cavity.

4.0 Technical Analysis

As described in the Applicable Safety Analyses Bases of Specification 3.9.5, boiling in the reactor core could lead to a loss of coolant in the reactor vessel. In addition, boiling could lead to boric acid plating out on components near the areas of the boiling activity if the boric acid solubility limit is reached. The loss of reactor coolant and the subsequent plate out of boric acid would eventually challenge the integrity of the fuel cladding, which is a fission product barrier.

With the upper internals package out of the reactor vessel, there are sufficient thermal communication flow paths such that there will be no significant bulk boiling in the core until the bulk fluid in the refueling cavity approaches saturation. The large mass of water in the refueling cavity (> 23 ft of water above the reactor vessel flange) serves as a passive backup source of heat removal should a loss of RHR cooling occur; however, the effectiveness of this heat removal capability is limited to the time that the refueling cavity remains subcooled. In the event of a loss of RHR cooling, adequate time is provided to initiate emergency procedures to cool the core before boiling occurs.

If the upper internals are installed, however, there may not be sufficient flow area between the reactor vessel and refueling cavity to establish sufficient thermal communication to preclude bulk boiling in the core. An assessment was performed which demonstrated that there is adequate flow area (through the upper head spray nozzles) to provide sufficient decay heat removal capability and preclude core uncovery, thus preventing core damage, in the event of a loss of RHR cooling with the reactor cavity filled and the upper internals installed in the reactor vessel.

An assessment was also performed to determine if a charging pump could be used to provide makeup for decay heat removal when the refueling cavity is filled and the upper internals are in place. The assessment demonstrated that the charging pump provides sufficient makeup for decay heat removal should a loss of RHR cooling occur. The limiting factor in this assessment was the maximum design RWST temperature of [120] °F, which effectively limits the allowable heatup of the refueling cavity fluid to [120] °F.

5.0 Regulatory Analysis

5.1 No Significant Hazards Consideration

A No Significant Hazards Consideration determination is not required for a Bases change.

5.2 Applicable Regulatory Requirements/Criteria

The proposed change clarifies the Bases to ensure that Specified Acceptable Fuel Design Limits will be met during shutdown. This ensures that the applicable regulatory requirements are met.

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission’s regulations, and (3) the approval of the proposed change will not be inimical to the common defense and security or to the health and safety of the public.

6.0 Environmental Consideration

An Environmental Consideration is not required for a Bases change.

7.0 References

None.

B 3.9 REFUELING OPERATIONS

B 3.9.5 Residual Heat Removal (RHR) and Coolant Circulation - High Water Level

BASES

BACKGROUND

The purpose of the RHR System in MODE 6 is to remove decay heat and sensible heat from the Reactor Coolant System (RCS), as required by GDC 34, to provide mixing of borated coolant and to prevent boron stratification (Ref. 1). Heat is removed from the RCS by circulating reactor coolant through the RHR heat exchanger(s), where the heat is transferred to the Component Cooling Water System. The coolant is then returned to the RCS via the RCS cold leg(s). Operation of the RHR System for normal cooldown or decay heat removal is manually accomplished from the control room. The heat removal rate is adjusted by controlling the flow of reactor coolant through the RHR heat exchanger(s) and the bypass. Mixing of the reactor coolant is maintained by this continuous circulation of reactor coolant through the RHR System.

APPLICABLE SAFETY ANALYSES

If the reactor coolant temperature is not maintained below 200°F, boiling of the reactor coolant could result. This could lead to a loss of coolant in the reactor vessel. Additionally, boiling of the reactor coolant could lead to a reduction in boron concentration in the coolant due to ~~boron~~ boric acid plating out on components near the areas of the boiling activity if the boric acid solubility limit is reached. The loss of reactor coolant and the reduction of boron concentration in the reactor coolant would eventually challenge the integrity of the fuel cladding, which is a fission product barrier. One train of the RHR System is required to be operational in MODE 6, with the water level ≥ 23 ft above the top of the reactor vessel flange, to prevent this challenge. The LCO does permit the RHR pump to be removed from operation for short durations, under the condition that the boron concentration is not diluted. This conditional stopping of the RHR pump does not result in a challenge to the fission product barrier.

The RHR System satisfies Criterion 4 of 10 CFR 50.36(c)(2)(ii).

LCO

Only one RHR loop is required for decay heat removal in MODE 6, with the water level ≥ 23 ft above the top of the reactor vessel flange. Only one RHR loop is required to be OPERABLE, because the volume of water above the reactor vessel flange provides backup decay heat removal capability. At least one RHR loop must be OPERABLE and in operation to provide:

a. Removal of decay heat,

BASES

LCO (continued)

b. Mixing of borated coolant to minimize the possibility of criticality, and

c. Indication of reactor coolant temperature.

An OPERABLE RHR loop includes an RHR pump, a heat exchanger, valves, piping, instruments, and controls to ensure an OPERABLE flow path and to determine the low end temperature. The flow path starts in one of the RCS hot legs and is returned to the RCS cold legs.

The LCO is modified by a Note that allows the required operating RHR loop to be removed from operation for up to 1 hour per 8 hour period, provided no operations are permitted that would dilute the RCS boron concentration by introduction of coolant into the RCS with boron concentration less than required to meet the minimum boron concentration of LCO 3.9.1. Boron concentration reduction with coolant at boron concentrations less than required to assure the RCS boron concentration is maintained is prohibited because uniform concentration distribution cannot be ensured without forced circulation. This permits operations such as core mapping or alterations in the vicinity of the reactor vessel hot leg nozzles and RCS to RHR isolation valve testing. During this 1 hour period, decay heat is removed by natural convection to the large mass of water in the refueling cavity.

[------------------------------ REVIEWER'S NOTE --------------------------------

The following Bases may apply depending on the plant design and plant-specific analyses.

The acceptability of the LCO and the LCO Note is based on preventing boiling in the core in the event of the loss of RHR cooling. It has been determined, however, that when the upper internals package is in place in the reactor vessel there may not be sufficient communication with the water above the core for adequate decay heat removal by natural convection to the water in the refueling cavity. As a result, boiling could occur in a relatively short period of time if a loss of RHR cooling occurs. As a compensatory measure, temporary administrative processes are implemented to reduce the risk of core boiling should a loss of RHR cooling occur. Maintaining the second train of RHR available or the availability of additional cooling equipment, including equipment not required to be OPERABLE (e.g. a centrifugal charging pump or a safety injection pump), contributes to this risk reduction. This strategy is consistent with NUMARC 91-06, "Guidelines for Industry Actions to Assess Shutdown Management," for management of shutdown tasks to maintain risk at an acceptably low level. This may require the availability of additional equipment beyond that required by the Technical

Specifications which can be used to provide the required cooling. An outage risk assessment of these cooling methods is performed to assure that the desired level of minimal risk is maintained (frequently referred to as maintaining a desired defense in depth). The level of detail involved in the assessment will be commensurate with the equipment affected.]

BASES

APPLICABILITY

One RHR loop must be OPERABLE and in operation in MODE 6, with the water level ≥ 23 ft above the top of the reactor vessel flange, to provide decay heat removal. The 23 ft water level was selected because it corresponds to the 23 ft requirement established for fuel movement in LCO 3.9.7, "Refueling Cavity Water Level." Requirements for the RHR System in other MODES are covered by LCOs in Section 3.4, Reactor Coolant System (RCS), and Section 3.5, Emergency Core Cooling Systems (ECCS). RHR loop requirements in MODE 6 with the water level < 23 ft are located in LCO 3.9.6, "Residual Heat Removal (RHR) and Coolant Circulation - Low Water Level."

ACTIONS

RHR loop requirements are met by having one RHR loop OPERABLE and in operation, except as permitted in the Note to the LCO.

A.1

If RHR loop requirements are not met, there will be no forced circulation to provide mixing to establish uniform boron concentrations. Suspending positive reactivity additions that could result in failure to meet the minimum boron concentration limit is required to assure continued safe operation. Introduction of coolant inventory must be from sources that have a boron concentration greater than that what would be required in the RCS for minimum refueling boron concentration. This may result in an overall reduction in RCS boron concentration, but provides acceptable margin to maintaining subcritical operation.

A.2

If RHR loop requirements are not met, actions shall be taken immediately to suspend loading of irradiated fuel assemblies in the core. With no forced circulation cooling, decay heat removal from the core occurs by natural convection to the heat sink provided by the water above the core. A minimum refueling water level of 23 ft above the reactor vessel flange provides an adequate available heat sink. Suspending any operation that would increase decay heat load, such as loading a fuel assembly, is a prudent action under this condition.

A.3

If RHR loop requirements are not met, actions shall be initiated and continued in order to satisfy RHR loop requirements. With the unit in MODE 6 and the refueling water level ≥ 23 ft above the top of the reactor vessel flange, corrective actions shall be initiated immediately.

BASES

ACTIONS (continued)

A.4, A.5, A.6.1, and A.6.2

If no RHR is in operation, the following actions must be taken:

a. The equipment hatch must be closed and secured with [four] bolts,

b. One door in each air lock must be closed, and

c. Each penetration providing direct access from the containment atmosphere to the outside atmosphere must be either closed by a manual or automatic isolation valve, blind flange, or equivalent, or verified to be capable of being closed by an OPERABLE Containment Purge and Exhaust Isolation System.

With RHR loop requirements not met, the potential exists for the coolant to boil and release radioactive gas to the containment atmosphere. Performing the actions described above ensures that all containment penetrations are either closed or can be closed so that the dose limits are not exceeded.

The Completion Time of 4 hours allows fixing of most RHR problems and is reasonable, based on the low probability of the coolant boiling in that time.

SURVEILLANCE REQUIREMENTS

SR 3.9.5.1

This Surveillance demonstrates that the RHR loop is in operation and circulating reactor coolant. The flow rate is determined by the flow rate necessary to provide sufficient decay heat removal capability and to prevent thermal and boron stratification in the core. The Frequency of 12 hours is sufficient, considering the flow, temperature, pump control, and alarm indications available to the operator in the control room for monitoring the RHR System.

REFERENCES

1. FSAR, Section [5.5.7].