



UNITED STATES
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

September 20, 1996

MEMORANDUM TO: William T. Russell, Director
Office of Nuclear Reactor Regulation

FROM: Ashok C. Thadani, Chairperson
NRR DPV Review Panel *A. C. Thadani*

SUBJECT: DIFFERING PROFESSIONAL VIEW ON THE IMPLEMENTATION OF
BULLETIN 80-04 AT OCONEE

In a memorandum to Frank Miraglia dated July 25, 1996, Luis Reyes forwarded a differing professional view (DPV) from Mr. Larry King, a reactor inspector in Region II, regarding the Office of Nuclear Reactor Regulation's (NRR) acceptance of feedwater isolation valve modifications that are not safety-related and non-single failure proof. These modifications were accepted as part of the actions taken by Duke Power Company at Oconee in response to Bulletin 80-04. In the view of Mr. King, the modifications proposed by Duke Power Company do not meet the intent of Bulletin 80-04, entitled "Analysis of PWR Main Steam Line Break with Continued Feedwater Addition."

The members of the ad hoc NRR DPV Review Panel were Ashok Thadani as Chairperson, Gary Holahan as a management member, and Tom Peebles as recommended by Mr. King. The panel commenced a review of the DPV that included a review of the documents provided by Mr. King and discussions with Rich Lobel and Bill Long, technical reviewers from the Containment Systems Branch, DSSA/NRR, Jim Tatum, technical reviewer from the Plant Systems Branch, DSSA/NRR, Len Wiens and Dave LaBarge, previous and current project managers for Oconee, DRPE/NRR, Jack Donohew, project manager, DRPE/NRR, and Larry King, reactor inspector, Region II.

Background

In February 1980, the NRC issued Bulletin 80-04 based on deficiencies identified in the analysis of containment overpressurization due to continued feedwater addition during a main steam line break (MSLB). The Bulletin requested all PWR licensees to address several concerns. One request in this Bulletin was that licensees needed to review the containment pressure response analysis to determine if the potential for containment overpressure for a MSLB inside containment included the impact of runout flow from the auxiliary feedwater system and the impact of other energy sources, such as continuation of feedwater or condensate flow. Licensees were also requested to consider their ability to detect and isolate the damaged steam generator from these sources and the ability of the pumps to remain operable after extended operation at runout flow. If the potential for containment overpressure existed, the licensees were to provide a proposed corrective action and a schedule for completion of the corrective action. If the unit was operating, the licensee was to provide a description of any interim action that would be taken until the proposed corrective action was completed. Although Bulletin

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80-04 was not a post-TMI modification, it was implemented during the post-TMI time frame when many modifications were being implemented by the licensees pursuant to 10 CFR 50.59 with NRC staff conducting post modification implementation inspections. Specific staff guidance in regard to modification implementation for Bulletin 80-04 was not found.

NRC staff reviews for Bulletin 80-04 (MPA B-69, closed) were performed with the assistance of Franklin Research (FRC) under contract to the Division of Licensing. FRC initially used review acceptance criteria established by the staff and discussed in a technical evaluation report (TER) dated November 17, 1981. Later, FRC requested the staff to provide clarifications regarding acceptability of operator action. A memorandum dated October 20, 1982 from Butler to Speis indicates that review criteria were established for crediting operator actions within ten minutes and thirty minutes.

The acceptance criterion established by the staff and used by FRC (Ref: "PWR MSLB with Continued Feedwater Addition," November 17, 1981.) states "The equipment needed to detect and initiate the isolation of the affected steam generator and the feedwater pumps, to prevent containment overpressure and/or unacceptable core reactivity increases, must comply with acceptance criteria specified in Section 7.4 of the Standard Review Plan." The acceptance criterion for modifications to the electrical instrumentation and controls needed to detect and initiate isolation of the affected steam generator and feedwater sources in order to prevent containment overpressurization stated that this must satisfy safety grade requirements including redundancy. The FRC document notes that non-safety grade equipment may be credited for backup for certain classes of single-failure vulnerabilities. Although no clear reference was found, F. Eltawila's January 12, 1977 treatise "Acceptability of Non-Safety Grade Equipment in Mitigating a Main Steam Line Break Accident Inside Containment," may have provided the rationale. The memo stated that since the radiological consequences following a postulated MSLB accident are less severe than for a loss of coolant accident, less stringent design requirements may be placed on systems needed to mitigate a MSLB. In addition, the memo documented analysis that was performed to bound the containment pressure response to a MSLB.

Duke Power Company responded to Bulletin 80-04 on May 7, 1980, and concluded that no corrective actions were necessary for Oconee. A request for additional information was sent to the licensee on April 9, 1982 and was responded to by the licensee on July 23, 1982. The licensee's response reaffirmed that there was no potential for containment overpressurization resulting from a MSLB with continued feedwater addition and that no operator action is assumed. The peak containment pressure is reached at 360 seconds and remains below the design limit of 59 psig with no operator action. The Oconee Bulletin 80-04 response was found to be acceptable and the SE/TER was forwarded to Projects on September 30, 1982 and to the licensee on October 14, 1982. The TER stated that there is no potential for containment overpressurization resulting from a MSLB with continued feedwater addition at Oconee and that "furthermore, the existing emergency procedure provides operator guidance to prevent uncontrolled feedwater addition to the affected steam generator." The TER concluded that no corrective actions are necessary, but "a probabilistic risk assessment study is planned for Oconee. If the

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results of the study indicate the need for any corrective actions with respect to the steam line break accident, appropriate corrective actions will be considered at that time." No followup of this last statement was identified.

By letter dated May 27, 1993, the licensee for Oconee notified the staff that a reanalysis of the containment response identified that containment design pressure is exceeded without operator action to isolate the main feedwater during a MSLB. During fuel cycle extension and reload optimization analysis, the licensee for Oconee had discovered that passive structural metal of the reactor coolant system had not been taken into account as a heat source and other initial assumptions made in the analysis were incorrect. Operator action for most scenarios the licensee analyzed was required within 120-170 seconds to maintain containment peak pressure below the design limit of 59 psig. However, the licensee noted that without credit for automatic main feedwater control with main feedwater flow in manual control, an unlikely operating mode, operator action was required in 25-30 seconds to close the main feedwater control valves. The licensee for Oconee also stated that although the design limit was 59 psig, the containment could withstand a peak pressure of 144 psig. The licensee submitted LER 93-06 dated July 1, 1993, describing this condition as being outside the design basis for a MSLB accident. On August 19, 1993, the licensee provided a supplemental response to Bulletin 80-04, stating that a modification would be installed to alleviate the reliance on operator action. The modification would initiate feedwater isolation by an automatic signal following a MSLB.

TACs M86649/50/51 were opened for review of the licensee's May 27, 1993, justification for continued operation and the August 1993 supplemental response to Bulletin 80-04 for Oconee. However, no work request was generated for the technical staff to review the submittal. L. Wiens' letter of October 6, 1993, closed-out the review stating that "we have not performed a technical review" but "the approach provides an acceptable response to address the concerns of Inspection and Enforcement Bulletin 80-04." The staff, by accepting the licensee's "approach", thereby accepted operator action. No rationale is stated in the staff's October 6, 1993 letter. In fact, this reliance on operator actions is inconsistent with the Speis to Butler memorandum dated October 20, 1982.

By letter dated June 14, 1995, the licensee notified the staff of changes to the conceptual design for the Bulletin 80-04 modification at Oconee including permanent reliance on operator action and that the schedule for implementation of the modification would be delayed. In this letter the licensee stated that the main feedwater equipment being controlled by the new MSLB circuitry is non-safety related and non-single failure proof. However, the associated pressure transmitters, logic and control circuitry installed by this modification for mitigation of a MSLB would be safety-related, redundant and single failure proof. In addition, the licensee noted that a technical specification amendment would be requested to address equipment added by this modification. The licensee did not submit nor were they requested to submit details of their modification for staff review.

By letter dated June 30, 1995, the staff found the delay in the licensee's schedule acceptable, but did not perform a technical review of this

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modification. Although no formal technical review request was initiated, the Containment Systems Branch did concur in both the 1993 and 1995 staff responses to Duke Power Company. The licensee documented a conference call with the Oconee project manager in August 1995, confirming the staff's "tacit approval" of the design approach without a detailed staff review, the agreement to complete the modification under 10 CFR 50.59, and the agreement to submit a technical specification amendment request following completion of the subject modification. In addition, the licensee stated that the modification was a safety enhancement and the project manager agreed with the licensee. The modification is designed to trip both main feedwater pumps, isolate all feedwater to both steam generators and prevent the turbine driven emergency feedwater pump from starting. To date the modification has been implemented on Oconee Units 1 and 2, and is due to be implemented on Unit 3 during the Fall 1996 outage. The licensee's June 15, 1995 supplement and the actual modifications were reviewed by Region II as reported in an Inspection Report dated January 4, 1996. No open items were identified regarding the modification.

It is the view of Mr. King that NRR has done an inadequate review of Oconee's response to Bulletin 80-04, and that failure to automatically secure feedwater with a MSLB could be a problem at other plants as well. He believes the modification at Oconee does not meet the safety related or single failure requirements of Bulletin 80-04.

Discussion

The NRR DPV Review Panel initially met with Messrs. Long, Lobel, LaBarge and Tatum on August 29, 1996, to gain a better understanding of the circumstances leading up to the licensee submittals and staff responses regarding Bulletin 80-04.

Mr. Long went through the background information that led to Bulletin 80-04 and Oconee's initial and supplemental responses. When Mr. Long described the error found in the input assumptions used in the computer code analysis regarding passive metal structures in the reactor coolant system, Mr. Thadani requested the staff to look into what computer codes were used for containment analysis and the assumptions made regarding main feedwater isolation. Mr. Long also mentioned Generic Issue 125.II.7 that was established to address AFW reliability concerns due to automatic auxiliary feedwater (AFW) isolation provided to prevent containment overpressure. As a result of the Davis-Besse event, consideration was given to having plants remove automatic auxiliary feedwater isolation systems in order to improve AFW reliability, the AFW reliability improvement being more beneficial than the MSLB protective feature. NUREG-1332 that documents the resolution of GI 125.II.7 found that removal of the AFW isolation feature would not be cost-beneficial. It is not clear what action was to be taken if the modifications were not made.

The panel discussed the staff's acceptance of operator action in Oconee's response, however, because a technical review was not documented, the rationale for the staff's acceptance could not easily be reconstructed. The staff's review appeared to be more focused on the modification schedule rather than the acceptability of operator action in the interim. Mr. Tatum noted a

similar situation identified at Haddam Neck which raised additional concerns regarding the adequacy of other plants' responses to Bulletin 80-04. The issue at Haddam Neck also involved the identification of nonconservative analysis of a MSLB. The original analysis was completed as part of the initial licensing effort and was erroneously reconfirmed as part of Northeast Nuclear Energy Company's response to Bulletin 80-04. In 1991, the licensee at Haddam Neck identified nonconservative assumptions regarding their MSLB analysis and, in 1992, completed a reanalysis of their previous response to Bulletin 80-04 and found it acceptable. In 1995, the licensee identified another incorrect assumption made in the previous MSLB containment analysis that over estimated the amount of metal structures inside containment acting as heat sinks. During the review, the licensee noted that should there be a single failure of the feedwater isolation valve following a MSLB the non-safety related feedwater regulator valve would not be able to close against the high differential pressure of the feedwater pumps, since they are not automatically secured. The licensee's fix included crediting operator action within 45 seconds if the feedwater isolation valve were to fail following a MSLB. The licensee concluded, under 10 CFR 50.59, that there was no unreviewed safety question. The staff has questioned the licensee's conclusion and their reliance on non-safety related valves. The licensee also submitted a license amendment to reduce the feedwater isolation valve stroke time.

On August 29, 1996, the NRR DPV Review Panel met with Mr. King to discuss his concerns with the Oconee response to Bulletin 80-04. Mr. King discussed an inspection he conducted at Crystal River Unit 3 about 3 to 4 years ago, in which he first found a problem with the implementation of Bulletin 80-04 requirements. He questioned whether they met containment design pressure following a MSLB and discovered that the main feedwater regulator valve did not close fast enough. Mr. King noted that the licensee for Crystal River installed a high speed actuator on the feedwater block valve and met the requirements of the Bulletin. When the staff subsequently performed a NUDOCS search for Crystal River documents, no documentation was found regarding the modification in connection with Bulletin 80-04.

During a subsequent inspection at Oconee, Mr. King reviewed their response to Bulletin 80-04. He noted that Duke had already identified and informed NRC of the problems with containment pressure during a MSLB. In January 1996, Mr. King reviewed Oconee's Bulletin 80-04 modification and associated 10 CFR 50.59 evaluation that states the modification is non-safety related and non-single failure proof. The licensee considered this modification as a safety enhancement, not a requirement, and told Mr. King that NRC had approved the modification and that it was a safety enhancement. The panel members noted that NRC did not really approve the design, but had focused on approving the implementation schedule. Mr. King said the licensee also provided him with a copy of their internal memo documenting the August 1995 call with the NRC project manager. Mr. King also noted that he had identified specific single failure problems with the Oconee modification and that the original emergency feedwater system was not single failure proof.

In the discussions with Mr. King, the crux of the concerns associated with his DPV was that the licensee for Oconee was pursuing a non-safety related, non-single failure proof fix as an enhancement that does not meet the requirements of Bulletin 80-04, and that the NRC did not perform a review.

On September 4, 1996, the NRR DPV panel met with Mr. Len Wiens, former project manager for Oconee, to discuss his recollection of the circumstances surrounding the licensee's submittals and staff responses. Mr. Wiens explained that technical staff section chiefs and branch chiefs had been involved in phone conversations with the licensee for Oconee. In his judgement, a mutual decision had been made not to complete a technical review, however the basis was not documented. Mr. Wiens also confirmed the contents of the licensee's internal memo documenting the August 1995 phone conversation. The panel discussed the fact that the inclusion of the steam generator pressure signals in the instrument surveillance Technical Specification was to be submitted upon completion of the modifications on all three units at Oconee. Mr. Thadani noted that implementing modifications pursuant to 10 CFR 50.59 prior to submitting technical specification amendments is inappropriate.

On September 12, 1996, the NRR DPV panel met with Messrs. Lobel and Donohew to further discuss the circumstances leading to the Oconee submittals and the original intent of Bulletin 80-04. The panel requested a sample review of responses to Bulletin 80-04 be conducted to determine if similar problems existed at other plants and what further actions may be necessary. Attachment 1 provides a summary of the sample review results.

Conclusions

On the basis of the review and discussion with the primary parties involved in review of the issue and the individual submitting the DPV, it was noted by the NRR DPV Review Panel that:

- (1) The Oconee supplemental responses to Bulletin 80-04 did not receive appropriate technical review (i.e., a work request was not generated and a safety evaluation providing the basis for acceptance was not documented).
- (2) It is not clear what has been accepted on other PWRs regarding corrective actions for the concerns raised in Bulletin 80-04. As discussed in Attachment 1, when modifications were necessary in response to Bulletin 80-04, it is not clear whether the staff intended licensees to obtain prior approval or to implement the modifications pursuant to 10 CFR 50.59. In addition, there appears to have been no consideration given to reopening the Bulletin 80-04 (MPA B-69) based on the Oconee or other submittals reviewed in Attachment 1 which identified errors in prior MSLB analyses.
- (3) The licensee for Oconee is implementing modifications prior to submitting technical specification amendments, thus bypassing staff review of the modification design. The licensee implemented Bulletin

80-04 via 10 CFR 50.59 evaluation with the project managers oral approval rather than obtaining staff review and approval of the design modification.

- (4) Possible generic implications of the mistake in the input assumptions of the codes used to support containment analysis did not appear to have been pursued.
- (5) The sample review of responses to Bulletin 80-04 noted that errors in analyses have been identified on other plants which, when corrected, led to predictions of containment overpressurization. When modifications were necessary in response to Bulletin 80-04, it is not clear whether the staff intended licensees to obtain prior approval or to implement the modifications pursuant to 10 CFR 50.59. The staff's emphasis appeared to be on implementation schedules and certification of completion rather than the technical acceptability.
- (6) Mr. King has played a positive role in identifying the Bulletin 80-04 issues at Oconee and highlighting the importance of conducting and documenting in-depth technical reviews in accordance with NRC requirements and practises.

Recommendations

Based on the conclusions above, the NRR DPV Review Panel recommends that:

- (1) The staff re-review the Oconee response to Bulletin 80-04 to ensure that the licensee's corrective action is appropriate and consistent with what was accepted on other plants.
- (2) The staff re-review the closeouts of other plants for Bulletin 80-04 to ensure that the licensees' corrective actions are appropriate. The review should also evaluate the overall safety implications of isolating auxiliary feedwater.
- (3) The staff review the possible generic implications of the Oconee and other licensee containment code analysis error(s).
- (4) Staff guidance and training be provided for the following process lessons learned;

Implementing modifications prior to submitting technical specification amendments is not an acceptable practice.

Identifying possible generic implications such as the mistake in the input assumptions of the codes used to support containment analysis.

Appropriately documenting the basis for regulatory decisions and technical reviews.

The appropriate process for reviewing revised responses to multiplant actions.

- (5) The results of this review should be forwarded to the working group which is currently reviewing 10 CFR 50.59 issues, to ensure that the lessons learned are appropriately incorporated in the 50.59 Action Plan.

Attachments:

1. Summary of Bulletin 80-04 Sample Review
2. DPV memo to F. Miraglia dated July 25, 1996

SUMMARY OF BULLETIN 80-04 SAMPLE REVIEW

TMI-1:

Conclusion in IEB 80-04 Review: The licensee stated there is no potential for containment overpressurization resulting from a MSLB with continued AFW addition because the main feedwater system is isolated, the AFW flow restrictors limit the flow to the affected steam generator, and AFW will continue to function. The staff found the licensee's analysis acceptable and no further action is required.

Changes made as a result of IEB 80-04 Review: None. Cavitating venturis were added to EFW lines earlier as a post TMI-2 fix.

Later changes related to MSLB: None found.

Crystal River

Conclusion in IEB 80-04 Review: There is no potential for containment overpressurization resulting from a MSLB with continued feedwater addition because the main feedwater system is isolated. Emergency feedwater pumps will not experience runout conditions due to preset flow control valves; therefore, they will be able to carry out their intended function without incurring damage during the MSLB event. No violation of specified acceptable fuel design limits. All potential water sources were identified. No further action was required.

NOTE: Crystal River had a steam line rupture matrix which isolated both main and auxiliary feedwater systems. Because of an event on February 26, 1980, licensee installed EFIC (Emergency Feedwater Initiation and Control) System which isolates EFW only to faulted steam generator. In the interim, licensee performed an analysis which assumed credit for isolating EFW to the faulted steam generator within 1 hour. NRC found this acceptable.

Changes made as a result of IEB 80-04 Review: See above. EFIC added during Bulletin 80-04 review, but because of an earlier incident.

Later changes related to MSLB: None found. The change described by Mr. King was not found in NUDOS in association with Bulletin 80-04.

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Conclusion in IEB 80-04 Review: There is no potential for containment overpressurization resulting from a MSLB with continued feedwater addition because the main feedwater is isolated. The EFW pumps will remain operable when subject to effects of runout flow and therefore, can be expected to carry out their intended function during the MSLB event. All potential water sources were identified.

There is no violation of specified acceptable fuel design limits.

Changes made as a result of IEB 80-04 Review: EFIC system installed (see Crystal River). Not a result of bulletin.

Later changes related to MSLB: 1991 reanalysis of MSLB due to moderator temperature coefficient concerns. Credit was taken for EFIC. However, without operator action, the startup feedwater valves would remain open, causing a return to criticality. EFIC was modified to close these valves. No operator action was required.

Surry Units 1 and 2

Conclusion in IEB 80-04 Review: There is no potential for containment overpressurization resulting from a MSLB with continued feedwater addition. A safety injection signal isolates main feedwater flow and flow restricting nozzles on the AFW system will limit AFW flow. All potential sources of water were identified. Although there is a return to power, no DNB occurs.

Changes made as a result of IEB 80-04 Review: Flow restricting orifices added to AFW lines to limit runout flow.

Later changes related to MSLB: None.

Millstone Unit 2

Conclusion in IEB 80-04 Review: There is no potential for containment overpressurization resulting from a MSLB with continued feedwater addition because main feedwater system is isolated and the initiation of the AFW system is delayed. No damage would be incurred by the AFW pumps since the calculated runout flow rate is within design capability of the pumps. Although there is a return to power, specified acceptable fuel design limits are not exceeded.

NOTE: Licensee analyses done for IEB 80-04 based on previous calculations for TMI issue related to automatic start of AFW.

Changes made as a result of IEB 80-04 Review: No further action was required.

Later changes related to MSLB: A November 1991 LER stated that previous MSLB analyses were non-conservative with respect to power level, break size and single failure. It also noted that containment pressure and temperature limits could be exceeded following a MSLB. A dedicated operator was stationed to close main feedwater block valves following a reactor trip. A January 1992 LER supplement informed the staff of short term (non-safety related) hardware changes which eliminated the need for a dedicated operator. In August 1992, the licensee notified the staff that two new postulated single failures could result in the containment pressure during a MSLB exceeding the design pressure. The licensee established a multi-disciplinary task group to ensure all single failures were considered and to propose design changes, if necessary. Proposed changes to TS were requested in a January 1993 submittal as a revised response to IEB 80-04. Based on the revised analyses, a staff SER was issued in December 1993 that approved the changes.

CONCLUSIONS

Operator action has been credited in the past for mitigating a MSLB but for times in excess of one hour, except for Millstone Unit 2 where the dedicated operator was to take specific action on any plant trip.

There have been errors in analyses which, when corrected, led to predictions of containment overpressurization. It is not clear that staff review would find these errors because of their detailed nature. The IEB 80-04 reviews examined here appear to have been thorough. When modifications were necessary in response to Bulletin 80-04, it is not clear whether the staff intended licensees to obtain prior approval or to implement the modifications pursuant to 10 CFR 50.59.