

March 25, 2016

MEMORANDUM TO: William M. Dean, Director
Office of Nuclear Reactor Regulation

FROM: Marissa G. Bailey, Acting Director */ra/*
Division of Engineering
Office of Nuclear Reactor Regulation

SUBJECT: BACKFIT REVIEW PANEL RECOMMENDATION REGARDING EXELON
APPEAL OF BACKFIT AFFECTING BRAIDWOOD AND BYRON
STATIONS REGARDING COMPLIANCE WITH 10 CFR 50.34(b),
GDC 15, GDC 21, GDC 29, AND THE LICENSING BASIS

In a memorandum dated January 12, 2016, you appointed me as Chairman of a Backfit Review Panel (the Panel), with members Anthony Gody and Adam Gendelman. The purpose of the Panel was to review Exelon Generation Company, LLC's (EGC's) appeal of a compliance backfit imposed by the U.S. Nuclear Regulatory Commission (NRC) on the Braidwood and Byron Stations. The Panel was chartered with providing a recommendation to you as to whether a backfit is necessary at Braidwood and Byron and whether the staff's application of the compliance backfit exception is in accordance with § 50.109(a)(4)(i) and is otherwise appropriate. The Panel's review was to be completed with a recommendation to you within three weeks following a public meeting with EGC, if one was held. A public meeting, in which EGC discussed its backfit appeal with the Panel, was held on March 7, 2016. A summary of the public meeting is available in Agencywide Documents Access Management System (ADAMS) at Accession No. ML16070A362 and the transcript is available in ADAMS at Accession No. ML16070A364.

The Panel has completed its review of EGC's appeal of the compliance backfit, which was imposed by the NRC in a letter dated October 9, 2015. This review consisted of a discussion with NRC staff involved in the initial backfit decision, a public meeting with EGC, and review of the documentation related to the issue.

Based on its review, the Panel recommends that you find that (1) imposition of the backfit is necessary and (2) application of the compliance backfit exception was done in accordance with § 50.109(a)(4)(i) and is appropriate. The basis for the Panel's conclusion is documented in the enclosure to this memorandum.

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The Panel also discovered during its review that the reliance on pressurizer power-operated relief valves (PORVs) or pressurizer safety valves (PSVs) to relieve water during mass addition events is a general strategy employed by many pressurized water reactor licensees. The NRC reviewed PORV reliability in Generic Issue (GI) 70, "Power-Operated Relief Valve and Block Valve Reliability." NRC staff conclusions on GI-70 are documented in NUREG-1316, "Technical Findings and Regulatory Analysis Related to Generic Issue 70." The NRC concluded that it was not cost-effective to upgrade (backfit) existing non-safety-grade PORVs and block valves (and associated control systems) to full safety-grade qualification status when they have been determined to perform any of the safety-related functions discussed in the NUREG or any identified in the future. However, the scope of GI-70 was focused on PORVs and not PSVs, and the staff did not appear to consider PORVs or PSVs as mitigating anticipated operational occurrences, such as mass addition events, in NUREG-1316. Therefore, the Panel recommends that the NRC staff review licensee use of this general strategy in light of the staff position communicated in the October 9, 2015, backfit to determine whether additional generic actions are necessary.

Enclosure:
Panel Evaluation of Backfit Appeal

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PANEL EVALUATION OF LICENSEE BACKFIT APPEAL

Introduction

In a memorandum dated January 12, 2016, the Director of the Office of Nuclear Reactor Regulation appointed a Backfit Review Panel (the Panel) to review Exelon Generation Company, LLC's (EGC's) appeal of a compliance backfit imposed by the NRC on the Braidwood and Byron Stations. The Panel reviewed the December 8, 2015, letter (Agencywide Documents Access Management System (ADAMS) Accession No. ML15342A112) in which EGC appealed the U.S. Nuclear Regulatory Commission's (NRC) October 9, 2015, backfit (ADAMS Accession No. ML14225A871) related to water qualification of relief valves predicted by the licensee's Updated Final Safety Analysis Report (UFSAR) Chapter 15 analyses to relieve water. The backfit was issued under the compliance exception provision of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50.109(a)(4)(i). EGC disagreed with the NRC, and in its appeal stated that the NRC failed to justify imposition of a backfit under the compliance exception. EGC further stated that the NRC should have pursued a cost justified substantial safety benefit analysis, per 10 CFR 50.109(a)(3). At issue was the Braidwood and Byron UFSAR prediction of water relief through a valve that is not qualified for water relief in the UFSAR analyses of inadvertent operation of emergency core cooling system during power operation (UFSAR Chapter 15.5.1), chemical and volume control system malfunction that increases reactor coolant inventory (UFSAR Chapter 15.5.2), and inadvertent opening of a pressurizer safety or relief valve (UFSAR Chapter 15.6.1). For the reasons discussed below, the Panel recommends that the appeal be denied.

Background

Pressurized water reactors, including the Braidwood and Byron plants, are designed with a closed-loop reactor coolant system (RCS). Water circulates through the RCS to remove heat from the reactor core and transfer it to heat-removal systems. Pressure in the RCS is controlled in the pressurizer, which contains heaters for increasing pressure and vent valves as a method of decreasing pressure. The pressurizer is typically partially filled with water, such that the heaters are covered with water that can be heated to raise RCS pressure and the steam space above the water can be vented to reduce RCS pressure. The vent valves consist of power-operated relief valves (PORVs), which can be manually opened and closed to lower or maintain pressure, and pressurizer safety valves (PSVs), which cannot be manually controlled and serve as structural overpressure protection for the RCS. Proper level in the pressurizer is maintained by balancing any RCS mass (water) addition with RCS mass (water or steam) removal. Certain events can occur that could cause the pressurizer to fill by adding water to the RCS. Events of this type are classified as mass addition events. If the mass addition is not terminated soon enough, continued mass addition would force water out of the PORVs or PSVs, which normally relieve steam.

The Standard Review Plan, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," (SRP) provides the NRC staff with guidance that describes methods or approaches that the NRC staff has found acceptable for meeting NRC requirements. The NRC staff uses the categorization of accidents and transients as described in Chapter 15.0, "Introduction - Transient and Accident Analyses," of the SRP to review UFSAR Chapter 15 safety analyses. Chapter 15.0, Section I.1.A of the SRP states, "Incidents of moderate frequency and infrequent events are also known as Condition II and Condition III events, respectively, in the commonly used, [often cited] but unofficial American

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Nuclear Society (ANS) standards.” In other words, Condition II events are more frequent than Condition III events. Additionally, Condition II events should produce less severe consequences than Condition III events, as noted in Chapter 15.0 to the SRP:

If the risk of an event is defined as the product of the event’s frequency of occurrence and its consequences, then the design of the plant should be such that all the AOOs and postulated accidents produce about the same level of risk (i.e., the risk is approximately constant across the spectrum of AOOs and postulated accidents). This is reflected in the general design criteria (GDC), which generally prohibit relatively frequent events (AOOs) from resulting in serious consequences, but allow the relatively rare events (postulated accidents) to produce more severe consequences.

Chapter 15.0 to the SRP identifies acceptance criteria for the various categories of events, including the following criterion applicable to Condition II events:

By itself, a Condition II incident cannot generate a more serious incident of the Condition III or IV category without other incidents occurring independently or result in a consequential loss of function of the RCS or reactor containment barriers.

Section 15.5.1-15.5.2, “Inadvertent Operation of ECCS and Chemical and Volume Control System Malfunction that Increases Reactor Coolant Inventory,” Revision 2, of the SRP provides that water relief through a valve not qualified for water relief is assumed to result in the valve sticking fully open. This would effectively produce a Condition III small-break loss of coolant accident that originates as a Condition II event, and therefore would violate the ANS design requirement.

In its October 9, 2015, letter and backfit, the NRC stated that, based upon their review of the analyses contained in the Braidwood and Byron UFSAR, Chapters 15.5.1, “Inadvertent Operation of Emergency Core Cooling System during Power Operation (IOECCS),” 15.5.2, “Chemical and Volume Control System (CVCS) Malfunction that Increases Reactor Coolant Inventory Malfunction,” and 15.6.1, “Inadvertent Opening of a Pressurizer Safety or Relief Valve (IOPSRV),” the NRC determined that the UFSAR predicted water relief through a valve that is not qualified for water relief. Therefore, the UFSAR did not contain analyses that demonstrate the structures, systems, and components would meet the design criteria for Condition II events, which are contained in Chapter 15.0.1.2 of the Braidwood and Byron UFSAR. The NRC found that the UFSAR was, therefore, not in compliance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.34(b) since it did not demonstrate compliance with the following General Design Criteria, which are contained in 10 CFR 50, Appendix A:

- GDC 15, “Reactor Coolant System Design,” requires that the reactor coolant system and its associated auxiliary control and protection systems be designed with sufficient margin to assure that the design conditions of the reactor coolant pressure boundary are not exceeded during any condition of normal operations, including anticipated operational occurrences (AOOs).
- GDC 21, “Protection System Reliability and Testability,” requires, in part, that the protection system be designed for high functional reliability and inservice testability

commensurate with the safety functions to be performed. Redundancy and independence designed into the protection system shall be sufficient to assure that (1) no single failure results in loss of the protection function and (2) removal from service of any component or channel does not result in loss of the required minimum redundancy unless the acceptable reliability of operation of the protection system can be otherwise demonstrated.

- GDC 29, "Protection Against Anticipated Operational Occurrences," requires that the protection and reactivity control systems be designed to assure an extremely high probability of accomplishing their safety functions in the event of AOOs.

The NRC staff conclusions with respect to noncompliance with GDCs 15, 21, and 29, 10 CFR 50.34(b), and UFSAR provisions with respect to prohibition of progression of Condition II events differ from a previous NRC position on the acceptability of the Braidwood and Byron design bases. The staff's earlier position was documented in the safety evaluation (SE) for an increase in reactor power enclosed with a letter dated May 4, 2001 (ADAMS Accession No. ML011420274). Therefore, the staff determined that the new conclusion and position constituted backfitting under 10 CFR 50.109(a)(1), and that further, the compliance exception in 10 CFR 50.109(a)(4)(i) applied.

Backfitting is defined in 10 CFR 50.109(a)(1) as the modification of, or addition to systems, structures, components, or design of a facility; or the design approval or manufacturing license for a facility; or the procedures or organization required to design, construct or operate a facility; any of which may result from a new or amended provision in the Commission's regulations or the imposition of a regulatory staff position interpreting the Commission's regulations that is either new or different from a previously applicable staff position. Backfitting requires an analysis to determine that there is a substantial increase in the overall protection of the public health and safety or the common defense and security, and that the direct and indirect costs of implementation are justified. There are three exceptions to the need to perform this analysis, one of which is if the modification is necessary to bring a facility into compliance with a license or the rules or orders of the Commission, or into conformance with written commitments by the licensee (the compliance exception). To invoke the compliance exception, the staff must provide a documented evaluation containing the basis for the use of the exception.

Summary of Licensee Appeal

In a letter dated December 8, 2015, EGC appealed the NRC's October 9, 2015, backfit. The appeal claimed that the compliance exception does not apply because the NRC did not explain how its prior positions were erroneous due to an omission or mistake of fact. The appeal noted that in documented safety evaluations associated with a 2001 stretch power uprate license amendment, and a 2004 license amendment approving pressurizer safety valve setpoint changes, the NRC approved the same inadvertent operation of the emergency core cooling system (IOECCS) analysis that it now claims to be inadequate.

In the appeal, EGC stated that the NRC's 2001 review and approval included requests for additional information (RAIs) that discussed the IOECCS analysis and Electric Power Research Institute (EPRI) testing of the PSVs in particular, and that the staff concluded it was acceptable to credit PSV liquid water discharge during an IOECCS event. The appeal further noted that the

NRC's 2004 review and approval also included an RAI that discussed PSV water discharge as a result of an IOECCS event. EGC's appeal stated that the NRC staff did not further explain its statement in the backfit that these prior approvals were "based on the use of water qualified PSVs, which upon further review was found to be unsubstantiated."

The appeal noted that the NRC's position that Condition II events cannot transition to Condition III events has remained consistent, but that NRC's application of GDCs 15, 21, and 29 to support the backfit appeared to differ from previous documented positions in the 2001 and 2004 safety evaluations for Braidwood and Byron. EGC concluded in reiterating its position that the NRC did not identify an omission or mistake of fact, which it believes is required to use the compliance exception to the backfit rule's requirement to perform a cost/benefit analysis.

NRC Evaluation of Licensee Appeal

The Panel reviewed EGC's December 8, 2015, appeal and met with EGC in a March 7, 2016, public meeting. The Panel was chartered with determining whether a backfit is necessary at Braidwood and Byron stations, and whether the staff's application of the compliance exception was in accordance with 10 CFR 50.109(a)(4)(i), and was otherwise appropriate.

First, the Panel finds that a backfit is necessary, and that the NRC staff correctly entered the backfit process due to a proposed change in staff position. As depicted in figure 2 of NUREG-1409, the first question the NRC must answer is whether the plant-specific Agency position is determined to be a backfit. In this case, the NRC staff correctly determined that it was. In particular, the Agency's view was a change in position with respect to the analyses showing that the Braidwood and Byron PSVs will reseal to prevent a Condition II event from transitioning to a Condition III event, and therefore, a change in position as to EGC's compliance with NRC requirements.

As depicted in figure 2 of NUREG-1409, given that the proposed staff position is a backfit, the staff must next perform a cost/benefit analysis to determine if the proposed backfit is a cost-justified substantial safety enhancement, or identify an applicable exception and provide a statement as to why that exception applies. The staff identified the compliance backfit as applicable here.

In its appeal, the licensee acknowledged that the Agency's position on the unacceptability of Condition II events transitioning to Condition III events has not changed. This Agency position necessarily includes the requirements to demonstrate that this will not occur, which in this case includes meeting GDCs 15, 21, and 29, and 10 CFR 50.34(b). The basis for this conclusion is fully set out in the October 9, 2015, SE discussion of water qualification, Section 3.1.2.4, "Water Qualification of PSVs:"

The Braidwood and Byron IOECCS analysis depends on water relief through the PSVs. PSVs typically provide protection against over pressurization during Condition III and IV events (e.g., feedline break). The Braidwood and Byron plants' reliance upon the PSVs for mitigation of Condition II events is a departure from the design (or functional) objectives of the PSVs as described in the UFSAR Chapter and Reference 8. Additionally, the licensee has invoked the PSVs as a mitigation system but has not applied the single-failure assumption (required in accident analyses to show compliance

with GDC 21) to that system (i.e., failure of a PSV to close) nor have they provided ASME water qualification documentation for the PSVs, causing the staff to be unable to conclude that there is compliance with GDC 21. Specifically, the following information is necessary to support water qualification of the PSVs:

- (1) Under the ASME Code [American Society of Mechanical Engineers Boiler and Pressure Code] requirements [Reference 9], it is necessary to provide the original Overpressure Protection Report showing the IOECCS event as a Condition II event and defining the operating conditions and required relief capacities associated with it. It is also necessary to provide the manufacturer's certification of the valves' relief capacity, under pressurized water conditions, and including test results.
- (2) According to the ASME OM [Operation and Maintenance] Code [Reference 1 O], it is necessary to provide the in service test history (procedure and results) for the pressurizer PSVs, including both water and steam tests, or alternatively provide a certified correlation test procedure and justification for use of an alternative test fluid.

The licensee argued that approval of the PSVs, first in 2001, was not a deviation from an NRC position, but application of it; pointing to specific RAIs and SER text that appears to specifically recognize the basis the licensee provided for its analyses as acceptable, even though the licensee's RAI responses did not demonstrate water qualification of the PSVs. On the contrary, the Panel finds that in its SE, the staff has shown that the approvals at issue for Braidwood and Byron are inconsistent with the Agency's general position. That the staff at the time appeared to have some awareness of an approach inconsistent with the requirements discussed here, in this case references to EPRI reports on the ability of these non-water qualified PSVs to reseal in certain circumstances, is not sufficient to support the licensee's position. NRC requirements at the time provided that the valves should have been water qualified and EGC did not demonstrate that they were.

Second, the Panel finds that the staff appropriately applied the compliance backfit exception because (1) the NRC has maintained a generic position that Condition II events cannot transition into Condition III events, as demonstrated in the preceding paragraphs, and (2) the staff identified the water qualification of the PSVs as a basis for the erroneous 2001 and 2004 approvals.

The staff stated that its imposition of the compliance exception was appropriate because its "interpretation, guidance, and general application (as opposed to the specific NRC approval for Braidwood and Byron) of GDCs 15, 21, and 29, 10 CFR, Section 50.34(b), have not changed with respect to the unacceptability of the specific Condition II events at the Braidwood and Byron plants evolving to Condition III events. In addition, the staff's interpretation of these plants' UFSAR provisions with respect to the prohibition of progression of Condition II events has not changed." The staff stated, in essence, that it was never the Agency's position that PSVs that are not qualified for water relief are acceptable as a method of preventing Condition II events from transitioning into Condition III events, including when such a configuration was approved at Braidwood and Byron.

The Statements of Consideration applicable to the compliance exception provide that in applying the exception to the backfit rule's analytical requirement, "new or modified

interpretations of what constitutes compliance would not fall within the exception.” This distinction is the heart of the compliance exception. If the NRC’s interpretation of a rule changes based on new information or a change in position, even where the new position is compatible with existing language in a requirement, the compliance exception is generally not available to implement that new position. Rather, the new position imposed via compliance backfit must be a change of position with regard to the compliance of a particular facility, but be consistent with the Agency’s general position.

The licensee also argued that the NRC staff failed to satisfy the compliance exception because the staff did not identify an omission or mistake of fact in the subject backfit. This language regarding an omission or mistake of fact comes from the same Statements of Consideration discussed previously, which, in describing the applicability of the backfit rule’s compliance exception, states that “[t]he compliance exception is intended to address situations in which the licensee has failed to meet known and established standards of the Commission because of omission or mistake of fact.” The NRC has not adopted EGC’s proposed interpretation that this language is exclusive (i.e., that the *only* compliance backfits are those based upon omission or mistake of fact). Guidance on the compliance exception in NUREG-1409 provides that while the staff must clearly identify whether a new Agency position is a backfit, a requirement to specifically identify an omission or mistake of fact in applying a compliance backfit where the rule is satisfied is not discussed. In addition, in describing the imposition of compliance backfits, NUREG-1409 makes no mention of the need to explicitly invoke the particular omission or mistake of fact (that must, under the licensee’s interpretation, be) at issue. However, even assuming for the sake of argument that an omission or mistake of fact must be identified as the basis of a compliance backfit, the staff did so here.

In the October 9, 2015, SE, the staff stated that its “acceptance of the IOECCS analysis in 2001 was based, among other things, on the use of water qualified PSV’s which upon further review, during the 2011 [measurement uncertainty recapture power uprate], was found to be unsubstantiated.” The staff also stated in the SE, “Specifically, the analyses contained in the Braidwood and Byron UFSAR, Chapters 15.5.1, ‘Inadvertent Operation of Emergency Core Cooling System during Power Operation (IOECCS),’ 15.5.2, ‘Chemical and Volume Control System (CVCS) Malfunction that Increases Reactor Coolant Inventory (CVCS) Malfunction,’ and 15.6.1, ‘Inadvertent Opening of a Pressurizer Safety or Relief Valve (IOPORV),’ predict water relief through a valve that is not qualified for water relief. Therefore, the UFSAR does not contain analyses that demonstrate the structures, systems, and components will meet the design criteria for Condition II faults as stated in the Braidwood and Byron UFSAR, Chapter 15.0.1.2.” Thus, as discussed in detail in the staff’s backfit analysis, the “mistake of fact” was the water qualification of the PSVs to prevent Condition II events from transitioning to Condition III events by reseating after predicted relief of water.

NRC Conclusion

Based on its review, the Panel determined that (1) imposition of the backfit is necessary, and (2) application of the compliance backfit exception was done in accordance with § 50.109, and is appropriate. The staff appropriately identified that its current view, while consistent with long-held Agency policy (and as noted by EGC), represented a change from the position the Agency took in the 2001 and 2004 licensing reviews specific to Braidwood and Byron. The staff also noted that the reason for the incorrect positions taken in 2001 and 2004 involved the water qualification of the PSVs. They were required to be water qualified, and they were not. The current analyses in Braidwood and Byron UFSAR sections 15.5.1, 15.5.2, and 15.6.1 do not demonstrate compliance with GDC 15, GDC 21, and GDC 29; therefore, Braidwood and Byron are not in compliance with 10 CFR 50.34(b) and their UFSAR Chapter 15.0.1.2 provisions with respect to the prohibition of progression of Condition II events to Condition III events.