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Your ref: Docket No. 52-006
Our ref: DCP/NRC2320

December 12, 2008

Subject: AP1000 Responses to Requests for Additional Information (SRP16)

Westinghouse is submitting responses to the NRC request for additional information (RAI) on SRP Section 16. These RAI responses are submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in the responses is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Responses are provided for the following RAIs:

RAI-SRP16-CTSB-10	RAI-SRP16-CTSB-33
RAI-SRP16-CTSB-27	RAI-SRP16-CTSB-35
RAI-SRP16-CTSB-28	RAI-SRP16-CTSB-36
RAI-SRP16-CTSB-29	RAI-SRP16-CTSB-37
RAI-SRP16-CTSB-31	RAI-SRP16-CTSB-71

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
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/Enclosure

1. Responses to Requests for Additional Information on SRP Section 16

D063
NRO

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ENCLOSURE 1

Responses to Requests for Additional Information on SRP Section 16

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP16-CTSB-10
Revision: 0

Question:

TS 3.4.8, Minimum RCS Flow.

Evaluate TS 3.4.8 and related information in TS bases B 3.4.8 for the applicability of a Note in LCO 3.4.8 to ensure operability of the PRHR HX is maintained in Shutdown Modes 4 and 5, if applicable. Revise LCO 3.4.8 and related information in the bases B 3.4.8, as appropriate.

For operability of the Passive Residual Heat Removal Heat Exchanger (PRHR HX) in Shutdown Modes 4 and 5 with RCS intact, LCO 3.5.5 contains a Note that requires "when any reactor coolant pumps (RCPs) are operating, at least one RCP must be operating in the loop with the PRHR HX, Loop 1." This Note should also be placed in LCO 3.4.8 when at least one RCP shall be in operation to provide the minimum RCS Flow in Modes 3, 4, and 5. The staff's concern is that a reverse flow in the idle loop may affect the operability of the PRHR HX, if required.

Westinghouse Response:

No change is proposed to TS 3.4.8 to cross-reference the RCP operating limits related to PRHR HX OPERABILITY that are specified in the note in LCOs 3.5.4 and 3.5.5 that are not associated with the RCS flow basis protected by LCO 3.4.8.

TS 3.4.8 establishes the minimum RCS loop flow requirements to maintain sufficient mixing of boric acid in the RCS during a boron dilution event. TS 3.4.8 flow requirements do <u>not</u> cross-reference the RCS flow requirements for PRHR HX OPERABILITY to avoid confusion with the basis for the TS 3.4.8 minimum RCS flow requirements.

As specified in the note for LCOs 3.5.4 and 3.5.5 that is based on establishing OPERABILITY of the PRHR HX, when any RCPs are operating in the specified MODES, at least one RCP must be operating in Loop 1.

Plant operating procedures must collectively compile the design and Technical Specification requirements that operators must follow, providing the administrative / operational controls. For example, the operating procedures must also integrate the flow-related design requirement that if any RCPs are operating, there must be at least one RCP operating in Loop 1 because both pressurizer spray flow lines come from the Loop 1 RCPs 1A and 1B. Either of these RCPs is the first RCP started for both reasons, PRHR HX operability and RCS spray flow capability.

The staff's concern presented in this RAI are appropriately captured from the various requirements throughout Technical Specification and integrated into the plant operating procedures used for all plant operating MODES.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP16-CTSB-27
Revision: 0

Question:

TS 3.4.6, Pressurizer Safety Valves.

Revise SR 3.4.6.1 and related information in TS bases B 3.4.6 to reconcile the lift setpoint requirements.

LCO 3.4.6 specifies the allowable range for OPERABILITY of the Pressurizer Safety Valves to be from 2460 psig to 2510 psig (2485 psig +/- 1%). SR 3.4.6.1 requires verification that the lift setting to be within +/- 1%. The basis for SR 3.4.6.1, however, states that "the pressurizer safety valve setpoint is +/- 3% for OPERABILITY, and the valves are reset to +/- 1% during the Surveillance to allow for drift." Also, it should be noted that the +/- 1% tolerance is based on ASME Code, Section III, NB 7500 requirements which state, in part, "the set pressure tolerance plus or minus shall not exceed the following: 2 psi (15 kPa) for pressures up to and including 70 psi (480 kPa), 3% for pressures from 70 psi (480 kPa) to 300 psi (2 MPa), 10 psi (70 kPa) for pressures over 300 psi (2 MPa) to 1,000 psi (7 MPa), and 1% for pressures over 1,000 psi (7 MPa). The set pressure tolerance shall apply unless a greater tolerance is established as permissible in the Overpressure Protection Report (NB-7200)."

Westinghouse Response:

See response to identical RAI - RAI-SRP-16-CTSB-08.

Design Control Document (DCD) Revision:

See response to identical RAI - RAI-SRP-16-CTSB-08.

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP16-CTSB-28
Revision: 0

Question:

TS 3.4.8, Minimum RCS Flow. Technical Report (TR) 80.

Revise LCO 3.4.8 and related information in TS bases B 3.4.8 to reflect the RNS pump operation including a justification that the affected RCS volume is well mixed under this configuration. Also, list FSAR Section 15.4.6 as a reference in the TS bases B 3.4.8.

AP1000 TS 3.4.8 is used to establish a minimum RCS flow rate through the reactor core in support of boron dilution event during plant shutdown at Mode 5. 10CFR50.36(d)(2)(ii) requires an LCO to be established for "a process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis." The fifth bullet paragraph of Section 15.4.6.2.2 is being revised under TR 80 to allow for an alternate equipment lineup (e.g. using RNS pumps versus one RCP, to maintain the minimum RCS flow required in Mode 5 under TS 3.4.8. No change to TS 3.4.8 or the associated bases B 3.4.8 is being proposed to account for this alternate equipment lineup.

Westinghouse Response:

See response to identical RAI - RAI-SRP-16-CTSB-09.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP16-CTSB-29
Revision: 0

Question:

TS 3.4.8, Minimum RCS Flow.

Evaluate TS 3.4.8 and related information in TS bases B 3.4.8 for the applicability of a Note in LCO 3.4.8 to ensure operability of the PRHR HX is maintained in Shutdown Modes 4 and 5, if applicable. Revise LCO 3.4.8 and related information in the bases B 3.4.8, as appropriate.

For operability of the Passive Residual Heat Removal Heat Exchanger (PRHR HX) in Shutdown Modes 4 and 5 with RCS intact, LCO 3.5.5 contains a Note that requires "when any reactor coolant pumps (RCPs) are operating, at least one RCP must be operating in the loop with the PRHR HX, Loop 1." This Note should also be placed in LCO 3.4.8 when at least one RCP shall be in operation to provide the minimum RCS Flow in Modes 3, 4, and 5. The staff's concern is that a reverse flow in the idle loop may affect the operability of the PRHR HX, if required.

Westinghouse Response:

See response to identical RAI - RAI-SRP-16-CTSB-10.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP16-CTSB-31
Revision: 0

Question:

TS 3.7.1, Main Steam Safety Valves (MSSVs). Technical Report (TR) 74C, Revision 0.

Provide additional justification for the change of tolerance from 1% to 3% for the setpoint setting of MSSVs in Table 3.7.1-2.

AP1000 DCD Revision 15 specifies a tolerance of 1%. TR 74C, Revision 0, proposed a change from 1% to 3%. The 1% tolerance was based on requirements of ASME Code, Section III, NC 7000 (Subsection NC 7512) which is listed as Reference 2 in the TS bases B 3.7.1. ASME Code Subsection NC 7512 states, in part, "The set pressure tolerance plus or minus shall not exceed the following: 2 psi (15 kPa) for pressures up to and including 70 psi (500 kPa), 3% for pressures over 70 psi (500 kPa) up to and including 300 psi (2000 kPa), 10 psi (70 kPa) for pressures over 300 psi (2000 kPa) up to and including 1000 psi (7000 kPa), and 1% for pressures over 1000 psi (7000 kPa). The set pressure tolerance shall apply unless a greater tolerance is established as permissible in the Overpressure Protection Report (NC-7200)." For justification of the proposed change, in TR 74C, Westinghouse states "Table 3.7.1-2 as-found setting was revised from 1% to 3% to be consistent with NUREG-1431 and the AP1000 Bases," however, the 3% value is bracketed in the STS, NUREG-1431, depending on conformance to ASME Code requirements discussed above.

Westinghouse Response:

See response to identical RAI - RAI-SRP-16-CTSB-11.

Design Control Document (DCD) Revision:

See response to identical RAI - RAI-SRP-16-CTSB-11.

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP16-CTSB-33
Revision: 0

Question:

TS Bases B 3.6.9, pH Adjustment. Technical Report (TR) 74A, Revision 1.

Revise the TS bases B 3.6.9 to provide the value of the minimum TSP manufactured density which is used to convert the required TSP amount from a mass number to a volume number.

A mass value of 27540 pounds is given for the required TSP amount in the AP1000 DCD Subsection 6.3.2.2.4. LCO 3.6.9 specifies a minimum TSP amount of 560 cubic feet. The TS bases B 3.6.9 further state "a required volume is specified instead of mass because it is not feasible to weigh the TSP in the containment. The minimum required volume is based on the manufactured density of TSP." The minimum TSP manufactured density value is needed to verify the accuracy of the calculated volume. In addition, TR 74A, Revision 1 proposed a change from "27540 pounds" to "26460 pounds" for the minimum TSP mass value listed in the TS bases B 3.6.9, but the specified volume number of 560 cubic feet remains the same in LCO 3.6.9. Also, DCD Subsection 6.3.2.2.4 should be changed to reflect the new mass number of 26460 pounds.

Westinghouse Response:

The bracketed value of 27,540 pounds represented a preliminary estimate for a Bases example in calculating the minimum TSP mass (and its associated TSP volume) for the AP1000 in the post-LOCA sump pH adjustment calculation.

The preliminary calculated Bases example mass (and its associated volume) considered effects such as those associated with the preliminary estimates of the post-accident, long-term acid and base formation phenomena discussed in the response to RAI-SRP6.5.2-CIB1-001, and also included additional margin to establish the minimum Technical Specification volume.

The minimum mass example calculation in the TS 3.6.9 Bases also reflected the overly conservative preliminary bracketed values of water volume and boron concentration that are shown marked out in the DCD Revision 16 update.

Therefore, the specific mass value (and its associated volume value) in the TS 3.6.9 Bases example is <u>not</u> directly tied to the minimum LCO and SR 3.6.9.1 TSP volume, due to the additional specified margin to determine the TS minimum volume limit from the example mass value.

The final un-bracketed value of 26,460 pounds was updated based on evolving containment sump pH calculation details and is consistent with the containment sump pH calculation, also reflecting updated containment water volumes and boron concentrations, as well as updated margin to establish the Technical Specification LCO and SR TSP volume.

The cumulative effects of updating all the various input information retained the initial Technical Specification TSP volume and slightly adjusted the example TSP mass in the TS 3.6.9 Bases example as indicated in the DCD Revision 16 markup changes.

The information in the Technical Specification limit and Bases example represent the current sump pH calculation information.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP16-CTSB-35
Revision: 0

Question:

TS 3.4.14 Low Temperature Over Protection System (LTOP)

Provide additional justification for the RCS vent reduction. The final value of an RCS vent is given as greater than or equal to 4.15 square inches replacing the bracketed (preliminary) value of 9.3 square inches.

Additional justification is needed to reduce the size of the RCS vent. The RCS vent size was 9.3 square inches and the requested change is 4.15 square inches. The AP1000 design of the RNS suction relief valve and piping should have been understood prior to in the design yet the cross sectional area of the valve has just been reduced by over half. With the exception of the numerical value, all other verbiage remained unchanged. Therefore there is no basis provided to support this change.

Westinghouse Response:

The bracketed volume of 9.3 in^2 represented a preliminary estimate of the RNS suction relief valve inlet piping size, assuming a 4-inch relief valve inlet line size. This preliminary sizing was based in early valve vendor information that indicated a larger relief valve was likely to be needed to support the required valve performance and valve orifice sizing, based on the LTOP analysis flow rates. The early information indicated that the smaller line size may possibly be acceptable, but the vendor could not definitively confirm that the smaller valve inlet pipe size was acceptable, so a larger inlet line size was selected.

The final un-bracketed value of 4.15 in^2 was updated based on evolving RNS LTOP information and subsequent confirmation with a valve vendor that a 3-inch RNS suction relief valve inlet line would be acceptable at relieving the rated LTOP flow rate (from the LTOP analysis calculation) with acceptable valve performance, as part of the continuing efforts to resolve bracketed TS information.

The AP1000 LTOP relief valve performance is sized based on design basis water-solid plant conditions since the plant design accommodates operation in this condition. However, the normally anticipated plant startup and shutdown operations are not expected to include water-solid operations. Therefore, LTOP operation with a steam bubble in the pressurizer are expected to be significantly less of a challenge to the LTOP relief valve flow rate and inlet conditions for either the mass or heat addition cases since the pressurizer steam bubble will help to mitigate (cushion) the consequences of either event, and to reduce the operational transients experienced by the LTOP relief valve for these events.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP16-CTSB-36
Revision: 0

Question:

TS 3.5.4 Passive Residual Heat Removal Heat Exchanger System

Deleted brackets in SR 3.5.4.3:

The volume of the non-condensable gases in the PRHR HX inlet line changed to <= 0.9 ft^3 from <= 0.4 ft^3. Provide additional justification for this change.

Westinghouse Response:

The bracketed volume of 0.4 ft^3 represented a preliminary estimate of the non-condensable gas volume in the PXS PRHR HX inlet piping since the specific location of the limit switch alarms was not finalized.

The un-bracketed value of 0.9 ft^3 was updated based on evolving design details for the PXS piping and reflects the correct design value, based on the position of the sensing limit switches in the high point pipe stub section.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP16-CTSB-37
Revision: 0

Question:

TS 3.5.6 In-containment Refueling Water Storage Tank

Deleted brackets in SR 3.5.6.2; Verify the IRWST borated water volume was changed and brackets removed:

Provide additional justification for the reduction of the IRWST borated water volume from 73,900 ft^3 to 73,100 ft^3. This change also affects SR 3.5.8.2.

Westinghouse Response:

The bracketed volume of 73,900 ft^3 represented a preliminary estimate of the minimum design basis IRWST water volume.

The un-bracketed value of 73,100 ft^3 was updated based on evolving IRWST design details, is consistent with the updated IRWST volume provided in DCD Table 6.3-2 (Sheet 2), and reflects a more conservative water volume that was appropriately used in safety analyses.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP16-CTSB-71
Revision: 0

Question:

Correct the following editorial errors:

1. (Page B 3.5.2) In Applicability first sentence, delete "4" to read "In Modes 1,2 and 3"

2. (Page 3.5.4-3) In SR 3.5.4.5, delete "System level"

3. (Page B 3.5.4-3) In Actions D.1 and D.2 first sentence, delete "or the LCO is not met for reasons other than Conditions A, B, or C."

4. (Page B 3.5.8-1) In LCO second paragraph, change from "sump recirculation isolation valves must be closed" to "sump recirculation isolation valves must be open"

Westinghouse Response:

1. Both LCO 3.5.2 and the associated Bases correctly specify the Applicability as:

   MODES 1, 2, 3, and 4 when the RCS is not being cooled by the Normal Residual Heat Removal System (RNS).

   Therefore, no change to the Bases 3.5.2, Applicability section is needed.

2. The reference to the System Level Inservice Testing in the Frequency for SR 3.5.4.5 will be corrected to delete "System Level."

3. The identified Bases 3.5.4 Actions D.1 and D.2 change is required. The attached markup shows deletion of "or the LCO is not met for reasons other than Conditions A, B, or C" from Action D.

4. The motor operated sump recirculation isolation valves are normally open as indicated in DCD Figure 6.3-2. The indicated TS 3.5.8 Bases sentence will be revised to be consistent with the PXS design.

Design Control Document (DCD) Revision:

A markup of the affected DCD Revision 17 page is attached.

PRA Revision:

None

Technical Report (TR) Revision:

None

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.5.4.1	Verify the outlet manual isolation valve is fully open.	12 hours
SR 3.5.4.2	Verify the inlet motor operated isolation valve is open.	12 hours
SR 3.5.4.3	Verify the volume of noncondensible gases in the PRHR HX inlet line is ≤ 0.9 ft^3.	24 hours
SR 3.5.4.4	Verify that power is removed from the inlet motor operated isolation valve.	31 days
SR 3.5.4.5	Verify both PRHR air operated outlet isolation valves and both IRWST gutter isolation valves are OPERABLE by stroking open the valves.	In accordance with the ~~System Level~~ Inservice Testing Program
SR 3.5.4.6	Verify PRHR HX heat transfer performance in accordance with the System Level OPERABILITY Testing Program.	10 years
SR 3.5.4.7	Verify by visual inspection that the IRWST gutters are not restricted by debris.	24 months

BASES

ACTIONS

A.1

The outlet line from the PRHR HX is controlled by a pair of normally closed, fail open, air operated valves, arranged in parallel. Thus they are redundant and, if either valve is OPERABLE, the system can function at 100% capacity, assuming other OPERABILITY conditions are met.

If one valve is inoperable, a Completion Time of 72 hours has been allowed to restore the inoperable valve(s) to OPERABLE status. This Completion Time is consistent with the Completion Times specified for other parallel redundant safety related systems.

B.1

With one air operated IRWST gutter isolation valve inoperable, the remaining isolation valve can function to drain the gutter to the IRWST. Action must be taken to restore the inoperable gutter isolation valve to OPERABLE status within 72 hours. The 72 hour Completion Time is acceptable based on the capability of the remaining valve to perform 100% of the required safety function assumed in the safety analyses.

C.1

Excessive amounts of noncondensible gases in the PRHR HX inlet line may interfere with the natural circulation flow of reactor coolant through the PRHR HX. The presence of some noncondensible gases does not mean that the PRHR HX is immediately inoperable, but that gases are collecting and should be vented. The venting of these gases requires containment entry to manually operate the appropriate vent valves. A Completion Time of 24 hours is acceptable considering that passive feed and bleed cooling is available to remove heat from the RCS.

D.1 and D.2

If any of the above Required Actions have not been accomplished in the required Completion Time ~~or the LCO is not met for reasons other than Conditions A, B, or C~~, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 4, with the RCS cooled by the RNS, within 24 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

B 3.5 PASSIVE CORE COOLING SYSTEM (PXS)

B 3.5.8 In-containment Refueling Water Storage Tank (IRWST) – Shutdown, MODE 6

BASES

BACKGROUND	A description of the IRWST is provided in LCO 3.5.6, "In-containment Refueling Water Storage Tank (IRWST) – Operating."
APPLICABLE SAFETY ANALYSES	For MODE 6, heat removal is provided by IRWST injection and containment sump recirculation. IRWST injection could be required to mitigate some events by providing RCS inventory makeup. One line with redundant, parallel valves is required to accommodate a single failure (to open) of an isolation valve. The IRWST satisfies Criteria 2 and 3 of 10 CFR 50.36(c)(2)(ii).
LCO	The IRWST requirements ensure that an adequate supply of borated water is available to supply the required volume of borated water as safety injection for core cooling and reactivity control. To be considered OPERABLE, the IRWST in combination with the refueling cavity must meet the water volume, boron concentration, and temperature limits defined in the Surveillance Requirements, and one path of injection and recirculation must be OPERABLE. The motor operated injection isolation valve must be open and power removed, and the motor operated sump recirculation isolation valves must be ~~closed~~ open and OPERABLE. Any cavity leakage should be estimated and made up with borated water such that the volume in the IRWST plus the refueling cavity will meet the IRWST volume requirement.
APPLICABILITY	In MODE 6, the IRWST is an RCS injection source of borated water for core cooling and reactivity control. The requirements for the IRWST in MODES 1, 2, 3, and 4 are specified in LCO 3.5.6, In-containment Refueling Water Storage Tank (IRWST) – Operating. The requirements for the IRWST in MODE 5 are specified in LCO 3.5.7, In-containment Refueling Water Storage Tank (IRWST) – Shutdown, MODE 5.