



Westinghouse Non-Proprietary Class 3

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PWROG
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PWROG-NRC Meeting to Discuss Technical Specification
3.5.3, “ECCS- Shutdown” in NUREG-1431
November 2, 2023



Purpose of the Meeting

- To discuss the applicability of the 10 CFR 50.36(c)(2)(ii) Criteria to Technical Specification 3.5.3 "ECCS- Shutdown"
- Obtain NRC feedback regarding the justification that Technical Specification 3.5.3 does not satisfy any of the Criteria of 10 CFR 50.36(c)(2)(ii) and can be relocated out of the Technical Specifications to a licensee-controlled document



Outline

- Timeline for the Mode 4 ECCS Technical Specification
- History: WCAP-12476, "Evaluation of LOCA During Mode 3 and 4 Operation for Westinghouse NSSS"
- Shutdown Risk and Operation Program
- LOCA DBA Analysis Regulatory Requirements
- TS 3.5.2, "ECCS - Operating," and TS 3.5.3, "ECCS - Shutdown" in NUREG-1431
- Applicability of the 10 CFR 50.36 Criteria to TS 3.5.3, "ECCS- Shutdown"
- Summary and Conclusions
- Open Discussion



Timeline for the Mode 4 ECCS Technical Specification

1973: Custom TS with ECCS requirements for Criticality and Power Operation only

1992: NUREG-1431, Rev. 0, TS 3.5.3 only requires one ECCS train in Mode 4

1976: NUREG-0452, Rev. 0, TS 3.5.3 only requires one ECCS train in Mode 4

1995: 10 CFR 50.36(c)(2)(ii) codified



History

- WCAP-12476, Rev. 0, "Evaluation of LOCA During Mode 3 and 4 Operation for Westinghouse NSSS," was submitted to the NRC for review and approval on November 27, 1991 (letter OG-91-61)
- WCAP-12476, Rev. 0, was withdrawn from NRC on April 28, 1999
 - The basis for the withdrawal was that in late 1997, the shutdown and low power issue was subsumed by proposed changes to 10 CFR 50.65, the Maintenance Rule (MR), which would require licensees to assess the impact on safety functions prior to removing equipment from service, and that the MR would apply to shutdown conditions
 - The letter discussed that a generic abnormal response guideline (ARG-2, "Shutdown LOCA") based on WCAP-12476 was developed to respond to a LOCA in Modes 3 and 4
 - ARG-2 and the analysis basis for it was not reviewed and approved by the NRC consistent with the Westinghouse Emergency Response Guideline analytical bases



History (continued)

- An NRC letter (ML003726027) to the WOG (now the PWROG) dated June 23, 2000, stated (emphasis added):
 - "...NRC review of WCAP-12476, "Evaluation of LOCA During Mode 3 and Mode 4 For Westinghouse NSSS," is not necessary because implementation of the issues discussed in the WCAP related to shutdown risk and shutdown operations, **including loss of coolant in Modes 3 and 4, are being addressed by licensees through voluntary programs.** It is the staff's position ... that NRC oversight of licensee performance in the area of shutdown operations will be through the oversight (inspection) process. Accordingly, any issues that arise as a result of NRC oversight of shutdown operations will be addressed through the means provided by the oversight process."



Voluntary Industry Activities

- Shutdown Risk and Operation Programs in accordance with NEI 91-06, "Guidelines for Industry Actions to Assess Shutdown Management," maintain key safety functions during shutdown conditions, including inventory control to address events involving a decrease in RCS inventory and decay heat removal
- 10CFR50.65(a)(4), the Maintenance Rule implementation activities in accordance with NUMARC 93-01, "Industry Guidance for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," assess and control the risk associated with out-of-service SSCs during shutdown conditions
- Generic ARG-2 "Shutdown LOCA" was implemented to address actions to mitigate a loss of coolant in Modes 3 and 4



LOCA DBA Analysis Regulatory Requirements

- 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," states (emphasis added):
 - "(a)(1)(i) Each boiling or pressurized light-water nuclear power reactor must be provided with an emergency core cooling system (ECCS) that must be designed so that its calculated cooling performance following postulated loss-of-coolant accidents conforms to the criteria set forth in paragraph (b) of this section. ECCS cooling performance must be calculated in accordance with an acceptable evaluation model and must be calculated for a number of postulated loss-of-coolant accidents of different sizes, locations, and other properties sufficient to provide assurance that the **most severe postulated loss-of-coolant accidents** are calculated..."
- Note that the regulation does not require all Modes to be analyzed



LOCA DBA Analysis Regulatory Requirements (continued)

- Appendix K to Part 50—ECCS Evaluation Models, states:
 - “I. Required and Acceptable Features of the Evaluation Models
 - A. Sources of heat during the LOCA. For the heat sources listed in paragraphs I.A.1 to 4 of this appendix it must be assumed that the reactor has been operating continuously at a power level at least 1.02 times the licensed power level (to allow for instrumentation error), with the maximum peaking factor allowed by the technical specifications...”
- Operation in Mode 4 when the reactor is subcritical is inconsistent with these regulatory requirements
- Appendix K only requires a LOCA analysis to be performed at 102% of the licensed power level (Mode 1) and does not require any analysis to be performed in any lower Modes of operation, i.e., Mode 4

LOCA DBA Analyses Conditions

- In Modes 1, 2, and 3, two ECCS trains are assumed:
 - Automatic actuation of all active components for the injection mode
 - Automatic SI is blocked at the lower end of Mode 3 to allow RCS cooldown/depressurization
 - The passive SI accumulators are aligned to inject
 - Accumulators are isolated at the lower end of Mode 3 to allow RCS cooldown/depressurization
 - Two trains are Operable to accommodate a single active failure
- In Mode 4, one ECCS train is required by TS 3.5.3
 - The passive SI accumulators are isolated during cooldown and are not available to inject
 - Automatic actuation signals are blocked during cooldown and manual actuation is acceptable for Operability
 - One ECCS train is required to be Operable therefore, the single failure criterion does not apply
- The LOCA DBA analyses are performed for the plant configuration in Modes 1–3 at the limiting condition of full (102%) power in Mode 1; no analyses are performed for the Mode 4 configuration



NUREG-1431 (Westinghouse STS) Summary

- TS 3.5.2 ensures that the assumptions for the availability of the ECCS to mitigate a LOCA DBA are met consistent with the regulations
- TS 3.5.3 is not associated with any DBA analyses, because there is no regulatory requirement to perform a Mode 4 DBA LOCA analysis that assumes the ECCS to mitigate it



NUREG-1431 (Westinghouse STS) Tech Spec 3.5.3 “ECCS-Shutdown” Bases

- The Applicable Safety Analyses Section of the Bases states:
 - “The Applicable Safety Analyses section of Bases 3.5.2 also applies to this Bases section.”
 - “The ECCS trains satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).”
- These statements are not correct:
 - The DBA LOCA safety analyses referenced for TS 3.5.2 in Modes 1, 2, 3 assume different configurations for the two Operable ECCS trains compared to the TS 3.5.3 requirements
 - There are no DBA analyses for a Mode 4 LOCA that are required by the regulations
 - The configuration of the ECCS required by TS 3.5.3 in Mode 4 is not assumed in any DBA safety analysis



10 CFR 50.36 Technical Specifications

- 10 CFR 50.36(b) states:
 - “The technical specifications will be derived from the analyses and evaluation included in the safety analysis report, and amendments thereto, submitted pursuant to § 50.34.”
- Typically, there is no Mode 4 LOCA analysis or evaluation included in the safety analysis report



Application of the 10 CFR 50.36 Criteria to TS 3.5.3

- “(A) Criterion 1. Installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary.”
 - TS 3.5.3 does not satisfy Criterion 1 because it is not instrumentation associated with the degradation of the reactor coolant pressure boundary
- “(B) Criterion 2. A process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.”
 - TS 3.5.3 does not satisfy Criterion 2 because it is not an initial condition assumed in any DBA or transient analysis



Application of the 10 CFR 50.36 Criteria to TS 3.5.3

- “(C) Criterion 3. A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.”
 - TS 3.5.3 does not satisfy Criterion 3 because there is no DBA analysis crediting one ECCS train in Mode 4 as a primary success path
- “(D) Criterion 4. A structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety.”
 - Technical Specification 3.5.3 does not satisfy Criterion 4
 - The NRC extensively evaluated shutdown conditions including a Mode 4 LOCA in the late 1990s and concluded that no regulatory action was required; this evaluation is assumed to have considered operating experience and risk insights
 - There is no operating experience of a loss of coolant inventory occurring in Mode 4, and shutdown PRA insights typically show that the loss of decay heat removal during reduced inventory operations is the dominant event during shutdown conditions



Summary and Conclusions

- There is no regulation requiring the analysis of a DBA LOCA in Mode 4, which is consistent with the NRC position stated in its June 23, 2000 letter regarding **voluntary** licensee actions
- Licensees address a Mode 4 loss of inventory and decay heat removal events with voluntary programs consistent with the June 23, 2000, NRC letter by the implementation of a Shutdown Risk and Operation Program (per NUMARC 91-06), that meets the applicable requirements in 10CFR50.65(a)(4) (per NUMARC 93-01), and implementation of ARG-2 to respond to the event in plant procedures
 - This ensures protection of the health and safety of the public
- One Operable ECCS train in Mode 4 does not satisfy any of the Criteria of 10 CFR 50.36(c)(2)(ii) and therefore should not be included in the Technical Specifications