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Your ref: Docket No. 52-006
Our ref: DCP/NRC2484

May 20, 2009

Subject: AP1000 Response to Request for Additional Information (SRP 5)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 5. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in this response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Enclosure 1 provides the response for the following RAI(s):

RAI-SRP5.3.2-CIB1-02 R1

Questions or requests for additional information related to the content and preparation of this response should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

Robert Sisk, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

/Enclosure

1. Response to Request for Additional Information on SRP Section 5

D063
NRO

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ENCLOSURE 1

Response to Request for Additional Information on SRP Section 5

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP5.3.2-CIB1-02
Revision: 1

Question:

Generic Letter (GL) 96-03 establishes seven specific technical criteria which PTLRs must satisfy. One of these criteria, PTLR criterion 3, pertains to the plant's Low Temperature Overpressure Protection (LTOP) system for ensuring that the reactor coolant system (RCS) pressure remains below the applicable P-T limits at low temperatures. PTLR criterion 3 states that the PTLR must provide LTOP system limit curves or setpoints. The AP1000 generic PTLR does not include this data. Please supplement the AP1000 generic PTLR to include LTOP system limit curves or setpoints.

Westinghouse Response:

The Normal Residual Heat Removal System (RNS) pump suction line relief valve or depressurization of the RCS and establishment of a vent area provides the LTOP for RCS at low temperature operation (≤275˚F) [LCO 3.4.14]. The AP1000 design basis Mass Input (MI) and the Heat Input (HI) transients have been analyzed (Reference 1) and the RNS pump suction line relief valve lift setpoint of 500 psig and a full open pressure of 550 psig will keep the RCS pressure below the allowable pressure temperature limit shown in Table 2 of the generic PTLR (Reference 2). The lift setpoint was determined using the methodology described in Reference 3.

The following section will be added in the PTLR.

2.1 Low Temperature Overpressure Protection (LTOP) System

The Normal Residual Heat Removal System (RNS) pump suction line relief valve will have a lift setpoint of 500 psig with a full open pressure of 550 psig. The lift setpoint has been developed using the NRC approved methodology specified in Reference 2.

References:

1) APP-RNS-M3C-002, Revision 2, AP1000 LTOPS Analyses/Normal RHR Relief Valve Sizing Evaluation

2) APP-RXS-Z0R-001, Revision 1, AP1000 Generic Pressure Temperature Limits Report

3) WCAP-14040-NP-A, Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves

Additional Westinghouse Response based on NRC comments at 3/18/09 meeting:

Westinghouse decided to provide a generic pressure-temperature limit report (PTLR) in conjunction with a future AP1000 DCD amendment for use by AP1000 COL applicants. Upon review and approval of the PTLR, COL applicants will be able to use it for their respective plants as long as the PTLR methodology remains the same. In conjunction with the Bellefonte R-COLA review, the NRC staff is requesting the COL applicant to provide license conditions in which (1) the COL Holder will be required to update its P-T limits using the PTLR methodologies approved in the AP1000 DCD and using plant-specific material properties and (2) the COL Holder will be required to inform the NRC of its plans to use updated P-T limits. Westinghouse provided its generic PTLR for NRC review and approval in a letter dated May 30, 2008. The NRC's evaluation of the PTLR will be discussed in a letter to Westinghouse. However, the staff finds that Westinghouse needs to provide the PTLR reference in its DCD.

Westinghouse will include the PTLR reference in DCD sections 5.3.3.1 and 5.3.7 as shown below. Revision 2 of the PTLR is provided under separate cover.

Design Control Document (DCD) Revision:

~~None~~

Modify DCD Section 5.3.3.1 as shown:

5.3.3 Pressure-Temperature Limits

5.3.3.1 Limit Curves

Heatup and cooldown pressure-temperature limit curves are required as a means of protecting the reactor vessel during startup and shut down to minimize the possibility of fast fracture. The methods outlined in Appendix G of Section III of the ASME Code are employed in the analysis of protection against nonductile failure. Beltline material properties degrade with radiation exposure, and this degradation is measured in terms of the adjusted reference nil ductility temperature, which includes a reference nil ductility temperature shift (ΔRT_{NDT}), initial RT_{NDT} and margin. The extent of the RT_{NDT} shift is enhanced by certain chemical elements (such as copper and nickel).

Predicted ΔRT_{NDT} values are derived considering the effect of fluence and copper and nickel content for the reactor vessel steels exposed to 550°F temperature. U.S. NRC Regulatory Guide 1.99 is used in calculating adjusted reference temperature. Since the AP1000 cold leg temperature exceeds 525°F (minimum steady-state temperature is 535°F at 100% power, thermal design flow, and 10% tube plugging), the procedures of Regulatory Guide 1.99 for nominal embrittlement apply. The heatup and cooldown curves are developed considering a sufficient magnitude of radiation embrittlement so that no

unirradiated ferritic materials in other components of the reactor coolant system will be limiting in the analysis.

The pressure-temperature curves are developed considering a radiation embrittlement of up to 54 effective full power years (EFPY) consistent with the plant design objective of 60 years with 90 percent availability. Copper, nickel contents and initial RT_{NDT} for materials in the reactor vessel beltline region and the reactor vessel flange and the closure head flange region are shown in Tables 5.3-1 and 5.3-3. The operating curves are developed with the methodology given in Reference 6, which is in accordance with 10 CFR 50, Appendix G with the following exceptions:

1. The fluence values used are calculated fluence values (i.e., comply with Regulatory Guide 1.190), not the best-estimate fluence values.

2. The K_{Ic} critical stress intensities are used in place of the K_{Ia} critical stress intensities. This methodology is taken from approved ASME Code Case N-641 (which covers Code Cases N-640 and N-588).

3. The 1996 Version of Appendix G to Section XI is used rather than the 1989 version.

The curves are applicable up to 54 effective full-power years. These curves, shown in Figures 5.3-2 and 5.3-3, are generic curves for the AP1000 reactor vessel design and they are limiting curves based on copper and nickel material composition (Reference 9). These curves are applicable as long as the following criteria are met:

- 10 CFR 50, Appendix G as related to pressure-temperature remains unchanged,

- Adjusted Reference Temperatures at 1/4T and 3/4T locations remain below the bases of Figures 5.3-2 and 5.3-3

The results of the material surveillance program described in subsection 5.3.2.6 will be used to verify the validity of ΔRT_{NDT} used in the calculation for the development of heatup and cooldown curves. The projected fluence, copper, and nickel contents along with the RT_{NDT} calculation will be adjusted if necessary, from time to time using the surveillance capsule results. This may require the development of new heatup and cooldown curves.

Higher rates of temperature changes when the reactor coolant system pressure is at or above the operating pressure do not impact the determination of the proper curve to use. Figure 5.3-2 also includes a curve for the leak test limit at steady-state temperature and curves for the criticality limit for nuclear heatup.

Temperature limits for core operation, inservice leak and hydrotests are calculated in accordance with the ASME Code, Section III, Appendix G.

Modify DCD Section 5.3.7 as shown:

5.3.7 References

1. ASTM E-185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels."

2. Regulatory Guide 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," United States Nuclear Regulatory Commission, Office of Nuclear Reactor Research, March, 2001.

3. WCAP-15557, "Qualification of the Westinghouse Pressure Vessel Neutron Fluence Evaluation Methodology," S. L. Anderson, August 2000.

4. NRC Policy Issue, "Pressurized Thermal Shock," SECY-82-465, November 23, 1982.

5. Theofanous, T.G., et al., "Limits of Coolability in the AP1000-Related ULPU-2400 Configuration V Facility," CRSS-03/06, June 2003.

6. WCAP-14040-NP-A, Revision 2, "Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves," J. D. Andrachek, et al., January 1996.

7. APP-GW-GLR-023, "Surveillance Capsule Lead Factor and Azimuthal Location Confirmation," Westinghouse Electric Company LLC.

8. APP-GW-GLR-060, "Reactor Vessel Insulation System – Verification of In-Vessel Retention Design Bases," Westinghouse Electric Company LLC.

9. APP-RXS-Z0R-001, Revision 2, "AP1000 Generic Pressure Temperature Limits Report," F. C. Gift, September 2008.

Modify DCD Chapter 16, Section 3.4.14, "LTOP System", as shown:

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.14 Low Temperature Overpressure Protection (LTOP) System

LCO 3.4.14 At least one of the following Overpressure Protection Systems shall be OPERABLE, with the accumulators isolated:

a. The Normal Residual Heat Removal System (RNS) suction relief valve with lift setting within the limit specified in the PTLR (Reference 3), or

b. The RCS depressurized and an RCS vent of ≥4.15 square inches.

Modify DCD Section 16.1.2 "References" (page 16.1-2), as shown:

16.1.2 References

1. APP-GW-GLR-064, "AP1000 Generic Technical Specifications Completion," Westinghouse Electric Company LLC.

2. APP-GW-GLN-075, "AP1000 Generic Technical Specifications for Design Changes," Westinghouse Electric Company LLC.

3. APP-RXS-Z0R-001, Revision 2, "AP1000 Generic Pressure Temperature Limits Report," F. C. Gift, September 2008.

Modify DCD Chapter 16, Section B 3.4.14, "LTOP System," as shown:

LTOP System
B 3.4.14

LCO

This LCO requires that the LTOP System is OPERABLE. The LTOP System is OPERABLE when the maximum coolant input and minimum pressure relief capabilities are OPERABLE. Violation of this LCO could lead to the loss of low temperature overpressure mitigation and violation of the Reference 1 limits as a result of an operational transient.

To limit the coolant input capability, the LCO requires all accumulator discharge isolation valves closed and immobilized, when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS temperature allowed in the PTLR.

The elements of the LCO that provide low temperature overpressure mitigation through pressure relief are:

a. One OPERABLE RNS suction relief valve; or

An RNS suction relief valve is OPERABLE for LTOP when both RNS suction isolation valves in one flow path are open, its setpoint is set within the PTLR (Reference 6) limits, and testing has proven its ability to open at this setpoint.

Modify DCD Section 16.1.2 "References" (Page B 3.4.14 – 8), as shown:

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix G, "Fracture Toughness Requirements."
2. Generic Letter 88-11, "NRC Position on Radiation Embrittlement of Reactor Vessel Materials and Its Impact on Plant Operation."
3. ASME Boiler and Pressure Vessel Code, Section III.
4. Section 5.2.2, "Overpressure Protection."
5. ASME OM Code, "Code for Operation and Maintenance of Nuclear Power Plants."
6. APP-RXS-Z0R-001, Revision 2, "AP1000 Generic Pressure Temperature Limits Report," F. C. Gift, September 2008.

PRA Revision:

None

Technical Report (TR) Revision:

None