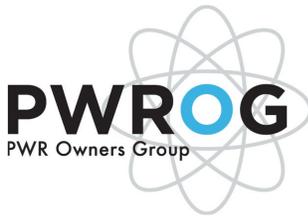


Pressurized Water Reactor Owners Group  
letter, OG-22-187, Subject: "PWR Owners Group  
Mode 4 LOCA Analysis for Westinghouse NSSS  
Plants"

9 pages follow this cover sheet



Program Management Office  
1000 Westinghouse Drive, Suite 172  
Cranberry Township, Pennsylvania 16066

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October 27, 2022

OG-22-187

Mr. Fadi Diya  
Senior Vice President and Chief Nuclear Officer  
Ameren Missouri  
Callaway Energy Center  
8315 County Road 459  
Steedman, MO 65077

Subject: PWR Owners Group  
**Mode 4 LOCA Analysis for Westinghouse NSSS Plants**

References: 1. NRC letter from Ami N. Agrawal (NRC) to Fadi Diya (Ameren Missouri),  
“Callaway Plant- Biennial Problem Identification and Resolution Inspection Report  
05000483/2022010,” October 12, 2022

Callaway received a Non-Cited Violation, NCV 05000483/2022010-03, “Failure to Perform Required Inservice Testing of Residual Heat Removal Heat Exchanger Pneumatically (Air) Operated Outlet and Bypass Valves,” in Reference 1, due to classifying the subject valves as “passive.” The “passive,” valve classification was made by Ameren, in part, because there is no Mode 4 LOCA analysis of record for Callaway.

The Attachment to this letter discusses the background regarding a Mode 4 LOCA analysis for Westinghouse NSSS plants.

If you have any questions, please do not hesitate to contact me at (602) 999-2080 or Mr. Dewey Olinski PE, Executive Director of the PWR Owners Group, Program Management Office at (412) 374-3025.

Sincerely yours,

Michael Powell  
Chief Operating Officer & Chairman  
Pressurized Water Reactor Owners Group

Attachment 1: Mode 4 LOCA Analysis for Westinghouse NSSS Plants, Westinghouse Non-Proprietary Class 3

cc: PWROG Management Committee  
PWROG Steering Committee  
PWROG Analysis Committee  
PWROG Licensing Committee  
PWROG PMO

Attachment to OG-22-187

Mode 4 LOCA Analysis for Westinghouse NSSS Plants

## **Introduction**

Callaway received a Non-Cited Violation, NCV 05000483/2022010-03, “Failure to Perform Required Inservice Testing of Residual Heat Removal Heat Exchanger Pneumatically (Air Operated Outlet and Bypass Valves,” due to classifying the subject valves as “passive.” The “passive,” valve classification was determined, in part, because there is no Mode 4 LOCA analysis of record (AOR) that assumes that these valves need to reposition. The LOCA AOR assumes that the plant is operating in Mode 1 (full power), as required by regulations. There is no Mode 4 LOCA AOR for Callaway because the regulations do not require this analysis.

This document discusses the background regarding a Mode 4 LOCA analysis for Westinghouse NSSS plants.

## **Regulatory Requirements**

The regulations do not require the analysis of a LOCA in any plant condition other than Mode 1 at full power. The relevant documents and regulations are discussed below.

### **WCAP-12476, Rev. 0, “Evaluation of LOCA During Mode 3 and 4 Operation for Westinghouse NSSS”**

WCAP-12476, Rev. 0 was submitted to the NRC for review and approval via WOG (now PWROG) letter OG-91-61, dated November 27, 1991 (Reference 2).

Letter OG-95-069, dated August 25, 1995 (Reference 3), referenced a conference call with the Staff that was held on August 16, 1995, stating that the Staff planned to address the WCAP as part of the ongoing overall shutdown risk review program. The letter also discussed that the WOG was informed verbally by the Staff that preliminary findings from that program determined that Mode 3 and 4 LOCAs were not significant to shutdown risk. The letter further discussed that generic procedural response guidelines that contained operator actions to respond to these postulated events. The letter concluded that the review of Mode 3 and 4 LOCAs should be included in the NRC’s shutdown risk program and that the review of the WCAP should not be completed until after the completion of that program.

Letter OG-99-039, dated April 28, 1999 (Reference 4), withdrew the WCAP from NRC review. The letter discussed that in late 1997, the shutdown and low power issue was subsumed by proposed changes to 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, was prepared to respond to a LOCA in Mode 3 and 4 based on the WCAP. The letter also discussed that a formal review of the WCAP was not required, and asked the NRC to confirm this.

In an NRC letter dated December 28, 1999 (Reference 5), the NRC discussed that they could not concur that the WCAP could be used as the basis to develop plant specific abnormal operating procedures and used to support various engineering evaluations related to shutdown operations

because the WCAP was not reviewed by the staff, and therefore no staff position was made regarding any conclusions in the WCAP.

An NRC letter dated June 23, 2000 (Reference 6), stated:

“...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, consistent with the direction provided by the Commission in Staff Requirements Memorandum, "Staff Requirements - SECY-97-168 - Issuance for Public Comment of Proposed Rulemaking Package for Shutdown and Fuel Storage Pool Operation," dated December 11, 1997, 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.”

Therefore, based on the WOG-NRC correspondence discussed above, and because WCAP-12476, Rev. 0 was not reviewed and approved by the NRC, it should not be incorporated in the licensing basis as a Mode 4 LOCA Chapter 15 AOR. Further, as stated by the Staff, Mode 3 and 4 LOCA are addressed through voluntary programs, (i.e., not by any regulations.)

*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 requirements; therefore, Appendix K only requires the LOCA analysis to be performed at 102% of licensed power level, i.e., Mode 1, and does not require any analysis to be performed in any lower Modes of operation, i.e., Mode 4.

**NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” Rev. 3**

Section 15.6.5, “Loss-of-Coolant Accidents Resulting From Spectrum of Postulated Piping Breaks Within the Reactor Coolant Pressure Boundary,” states:

“III REVIEW PROCEDURES

*For the review of the ECCS performance analysis, as presented in the applicant's SAR, the reviewer verifies the following:*

5. *The parameters and assumptions used for the calculations were conservatively chosen, including the following points:*

A. *The initial power level is taken as the licensed core thermal power for the number of loops initially assumed to be operating plus an allowance of 2% to account for power measurement uncertainties, unless a lower level of uncertainty can be justified by the applicant. The number of loops operating at the initiation of the event should correspond to the operating condition which maximizes the consequences of the event.”*

Operation in Mode 4 when the reactor is subcritical is inconsistent with these requirements; therefore, the Standard Review Plan (SRP) only requires the LOCA analysis to be performed at 102% of the licensed power level, i.e., Mode 1, and does not require an analysis to be performed in any lower Modes of operation, i.e., Mode 4. Additionally, the Safety Injection on Containment Pressure- High 1 and Pressurizer Pressure- Low ESFAS Functions, and Accumulators, which are assumed to function in the LOCA analysis that is performed at 102% of the licensed power level are not available in Mode 4.

*Appendix A to Part 50—General Design Criteria for Nuclear Power Plants, Criterion 35- Emergency core cooling., states:*

“A system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts.

Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.”

GDC 35 requires that a single failure of the ECCS to be assumed. Technical Specification (TS) 3.5.2, “ECCS- Operating,” in NUREG-1431, Rev. 5 (Reference 1), requires two ECCS trains to be operable, which addresses the single failure requirement of GDC 35. TS 3.5.3, “ECCS- Shutdown,” in NUREG-1431, Rev. 5 only requires one train of ECCS to be operable, and a single failure of the ECCS is not required to be assumed in Mode 4.

Therefore GDC 35 is not applicable to the ECCS requirements in Mode 4.

### **The Bases for TS 3.5.2, “ECCS-Operating,” in NUREG-1431, Rev. 5**

The Applicable Safety Analyses Section of the Bases states:

*“Each ECCS subsystem is taken credit for in a large break LOCA event at full power (Refs. 3 and 4).”*

Reference 4 refers to “FSAR, Chapter [15], Accident Analysis” in the Reference Section of the Bases.

These Bases discussions refer to the Chapter 15 LOCA analysis that is performed at 100% power, i.e., in Mode 1.

The LCO Sections of the Bases states:

*“In MODES 1, 2, and 3, two independent (and redundant) ECCS trains are required to ensure that sufficient ECCS flow is available, assuming a single failure affecting either train.”*

This Bases discussion complies with 10 CFR 50, Appendix A, GDC 35, which is Reference 1 in the Reference Section of the Bases.

### **The Bases for TS 3.5.3, “ECCS-Shutdown,” in NUREG-1431, Rev. 5**

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.”*

As discussed in the discussion above regarding the Bases for TS 3.5.2, the safety analysis discussed in the Bases for TS 3.5.2 is the Chapter 15 LOCA analysis performed at 100%, i.e., in Mode 1, which is not applicable to Mode 4.

The Applicable Safety Analyses Section of the Bases also states:

*“Due to the stable conditions associated with operation in MODE 4 and the reduced probability of occurrence of a Design Basis Accident (DBA), the ECCS operational requirements are reduced. It is understood in these reductions that certain automatic safety injection (SI) actuation is not available. In this MODE, sufficient time exists for manual actuation of the required ECCS to mitigate the consequences of a DBA.*

*Only one train of ECCS is required for MODE 4. This requirement dictates that single failures are not considered during this MODE of operation. The ECCS trains satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).”*

There is no Mode 4 DBA that credits an ECCS train as discussed above, i.e., a LOCA analysis. The LOCA DBA discussed in the Bases of TS 3.5.2 is performed at 100%, i.e., in Mode 1, therefore, an ECCS train in Mode 4 does not satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

The Reference Section of the Bases states:

*“The applicable references from Bases 3.5.2 also apply.”*

Two of the References in the Reference Section of TS 3.5.2 are 10 CFR 50, Appendix A, GDC 35 and FSAR, Chapter [15], Accident Analysis, which are both not applicable to Mode 4.

## **Technical Specifications Task Force Traveler TSTF-575-T, “Revise TS 3.5.3, ECCS-Shutdown, Bases”**

The Summary Description in TSTF-575-T states:

*“The Bases for Pressurized Water Reactor (PWR) (PWR) Standard Technical Specifications (STS) 3.5.3, “ECCS – Shutdown,” are revised. The current Bases contain misleading information. The current Bases infer that there are analyses that credit the use of the Emergency Core Cooling System (ECCS) in shutdown modes to mitigate a loss of coolant accident (LOCA) or other design basis accidents (DBAs). However, that is inconsistent with the licensing and design basis of operating plants. The proposed change corrects the Bases to be consistent with the Final Safety Analysis Report.”*

The Bases for TS 3.5.3 should be revised to delete any discussions regarding a LOCA or other DBAs, and the statement in the Applicable Safety Analysis Section should be revised that an ECCS train satisfies Criterion 4 of 10 CFR 50.36(c)(2)(ii) in Mode 4, not Criterion 3, as shown in TSTF-575-T.

The Bases changes to TS 3.5.3, in TSTF-575-T, can be made under the provisions of the TS Bases Control Program, because the changes revise incorrect information that is contained in the Bases.

### **Summary and Conclusions**

The NRC does not require a Mode 3 or Mode 4 LOCA to be performed by the regulations, but instead allow licensees to address these events with voluntary programs. WCAP-12476, Rev. 1 was not reviewed and approved by the NRC, therefore, it should not be incorporated in the licensing basis as a Mode 4 LOCA Chapter 15 AOR.

Appendix K and the SRP only require the LOCA analysis to be performed at 102% of the licensed power level, i.e., Mode 1, and do not require an analysis to be performed in any lower Modes of operation, i.e., Mode 4.

As discussed above, there are no regulatory requirements that require a licensee to perform a LOCA analysis Mode 4.

GDC 35 is not applicable to the ECCS in Mode 4.

The Bases for TS 3.5.3 should be revised to delete any discussions regarding a LOCA or other DBAs, and the statement in the Applicable Safety Analysis Section should be revised that an ECCS train satisfies Criterion 4 of 10 CFR 50.36(c)(2)(ii) in Mode 4, not Criterion 3, as shown in TSTF-575-T. The Bases changes to TS 3.5.3 in TSTF-575-T can be made under the provisions of the TS Bases Control Program, because the changes revise incorrect information that is contained in the Bases.

## References

1. NUREG-1431, "Standard Technical Specifications Westinghouse Plants," Rev. 5, Volumes 1 and 2.
2. OG-91-61, from Lawrence A. Walsh (Westinghouse Owners Group) to David Meyer (NRC), "Submittal of WCAP-12476, "Evaluation of LOCA During Mode 3 and 4 Operation for Westinghouse NSSS," dated November 27, 1991.
3. OG-95-069, from Louis F. Liberatori (Westinghouse Owners Group) to Robert C. Jones (NRC), "Review of WCAP-12476, "Evaluation of LOCA During Mode 3 and 4 Operation for Westinghouse NSSS," dated August 25, 1995.
4. OG-99-039, from Louis F. Liberatori and Bob Bryan (Westinghouse Owners Group) to the Document Control Desk, "Withdrawal of Topical Report WCAP-12476, "Evaluation of LOCA During Mode 3 and 4 Operation for Westinghouse NSSS," Non-Proprietary (MUHP-1499)," dated April 28, 1999.
5. NRC letter from Stuart A. Richards (NRC) to Andrew Drake (Westinghouse Owners Group), "Withdrawal of Topical Report WCAP-12476, "Evaluation of LOCA During Mode 3 and 4 Operation for Westinghouse NSSS," Non-Proprietary (MUHP-1499) (TAC NO. M83321)," dated December 28, 1999.
6. NRC letter from Stuart A. Richards (NRC) to Karl Jacobs (Westinghouse Owners Group), "Withdrawal of Topical Report WCAP-12476, "Evaluation of LOCA During Mode 3 and 4 Operation for Westinghouse NSSS," Non-Proprietary (MUHP-1499) (TAC NO. M83321)," dated June 23, 2000.