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LTR-NRC-14-24

April 22, 2014

Subject: Submittal of LTR-FSE-14-29, Revision 0, "Acceptance Criteria and Applicability of the Westinghouse SHEILD® Passive Shutdown Seal for FLEX Strategies" (Non-Proprietary)

Enclosed is a copy of the non-proprietary engineering letter LTR-FSE-14-29 Revision 0, "Acceptance Criteria and Applicability of the Westinghouse **SHIELD**® [1] Passive Shutdown Seal for FLEX Strategies."

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Very truly yours,

James A. Gresham, Manager
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Enclosure

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Our ref: LTR-FSE-14-29, Revision 0

April 22, 2014

Subject: Acceptance Criteria and Applicability of the Westinghouse SHEILD® Passive Shutdown Seal for FLEX Strategies

References:

1. TR-FSE-14-1-P/NP, Revision 1, "Use of the Westinghouse SHIELD® Passive Shutdown Seal for FLEX Strategies," March 18, 2014

Background:

Westinghouse was requested by the United States Nuclear Regulatory Commission (NRC) to provide clarifications on the following topics based on their review of TR-FSE-14-1-P/NP, Revision 1, "Use of the Westinghouse SHIELD® Passive Shutdown Seal for FLEX Strategies," (Reference 1) received by NRC document control on March 21, 2014:

1. Pump Model Applicability
2. Reactor Coolant System Cold Leg Temperature
3. Reactor Coolant System Pressure
4. Treatment of the Shutdown Seal in Thermal Hydraulic Analyses

Discussion:

1. Pump Model Applicability

The performance of **SHIELD®** [1] passive thermal shutdown seal described in Reference 1 is applicable when the component is installed in Westinghouse-designed reactor coolant pumps of the Models 93, 93A, and 93A-1 designs. Implementation of the shutdown seal to pumps of those designs is supported by the qualification testing program documented in Section 7 of Reference 1. The qualification testing program documented in that section was designed to be representative of the Models 93, 93A, and 93A-1 reactor coolant pumps. In instances in which there is a difference between designs for each model, the most limiting configuration was used for testing (e.g., endurance testing was performed using the Model 93A-1 arrangement, as it has the largest extrusion gap). This approach ensures that the test program provided in Section 7 of Reference 1 is applicable to the shutdown seal for the Models 93, 93A, and 93A-1 pump designs.

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2. RCS Cold Leg Temperature

In consideration of the design parameters provided in Section 2.4.2 of Reference 1 the SHIELD passive thermal shutdown seal is limited to applications in which water in the reactor coolant system cold leg stabilizes at a temperature of 571°F during a loss of seal cooling event, not including short-term transient effects immediately following reactor trip.

The testing and evaluation methods outlined in Section 7.1.1 and 7.1.5 of Reference 1 regarding polymer ring and sleeve O-ring (Model 93A) are acceptable and can be applied to extend the applicability of the cited performance to equilibrium coolant temperatures higher than 571°F at the shutdown seal location.

In order for the shutdown seal to be implemented in plants in which the cold leg stabilizes at a temperature greater than 571°F:

1) Additional analysis can be performed to confirm that the maximum water temperature at the shutdown seal location is equal to or below that at which the polymer ring and sleeve O-ring (Model 93A) have been tested, as provided in Reference 1, Sections 7.2.1 and 7.2.3, respectively; or alternatively,

2) The polymer ring and sleeve O-ring (Model 93A) can be re-tested at the maximum water temperature and pressure, in the same fashion as the tests described in Reference 1, Section 7.1.1 and 7.1.5.

3. Reactor Coolant System Pressure

The performance of the Models 93 and 93A-1 SHIELD passive thermal shutdown seal described in Reference 1 is applicable when the long term post-trip reactor coolant pressure does not exceed 2250 PSIA. The performance of the component is not impacted by pressures of up to 2500 PSIA within the first 120 minutes of reactor trip, which is demonstrated by the polymer ring endurance testing described in Section 7.3.8.2, the results of which are provided in Section 7.4.8.2.2. As demonstrated in those tests, four polymer rings were held above 2500 PSIA for 168 hours without any leakage being measured.

The performance of the Model 93A SHIELD passive thermal shutdown seal described in Reference 1 is applicable when the long term post-trip reactor coolant pressure is bounded by the transient shown in Figure 7.1-2 of Reference 1. The transient shown in Figure 7.1-2 is based on a thermal hydraulic analysis of the reactor coolant system under extended loss of AC power conditions, which showed that, without operator action, a gradual depressurization is expected to occur as the pressurizer loses heat to the environment. A more rapid depressurization than that which is shown in Figure 7.1-2 would not impact the shutdown seal performance. Plants installing the shutdown seal should review applicable safety analyses to confirm that reactor coolant system pressure will not exceed the curve provided in Figure 7.1-2. For ELAP scenarios, the maximum reactor coolant system pressure is bounded by Figure 7.1-2 and the shutdown seal is qualified for use at those conditions. For certain non-ELAP scenarios, the reactor coolant system pressure may approach 2500 PSIA for the first 120 minutes following reactor trip. The polymer ring endurance testing described in Section 7.3.8.2 and Section 7.4.8.2.2 demonstrates that the polymer ring will maintain sealing at those conditions. Additionally, O-ring reliability testing discussed in Section 7.1.5 provides confidence that the shaft sleeve O-ring will maintain sealing at those conditions.

The testing and evaluation methods outlined in Section 7.1.1 and 7.1.5 of Reference 1 regarding polymer ring and secondary elastomer seal thermal performance are acceptable and can be applied to extend the applicability of the cited performance to pressures greater than those described above.

4. Treatment of the Shutdown Seal in Thermal Hydraulic Analyses

For thermal hydraulic evaluations of the reactor coolant system during ELAP conditions, Westinghouse recommends assuming a constant seal leakage rate of 1 gpm/pump starting at the time of reactor trip and continuing for the duration of the event. Although seal leakage may be higher than 1 gpm/pump before shutdown seal actuation, the total integrated inventory loss expected during that time period is negligible when compared to the total RCS mass because the time period before actuation is on the order of 10 minutes compared to the 168 hour duration of the ELAP event.

Please contact the undersigned with any questions or concerns.

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