



Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant, Unit 2
NRC Docket No. 50-391

Subject: Watts Bar Nuclear Plant (WBN) Unit 2 – Final Safety Analysis Report (FSAR) – Response to Requests for Additional Information

This letter responds to four requests for additional information (RAIs) regarding the Unit 2 FSAR concerning malfunction of the chemical and volume control system and the inadvertent operation of the Emergency Core Cooling System.

There are no new regulatory commitments contained in this letter. If you have any questions, please contact Bill Crouch at (423) 365-2004.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 10th day of February, 2011.

Sincerely,

Marie Gillman
Acting Watts Bar Unit 2 Vice President

DO30
MRR

Enclosure:

1. Responses to RAIs Regarding Unit 2 FSAR

References:

1. NRC to TVA letter dated June 23, 2010, "Watts Bar Nuclear Plant, Unit 2 - Request for Additional Information Regarding Licensee's Final Safety Analysis Report Amendment Related to Reactor Systems, Nuclear Performance and Code Review, and Plant Systems (TAC No. ME2731)" (ADAMS Accession No. ML101450084)]
2. NRC to TVA letter dated August 11, 2010, "Summary of August 3, 2010, Meeting With Tennessee Valley Authority Regarding Watts Bar Nuclear Plant, Unit 2, Final Safety Analysis Report" (ADAMS Accession No. ML102180055)
3. TVA to NRC letter dated October 4, 2010, "Watts Bar Nuclear Plant (WBN) Unit 2 – Final Safety Analysis Report (FSAR) – Response to Requests for Additional Information" (ADAMS Accession No. ML102800347)
4. NRC to TVA letter dated September 20, 2010, "Watts Bar Nuclear Plant, Unit 2 - Request for Additional Information Regarding Final Safety Analysis Report Related to Section 15 (TAC No. ME4074)" (ADAMS Accession No. ML102590244)
5. TVA to NRC letter dated November 9, 2010, "Watts Bar Nuclear Plant (WBN) Unit 2 – Final Safety Analysis Report (FSAR) – Response to Requests for Additional Information" (ADAMS Accession No. ML103200146)

cc (Enclosure):

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RAI for Various Portions of the FSAR [from NRC letter dated June 23, 2010 (Reference 1)]

SRXB 2. (15.2.14)

As an incident of moderate frequency, the Inadvertent Operation of Emergency Core Cooling System event (reported in Section 15.2.14 of FSAR Amendment 90), must not generate a more serious plant condition without other faults occurring independently. To meet this requirement, Section 15.2.14 states that, "Westinghouse currently uses the more restrictive criterion that a water-solid pressurizer condition be precluded when the pressurizer is at or above the set pressure of the pressurizer safety relief valves (PSRVs). This addresses any concerns regarding subcooled water relief through the plant PSRVs, which are not qualified for this condition. Should water relief through the pressurizer power-operated relief valves (PORVs) occur, the PORV block valves would be available, following the transient, to isolate the [reactor coolant system] RCS."

The NRC staff's position is outlined in Regulatory Issue Summary (RIS) 2005-29. Please provide an evaluation of the Inadvertent Operation of Emergency Core Cooling System event that is consistent with RIS 2005-29 and the guidelines of NUREG-0800, Rev 3.

Response:

The RIS presents concerns related to crediting the use of non-safety related pressurizer PORVs for mitigation of the Inadvertent Emergency Core Cooling System (ECCS) event and for protecting the PSRVs from water relief.

WBN Unit 1 was not licensed to the RIS 2005-09 positions. In this matter for WBN Unit 2, TVA is following the guidance provided by SECY-07-0096, "POSSIBLE REACTIVATION OF CONSTRUCTION AND LICENSING ACTIVITIES FOR THE WATTS BAR NUCLEAR PLANT UNIT 2, which stated, "The Commission supports a licensing review approach that employs the current licensing basis for Unit 1 as the reference basis for the review and licensing of Unit 2."

The inadvertent ECCS analysis presented in the FSAR is conservative and sufficient. WBN assures compliance with the analysis via operator manual actions as described below.

Background

The WBN analysis for inadvertent operation of the Emergency Core Cooling System (ECCS) is presented in Unit 2 FSAR Section 15.2.14 and is based on Westinghouse Letter LTR-A-09-181, Revision 1, dated November 17, 2009. The following excerpts are from the FSAR:

"Inadvertent operation of the ECCS at power is classified as a Condition II event, a fault of moderate frequency. The criteria established for Condition II events include...

- (c) An incident of moderate frequency should not generate a more serious plant condition without other faults occurring independently."

To address criterion (c), Westinghouse currently uses the more restrictive criterion that a water-solid pressurizer condition be precluded when the pressurizer is at or above the set pressure of the pressurizer safety relief valves (PSRVs). This addresses any concerns

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regarding subcooled water relief through the plant PSRVs, which are not qualified for this condition. Should water relief through the pressurizer power-operated relief valves (PORVs) occur, the PORV block valves would be available, following the transient, to isolate the reactor coolant system (RCS).

Pressurizer water level increases throughout the transient. Spray flow helps to condense the pressurizer steam bubble, causing a pressurizer insurge and minimizing pressurizer pressure. The ECCS injection flow is terminated via operator action in accordance with plant emergency procedures, and the increase in pressurizer level stops. The time required for injection termination is tracked in WBN procedure TI-12.19, "Control of Time Critical Operator Actions" as a time critical operator action which imposes additional restrictions and training requirements.

Although the pressurizer becomes water solid just prior to Safety Injection termination, the maximum pressure reached is below the pressurizer safety valve opening setpoint, thus preventing the safety valves from opening. As such, the integrity of the safety valves is not compromised. This precludes possible damage to the valves which could potentially generate a more serious plant condition.

The analysis acceptance criterion is that prevention of water relief through the pressurizer safety valves is adequate to demonstrate that the event does not propagate into a more serious event. This is based on the conservative assumption that any relief out of the safeties could cause challenge to the valves which might result in a small break loss-of-coolant-accident (Condition III event). The PORVs (and associated pressure relieving flow rate) are not modeled in the analysis since they would reduce the pressure of the filled pressurizer, thus reducing the possibility of opening the PSRVs. The modeling of the PORVs as unavailable is therefore considered a conservatism from the perspective of the safety analysis. In addition, PORV flow would be able to be terminated by the PORV block valves if required.

Although operator action terminates injection within 10 minutes in the safety analysis (the safety analysis has inherent conservatisms with respect to failure of non-safety related systems), informal studies on the WBN simulator at nominal plant conditions indicate the neither the PORVs nor PSRVs would be challenged for 30 minutes, thereby demonstrating additional margin.

Conclusion

The RIS was not part of the Unit 1 licensing basis. The safety analysis conservatively demonstrates the PSRVs are protected from water relief. With respect to the RIS position, WBN does not rely on the PORVs to protect the safety valves and although the pressurizer approaches water solid condition, the set pressure of the safeties is not reached and the valves are not expected to open.

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RAI for FSAR 5.2.2 [taken from NRC letter dated August 11, 2010 (Reference 2)]

5.2.2 - 1.b. *Further, the NRC staff discussed its comments on the analysis of an inadvertent actuation of the emergency core cooling system. The NRC staff informed TVA that it needs to consider the information in NRC Regulatory Information Summary 2005-29, "Anticipated Transients That Could Develop into More Serious Events," dealing with the qualification of the pressurizer power-operated relief valves (PORVs) for water discharge and the closure of the PORV block valves.*

See October 4, 2010, letter to NRC for original response (Reference 3):

Replacement Response:

See the response to RAI **SRXB 2. (15.2.14)**.

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RAIs for FSAR Chapter 15 [taken from NRC letter dated September 20, 2010 (Reference 4)]

Safety Evaluation Report (SER) 15.0.0

15.0.0 – 1.a. FSAR 15.0.0, “Accident Analyses”

FSAR Chapter 15 addresses the accident conditions listed in Table 15-1 of Regulatory Guide (RG) 1.70, which apply to WBN Units 1 and 2. The events listed in RG Table 15-1, include Item 5.2, “Chemical and volume control system [CVCS] malfunction (or operator error) that increases reactor coolant inventory.” Discuss why this analysis was not included in FSAR Chapter 15.2.14, as a Condition II event.

See November 9, 2010, letter to NRC for the original response (Reference 5):

Replacement Response:

This analysis was not included in Chapter 15.2.14 as a Condition II event since it is considered bounded by the Inadvertent Operation of the Emergency Core Cooling System event described in section 15.2.14. The approach used to address this accident condition for WBN Unit 2 is the same as that previously submitted and accepted for WBN Unit 1, and is described in detail below. The above method of bounding the transient is consistent with the FSAR accepted by the NRC at the time in which WBN Unit 1 was licensed. In this matter for WBN Unit 2, TVA is following the guidance provided by SECY-07-0096, “POSSIBLE REACTIVATION OF CONSTRUCTION AND LICENSING ACTIVITIES FOR THE WATTS BAR NUCLEAR PLANT UNIT 2,” which stated, “The Commission supports a licensing review approach that employs the current licensing basis for Unit 1 as the reference basis for the review and licensing of Unit 2.”

Background

The Inadvertent Operation of the Emergency Core Cooling System (inadvertent ECCS) event conservatively bounds the response to a CVCS malfunction event. The inadvertent ECCS event is described in FSAR Section 15.2.14 and is discussed in the response to **RAI SRXB 2. (15.2.14)**.

For the inadvertent ECCS event, two cases are analyzed to address the acceptance criteria of interest, including core DNB and pressurizer overfill.

In both cases, the charging pumps force concentrated boric acid solution from the RWST, through the common injection header and injection lines, and into the cold leg of each reactor coolant loop. The safety injection pumps also start automatically, but provide no flow when the RCS is at normal pressure. The passive injection system and the low head system provide no flow at normal RCS pressure. As a result, the same injection flowrates (i.e., charging flow) as would be expected in a CVCS malfunction event are modeled in the inadvertent ECCS analysis.

During a CVCS malfunction event, the injected flow would be expected to originate in the volume control tank (VCT) rather than in the RWST; as a result, the boron concentration of the injected flow would be expected to be lower during a CVCS malfunction event compared to an inadvertent ECCS event. As stated in Unit 2 FSAR Section 15.2.14.1 relative to the DNB case,

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“the reactor experiences a negative reactivity excursion due to the injected boron causing a decrease in reactor power. The power mismatch causes a drop in primary coolant temperature and coolant shrinkage. Pressurizer pressure and level drop.... The transient is eventually terminated by the reactor protection system low pressure trip or by manual trip.” As such, without the boron in the injected fluid, there would be no power mismatch and ultimately no pressure drop. The pressure drop is the only adverse impact with respect to DNB concerns caused by the event. Furthermore, the reactor trip is conservatively modeled to not occur as a result of the spurious safety injection signal, rather from the reactor protection system. The reactor protection system would provide the reactor protection during a CVCS malfunction event. Therefore, the inadvertent ECCS event bounds the CVCS malfunction event relative to DNB acceptance criteria.

With respect to pressurizer overflow, the boron concentration of the injected flow is of little concern as a reactor trip is assumed to occur as a result of the spurious safety injection signal. As discussed above, relative to DNB, a reactor protection system signal (for example, low pressurizer pressure) would be expected to cause the reactor trip. However, since the event for overflow is a timed event (i.e., the event duration is a function of an operator action to gain control of the plant), the delaying of a reactor trip would lead to less limiting results. As a result of the reactor trip, the RCS fluid contracts in response to the sudden loss of heat addition to the system. The fluid contraction causes an outsurge from the pressurizer and decrease in pressurizer water level. As the reactor trip is delayed, the time available between the reactor trip and the assumed operator action time decreases and therefore so does the likelihood that the pressurizer will fill within this time frame. As such, the modeling of a reactor trip at event initiation is conservative and the inadvertent ECCS analysis for pressurizer overflow conservatively bounds the pressurizer fill response to a CVCS malfunction event.

Conclusion

The CVCS malfunction event is not presented in the FSAR since it is qualitatively bounded by the Inadvertent ECCS event. This is the same position as previously licensed for Unit 1.

SER 15.2.2, “Change in Inventory Transients”

15.2.3 - 2.d. *FSAR 15.2.14, “Inadvertent Operation of Emergency Core Cooling System”*

How does the inadvertent ECCS actuation at power analysis address the concerns raised in RIS 2005-29?

Response:

See the response to RAI SRXB 2. (15.2.14).