

B 3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

B 3.5.4 Refueling Water Storage Tank (RWST)

BASES

- BACKGROUND** The RWST supplies borated water to the Chemical and Volume Control System (CVCS) during abnormal operating conditions, to the refueling pool during refueling and makeup operations, and to the ECCS during accident conditions.
- The RWST supplies both trains of the ECCS through separate supply headers during the injection phase of a loss of coolant accident (LOCA) recovery. A motor operated isolation valve is provided in each header to isolate the RWST once the system has been transferred to the recirculation mode. The recirculation mode is entered when pump suction is transferred to the containment sump following receipt of the RWST—Low Level signal. Use of a single RWST to supply both trains of the ECCS is acceptable since the RWST is a passive component, and since injection phase passive failures are not required to be assumed to occur coincidentally with Design Basis Events.
- The switchover from normal operation to the injection phase of ECCS operation requires changing centrifugal charging pump suction from the CVCS volume control tank (VCT) to the RWST through the use of isolation valves.
- During normal operation in MODES 1, 2, and 3, the safety injection (SI) and residual heat removal (RHR) pumps are aligned to take suction from the RWST.
- The ECCS pumps are provided with recirculation lines that ensure each pump can maintain minimum flow requirements when operating at or near shutoff head conditions.
- When the suction for the ECCS pumps is transferred to the containment sump, the RWST flow paths must be isolated to prevent a release of the containment sump contents to the RWST, which could result in a release of contaminants to the atmosphere and the eventual loss of suction head for the ECCS pumps.
- This LCO ensures that:
- a. The RWST contains sufficient borated water to support the ECCS during the injection phase;

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BACKGROUND (continued)

- b. Sufficient water volume exists in the containment sump to support continued operation of the ECCS and Containment Spray System pumps at the time of transfer to the recirculation mode of cooling; and
- c. The reactor remains subcritical following a LOCA.

Insufficient water in the RWST could result in insufficient cooling capacity when the transfer to the recirculation mode occurs. Improper boron concentrations could result in a reduction of SDM or excessive boric acid precipitation in the core following the LOCA, as well as excessive caustic stress corrosion of mechanical components and systems inside the containment.

APPLICABLE
SAFETY ANALYSES

During accident conditions, the RWST provides a source of borated water to the ECCS pumps. As such, it provides core cooling and replacement inventory and is a source of negative reactivity for reactor shutdown (Ref. 1). The design basis transients and applicable safety analyses concerning each of these systems are discussed in the Applicable Safety Analyses section of B 3.5.2, "ECCS—Operating"; B 3.5.3, "ECCS—Shutdown". These analyses are used to assess changes to the RWST in order to evaluate their effects in relation to the acceptance limits in the analyses.

The RWST must also meet volume, boron concentration, and temperature requirements for non-LOCA events. The volume is not an explicit assumption in non-LOCA events since the required volume is a small fraction of the available volume. The deliverable volume limit is set by the LOCA and containment analyses. For the RWST, the deliverable volume is different from the total volume contained due to the location of the piping connection. The ECCS water boron concentration is an explicit assumption in the main steam line break (MSLB) analysis to ensure the required shutdown capability. This assumption is important in ensuring the required shutdown capability. Although the maximum temperature is a conservative assumption in the feedwater line break analysis, SI termination occurs very quickly in this analysis and long before significant RCS heatup occurs. The minimum temperature is an assumption in the MSLB actuation analyses.

For a large break LOCA analysis, the RWST level setpoint equivalent to the minimum water volume limit of 383,146 gallons and the lower boron concentration limits listed in the COLR are used to compute the post

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APPLICABLE SAFETY ANALYSES (continued)

LOCA sump boron concentration necessary to assure subcriticality, with all rods in (crediting control rod assembly insertion), minus the highest worth rod out (ARI N-1). The large cold leg break LOCA is the limiting case since boron accumulation in the core will be maximized during the cold leg recirculation phase due to core boiling. The accumulation of boron in the core prevents the boron from returning to the sump, which leads to a boron diluted sump condition. A reduction in the RWST minimum boron concentration would produce a subsequent reduction in the available containment sump concentration for post LOCA shutdown, potentially causing the core to become re-critical by injecting boron diluted sump water into the core when switching over to hot leg recirculation.

The RWST minimum boron concentration is also used in the post-LOCA subcriticality verification during the injection phase. For each reload cycle, the all rods out (ARO, no credit for control rod assembly insertion) critical boron concentration is verified to be less than the minimum allowed RWST boron concentration. No credit is taken for control rod assembly insertion when verifying subcriticality during the injection phase, but credit is taken for control rod assembly insertion in the post-LOCA subcriticality calculation during the sump recirculation phase to offset the boron diluted sump condition described above.

The upper limit on boron concentration as listed in the COLR is used to determine the maximum allowable time to switch to hot leg recirculation following a LOCA. The purpose of switching from cold leg to hot leg injection is to avoid boron precipitation in the core following the accident.

The RWST temperature limits were originally established with containment spray aligned to the RWST and were not revised when the Containment Spray System became a manually actuated system with the initial suction source changed to the Containment Sump. The RWST temperature limits are contained within additional analyses and remain valid, although the basis is historical and no longer relevant. The following paragraph is retained for historical purposes only.

In the ECCS analysis, the containment spray temperature is assumed to be equal to the RWST lower temperature limit of 70°F. If the lower temperature limit was violated, the containment spray could further reduce containment pressure, which decreases the saturated steam specific volume. This means that each pound of steam generated during core reflood tends to occupy a larger volume, which decreases the rate at which steam can be vented out the break and increases peak clad temperature. The upper temperature limit of 100°F, plus an allowance for temperature measurement uncertainty, is used in the containment

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APPLICABLE SAFETY ANALYSES (continued)

OPERABILITY analysis. Exceeding this temperature will result in higher containment pressures due to reduced containment spray cooling capacity. For the containment response following an MSLB, the lower limit on boron concentration and the upper limit on RWST water temperature are used to maximize the total energy release to containment.

The RWST satisfies Criterion 3 of 10 CFR 50.36 (Ref. 2).

LCO

The RWST ensures that an adequate supply of borated water is available to cool and cover the core in the event of a LOCA, to maintain the reactor subcritical following a DBA, and to ensure adequate level in the containment sump to support ECCS and Containment Spray System pump operation in the recirculation mode.

To be considered OPERABLE, the RWST must meet the water volume, boron concentration, and temperature limits established in the SRs.

APPLICABILITY

In MODES 1, 2, 3, and 4, RWST OPERABILITY requirements are dictated by ECCS OPERABILITY requirements. Since both the ECCS must be OPERABLE in MODES 1, 2, 3, and 4, the RWST must also be OPERABLE to support their operation. Core cooling requirements in MODE 5 are addressed by LCO 3.4.7, "RCS Loops—MODE 5, Loops Filled," and LCO 3.4.8, "RCS Loops—MODE 5, Loops Not Filled." MODE 6 core cooling requirements are addressed by LCO 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation—High Water Level," and LCO 3.9.6, "Residual Heat Removal (RHR) and Coolant Circulation—Low Water Level."

ACTIONS

A.1

With RWST boron concentration or borated water temperature not within limits, they must be returned to within limits within 8 hours. Under these conditions neither the ECCS nor the Containment Spray System can perform its design function. Therefore, prompt action must be taken to restore the tank to OPERABLE condition. The 8 hour limit to restore the RWST temperature or boron concentration to within limits was developed considering the time required to change either the boron concentration or temperature and the fact that the contents of the tank are still available for injection.

B.1

With the RWST inoperable for reasons other than Condition A (e.g., water volume), it must be restored to OPERABLE status within 1 hour.

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ACTIONS (continued)

In this Condition, the ECCS cannot perform its design function. Therefore, prompt action must be taken to restore the tank to OPERABLE status or to place the plant in a MODE in which the RWST is not required. The short time limit of 1 hour to restore the RWST to OPERABLE status is based on this condition simultaneously affecting redundant trains.

C.1 and C.2

If the RWST cannot be returned to OPERABLE status within the associated Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE
REQUIREMENTSSR 3.5.4.1

The RWST borated water temperature should be verified to be within the limits assumed in the accident analyses band. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

SR 3.5.4.2

The RWST water volume should be verified to be above the required minimum level plus instrument uncertainty in order to ensure that a sufficient initial supply is available for injection and to support continued ECCS and Containment Spray System pump operation on recirculation. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

SR 3.5.4.3

The boron concentration of the RWST should be verified to be within the required limits. This SR ensures that the reactor will remain subcritical following a LOCA and that the boron content assumed for the injection water in the MSLB analysis is available. Further, it assures that the resulting sump pH will be maintained in an acceptable range so that boron precipitation in the core will not occur and the effect of chloride and caustic stress corrosion on mechanical systems and components will be minimized. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

BASES

- REFERENCES
1. UFSAR, Chapter 6 and Chapter 15.
 2. 10 CFR 50.36, Technical Specifications, (c)(2)(ii).