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Subject: AP1000 Response to Proposed Open Item (Chapter 16)

Westinghouse is submitting a response to the NRC open item (OI) on Chapter 16. This proposed open item 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 proposed Open Item(s):

OI-SRP16-CTSB-07
OI-SRP16-CTSB-61
OI-SRP16-CTSB-62

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,

D. A. Lindgren / FOR

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/Enclosure

1. Response to Request for Additional Information on SRP Section 16

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NRO

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ENCLOSURE 1

Response to Request for Additional Information on Chapter 16

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: OI-SRP16-CTSB-07
Revision: 0

Question:

Although no change was proposed to TS 3.4.11/12 as part of the AP1000 DC amendment application, the staff noted that the scope of Condition A was not clearly defined. In RAI-SRP16-CTSB-07, the staff asked Westinghouse to explain the difference in scope of inoperable equipment involved between TS 3.4.11/3.4.12 Condition A, which states "One required flow path inoperable," and Condition B, which states, "One required stage 1 ADS flow path inoperable AND Either one required stage 2 or stage 3 ADS flow path inoperable."

In its October 27, 2008, response letter, Westinghouse stated the following:

> As described in the 3.4.11 and 3.4.12 Bases, Conditions A and B cover two different combinations of ADS flow path inoperabilities....Separate Conditions are specified, since both Conditions A and B may be entered at the same time. The inoperabilities covered by the two Conditions are permissible at the same time, since the safety function can be accomplished by the remaining seven ADS flow paths without a single failure. The loss of capacity while in Conditions A and B is equivalent to a single failure of the power to the valves in one division, as considered in the accident analyses.

Westinghouse further stated "the LCO 3.4.11 and LCO 3.4.12 and associated Bases are technically correct, as-is. However, to clarify the system status while in both Conditions A and B the following statement is added in each of the Bases at the beginning of the Actions sections:

> The loss of automatic depressurization system (ADS) capacity, if both Conditions A and B are entered at the same time, is equivalent to a single failure of the power to the valves in one division, as considered in the accident analyses."

Based on this response and considering the four-stage ADS design, the staff believes that additional changes are required for Condition A to explicitly list Stage 4 ADS flow path in its scope and to clearly indicate the difference between Conditions A and B. The NRC staff identified this as Open Item OI-SRP16-CTSB-07.

Westinghouse Response:

The LCO 3.4.11 and 3.4.12 Conditions have been revised to provide a new, separate Condition for one inoperable stage 4 ADS flow path. In conjunction with this change, the existing Conditions have been modified to provide coverage for inoperabilities up to the equivalent to the loss of the ADS division with the largest capacity. The new and revised Conditions are as follows:

Condition A one inoperable stage 1, 2, or 3 flow path; restore within 7days

Condition B	one inoperable stage 4 flow path; restore within 72 hours
Condition C	two or three inoperable flow paths with a combined inoperable flow capacity no more than that of the largest capacity division; restore within 72 hours
Condition D	same as old Condition C; shutdown to MODE 5 within 36 hours

For Condition C, any combination of two or three inoperable flow paths up to the largest capacity ADS division is equivalent to the worst case single failure of a division. ADS divisions A and B are the largest capacity divisions consisting of:

One stage 1 - 4" flow path

One stage 2 - 8" flow path

One stage 4 - 14" flow path

Inoperabilities of two or three flow paths with a combined inoperable flow capacity greater than that of the largest capacity division are not covered by Condition C and require entry into Condition D.

Corresponding Bases changes have been made, including an explanation of the applicable Condition C inoperabilities.

Markups of LCO 3.4.11 and LCO 3.4.12 and the associated Bases are attached.

Design Control Document (DCD) Revision:

Markups of LCO 3.4.11 and the Bases are attached. The same changes also apply to LCO 3.4.12 and the Bases

PRA Revision:

None

Technical Report (TR) Revision:

None

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.11 Automatic Depressurization System (ADS) – Operating

LCO 3.4.11 The ADS, including 10 flow paths, shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One stage 1, 2, or 3 ADS flow path inoperable.	A.1 Restore flow path~~(s)~~ to OPERABLE status.	~~72 hours~~ 7 days
B. One stage 4 ADS flow path inoperable.	B.1 Restore flow path to OPERABLE status.	72 hours
~~B. One stage 1 ADS flow path inoperable. AND Either one stage 2 ADS flow path inoperable or one stage 3 ADS flow path inoperable.~~	~~B.1 Restore flow path(s) to OPERABLE status.~~	~~72 hours~~
C. Two or three ADS flow paths inoperable with a combined inoperable flow capacity less than or equal to that of a division with the largest ADS flow capacity.	C.1 Restore flow paths to OPERABLE status.	72 hours
~~C~~ D. Required Action and associated Completion Time not met. OR Requirements of LCO not met for reasons other than Condition A, B, or C.	~~C~~ D.1 Be in MODE 3. AND ~~C~~ D.2 Be in MODE 5.	6 hours 36 hours

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.12 Automatic Depressurization System (ADS) – Shutdown, RCS Intact

LCO 3.4.12 The ADS, including 9 flow paths, shall be OPERABLE.

APPLICABILITY: MODE 5 with RCS pressure boundary intact.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required stage 1, 2, or 3 ADS flow path inoperable.	A.1 Restore flow path~~(s)~~ to OPERABLE status.	~~72 hours~~ 7 days
B. One required stage 4 ADS flow path inoperable.	B.1 Restore flow path to OPERABLE status.	72 hours
~~B. One required stage 1 ADS flow path inoperable.~~ ~~AND~~ ~~Either one required stage 2 or stage 3 ADS flow path inoperable.~~	~~B.1 Restore flow path(s) to OPERABLE status.~~	~~72 hours~~
C. Two or three required ADS flow paths inoperable with a combined inoperable flow capacity less than or equal to that of a division with the largest ADS flow capacity.	C.1 Restore flow paths to OPERABLE status.	72 hours
~~C~~ D. Required Action and associated Completion Time not met. OR Requirements of LCO not met for reasons other than Condition A, B, or C.	~~C~~ D.1 Initiate action to be in MODE 5, with RCS open and ≥ 20% pressurizer level.	Immediately

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.11 Automatic Depressurization System (ADS) – Operating

BASES

BACKGROUND

The ADS is designed to assure that core cooling and injection can be achieved for Design Basis Accidents (DBA). The four stages of ADS valves are sequenced in coordination with the passive core cooling system injection performance characteristics.

The ADS consists of 10 flow paths arranged in four different stages that open sequentially (Ref. 1). Stages 1, 2, and 3 each include 2 flow paths. Each of the stage 1, 2, 3 flow paths has a common inlet header connected to the top of the pressurizer. The outlets of the stage 1, 2, 3 flow paths combine into one of the two common discharge lines to the spargers located in the incontainment refueling water storage tank (IRWST). The first stage valves are 4 inch valves with DC motor operators. The second and third stage valves are 8 inch valves with DC motor operators. An OPERABLE stage 1, 2, or 3 automatic depressurization flow path consists of two OPERABLE normally closed motor operated valves, in series.

Stage 4 includes 4 flow paths. The fourth stage ADS valves are 14 inch squib valves. The four fourth stage flow paths connect directly to the top of the reactor coolant hot legs and vent directly into the associated steam generator compartment. An OPERABLE stage 4 flow path consists of an open motor operated valve and an OPERABLE closed squib valve. These motor operated valves are not required to be OPERABLE because they are open.

The automatic depressurization valves are designed to open automatically when actuated, and to remain open for the duration of any automatic depressurization event. The valves are actuated sequentially. The stage 1 valves are actuated on a low core makeup tank (CMT) level. Stages 2 and 3 are actuated on the stage 1 signal plus time delays. Stage 4 is actuated on a Low 2 CMT level signal with a minimum time delay after stage 3. Stage 4 is blocked from actuating at normal RCS pressure.

In order to perform a controlled, manual depressurization of the RCS, the valves are opened starting with the first stage. The first stage valves can also be modulated to perform a partial RCS depressurization if required. ADS stage 1, 2, 3 valves may be manually operated under controlled conditions for testing purposes.

BASES

APPLICABILITY

In MODES 1, 2, 3 and 4 the ADS must be OPERABLE to mitigate the potential consequences of any event which causes a reduction in the RCS inventory, such as a LOCA.

The requirements for the ADS in MODES 5 and 6 are specified in LCO 3.4.12, "Automatic Depressurization System (ADS) – Shutdown, RCS Intact," and LCO 3.4.13, "Automatic Depressurization System – Shutdown, RCS Open."

ACTIONS

A.1

If any one ADS stage 1, 2, or 3 flow path is determined to be inoperable, the remaining OPERABLE ADS flow paths are more than adequate to perform the required safety function as long as a single failure involving the other flow path of the same stage does not also occur. A flow path is inoperable if one or two of the ADS valves in the flow path are determined to be inoperable. A Completion Time of ~~72 hours~~ 7 days is reasonable based on the capability of the remaining ADS valves to perform the required safety functions assumed in the safety analyses and the low probability of a DBA during this time period. ~~This Completion Time is the same as is used for two train ECCS systems which are capable of performing their safety function without a single failure.~~

If more than one ADS stage 1, 2, or 3 flow path are inoperable, Condition C or D is applicable.

~~B.1~~

~~If two flow paths, consisting of one stage 1 and either one stage 2 or 3, are determined to be inoperable, the remaining OPERABLE ADS flow paths are adequate to perform the required safety function as long as a single failure does not also occur. A flow path is inoperable if one or two of the ADS valves in the flow path are determined to be inoperable. A Completion Time of 72 hours is reasonable based on the capability of the remaining ADS valves to perform the required safety functions assumed in the safety analyses and the low probability of a DBA during this time period. This Completion Time is the same as is used for two train ECCS systems which are capable of performing their safety function without a single failure.~~

B.1

If any one ADS stage 4 flow path is determined to be inoperable, the remaining OPERABLE stage 4 ADS flow paths are adequate to perform the required safety function as long as a single failure of an additional stage 4 ADS flow path does not also occur. A Completion Time of 72 hours is reasonable based on the capability of the remaining ADS valves to perform the required safety functions assumed in the safety analyses

BASES

ACTIONS (continued)

and the low probability of a DBA during this time period. This Completion Time is the same as is used for two train ECCS systems which are capable of performing their safety function without a single failure.

C.1

If two or three flow paths with a combined flow capacity less than or equal to the largest capacity ADS division are determined to be inoperable, the remaining OPERABLE ADS flow paths are adequate to perform the required safety function as long as a single failure does not also occur. Divisions A and B have the largest flow capacity, each consisting of one 4 inch flow path, one 8 inch flow path and one 14 inch flow path. This Condition is equivalent to the worst case single failure of an ADS division.

This Condition is applicable to any combination of two inoperable flow paths, except two stage 4 flow paths. Applicable combinations of three inoperable flow paths include:

One stage 1, one stage 2 or 3 and one stage 4

One stage 1 and two stage 2 or 3

Two stage 1 and one stage 2, 3 or 4

Two stage 2 or 3 and one stage 4

Three stage 2 or 3

A Completion Time of 72 hours is reasonable based on the capability of the remaining ADS valves to perform the required safety functions assumed in the safety analyses and the low probability of a DBA during this time period. This Completion Time is the same as is used for two train ECCS systems which are capable of performing their safety function without a single failure.

Condition D is applicable, if two stage 4 flow paths are inoperable, more than three flow paths are inoperable, or a combination of three flow paths not listed above (i.e., with a combined flow capacity greater than the largest capacity ADS division) is inoperable.

~~C~~ D.1 and ~~C~~ D.2

If the Required Actions and associated Completion Times are not met or the requirements of LCO 3.4.11 are not met for reasons other than Condition A, B, or C, the plant must be brought to MODE 5 where the probability and consequences on an event are minimized. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 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, without challenging plant systems.

BASES

APPLICABILITY (continued)

The requirements for the ADS in MODES 1 through 4 are specified in LCO 3.4.11, "Automatic Depressurization System (ADS) – Operating;" and in MODE 5 with the RCS pressure boundary open and MODE 6 in LCO 3.4.13, "Automatic Depressurization System (ADS) – Shutdown, RCS Open."

ACTIONS

A.1

If any one ADS stage 1, 2, or 3 flow path is determined to be inoperable, the remaining OPERABLE ADS flow paths are more than adequate to perform the required safety function as long as a single failure involving the other flow path of the same stage does not also occur. A flow path is inoperable if one or two of the ADS valves in the flow path are determined to be inoperable. A Completion Time of ~~72 hours~~ 7 days is acceptable since the OPERABLE ADS paths can mitigate shutdown events without a single failure.

If more than one ADS stage 1, 2, or 3 flow path are inoperable, Condition C or D is applicable.

~~B.1~~

~~If two flow paths, consisting of one stage 1 and either one stage 2 or 3, are determined to be inoperable, the remaining OPERABLE ADS flow paths are adequate to perform the required safety function. A flow path is inoperable if one or two of the ADS valves in the flow path are determined to be inoperable. A Completion Time of 72 hours is acceptable since the OPERABLE ADS paths can mitigate shutdown events without a single failure.~~

B.1

If any one ADS stage 4 flow path is determined to be inoperable, the remaining OPERABLE stage 4 ADS flow paths are adequate to perform the required safety function as long as a single failure of an additional stage 4 ADS flow path does not also occur. A Completion Time of 72 hours is reasonable based on the capability of the remaining ADS valves to perform the required safety functions assumed in the safety analyses and the low probability of a shutdown event during this time period. This Completion Time is the same as is used for two train ECCS systems which are capable of performing their safety function without a single failure.

BASES

ACTIONS (continued)

C.1

If two or three flow paths with a combined flow capacity less than or equal to the largest capacity ADS division are determined to be inoperable, the remaining OPERABLE ADS flow paths are adequate to perform the required safety function as long as a single failure does not also occur. Divisions A and B have the largest flow capacity, each consisting of one 4 inch flow path, one 8 inch flow path and one 14 inch flow path. This Condition is equivalent to the worst case single failure of an ADS division.

This Condition is applicable to any combination of two inoperable flow paths, except two stage 4 flow paths. Applicable combinations of three inoperable flow paths include:

One stage 1, one stage 2 or 3 and one stage 4
One stage 1 and two stage 2 or 3
Two stage 1 and one stage 2, 3 or 4
Two stage 2 or 3 and one stage 4
Three stage 2 or 3

A Completion Time of 72 hours is reasonable based on the capability of the remaining ADS valves to perform the required safety functions assumed in the safety analyses and the low probability of a shutdown event during this time period. This Completion Time is the same as is used for two train ECCS systems which are capable of performing their safety function without a single failure.

Condition D is applicable, if two stage 4 flow paths are inoperable, more than three flow paths are inoperable, or a combination of three flow paths not listed above (i.e., with a combined flow capacity greater than the largest capacity ADS division) is inoperable.

~~C~~D.1

If the Required Actions and associated Completion Times are not met or the requirements of LCO 3.4.12 are not met for reasons other than Condition A, B, or C, the plant must be placed in a MODE in which this LCO does not apply. Action must be initiated, immediately, to place the plant in MODE 5 with the RCS pressure boundary open and ≥ 20% pressurizer level.

SURVEILLANCE REQUIREMENTS

SR 3.4.12.1

The LCO 3.4.11 Surveillance Requirements are applicable to the ADS valves required to be OPERABLE. The Frequencies associated with

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: OI-SRP16-CTSB-61
Revision: 0

Question:

Revise the reference sections in TS Bases B 3.6.1, B 3.6.2, and B 3.6.3 to list specific sections of DCD Chapter 15 that support the specific accidents discussed in the body of the bases. In RAI-SRP16-CTSB-61, the staff asked Westinghouse to specify the sections of DCD Chapter 15 that support the specific accident discussed in the "Applicable Safety Analyses" section of TS Bases B 3.6.1, 3.6.2, and 3.6.3.

In its November 19, 2008, response letter, Westinghouse stated, "the level of detail provided by the 3.6.1, 3.6.2, and 3.6.3 Bases references to Chapter 15 is consistent with the STS," and made no further change to the bases. The staff found this reason unacceptable. The staff's concern is that DCD Chapter 15 is voluminous as it contains more than 600 pages. Without references to specific sections, validation of the information discussed in the affected TS bases would require significant effort and time from the plant operators who implement TS requirements and often refer to the TS bases for clarifications needed quickly.

Westinghouse Response:

DCD Section 16.1.1 contains the follow statement:

> The content of the AP1000 Technical Specifications meets the 10CFR50.36 requirements and is consistent with the Technical Specification Improvement Program, NUREG 1431, Rev. 2, to the maximum extent possible. The content differs from NUREG 1431 only as necessary to reflect technical differences between the "typical" Westinghouse design and the AP1000 design.

Referencing Chapter 15 as opposed to the specific sections in Chapter 15 in the BASES for Technical Specifications 3.6.1, "Containment," 3.6.2, "Containment Air Locks," and 3.6.3, "Containment Isolation Valves" is consistent with NUREG-1431 Rev 2.

The specific statements in the bases referencing Chapter 15 are listed below.

3.6.1 Containment

> The DBAs that result in a challenge to containment OPERABILITY from high pressures and temperatures are a loss of coolant accident (LOCA), a steam line break, and a rod ejection accident (REA) (Ref. 2).

3.6.2 Containment Air Locks

The DBA that results in the largest release of radioactive material within containment is a loss of coolant accident (LOCA) (Ref. 3).

3.6.3 Containment Isolation Valves

The DBAs that result in a release of radioactive material within containment are a loss of coolant accident (LOCA) and a rod ejection accident (Ref. 2).

Referencing the whole chapter is appropriate for these statements since they are with respect to general conclusions when all of the Chapter 15 Safety analyses are taken into account. With respect to the statement in the Bases for TS 3.6.2 for example, only after considering the releases of the radioactivity from all of the Chapter 15 events can it be determined that the largest release is from a LOCA.

While Chapter 15 contains more than 600 pages, plant operators are very familiar with Chapter 15 and will easily locate specific sections using the table of contents. LOCA, steam line break, and rod ejection are identified in the Table of Contents as Sections 15.6.5, 15.1.5, and 15.4.8 respectively. In the event the plant operators desire additional validation of information in the TS Bases, they will not hesitate to contact licensing or engineering plant management and staff at any time of the day.

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: OI-SRP16-CTSB-62
Revision: 0

Question:

TS 3.4.8 Minimum RCS Flow

The applicant also proposed to replace the preliminary bracketed value of 10000 gpm for the minimum RCS flow with a final value of 3000 gpm. Conforming changes were proposed in SR 3.4.8.1 and related information in the TS bases to match the new minimum flow value (e.g. the minimum pump speed setting of 25% was replaced with new value of 10%). Westinghouse cited the NRC accepted response to RAI 440.106 during the AP1000 Design Certification review as justification for the proposed flow reduction. In RAI-SRP16-CTSB-62, the applicant was asked to provide additional details to support these changes. In its response dated December 17, 2008, the applicant reiterated information that was provided in the response to RAI 440.106, but further stated:

> "AP1000 RCS flow calculations show that the expected RCS flow with a single reactor coolant pump (RCP) operating at its lowest allowable operating speed is approximately 17,000 gpm. The associated reactor vessel flow is approximately 11,000 gpm. This is well above the 3000 gpm flow mixing requirement from the LOFT testing, and also above the preliminary bracketed value of 10000 gpm ..."

The staff noted that the new proposed value of 10% for the pump minimum speed setting in SR 3.4.8.1, corresponding approximately to a calculated flow of 7875 gpm, appears to be inconsistent with the lowest allowable operating speed stated above.

Westinghouse Response:

The perceived inconsistency in flows is a result of the different bases for the TS 4.3.8 limit and the lowest allowable operating speed for the RCPs. The TS 4.3.8 limit is to verify the plant operates within the assumptions of the safety analyses while the limit for the minimum RCP takes into account factors associated with equipment such as stress and wear.

The purpose of SR 3.4.8.1 is to verify that RCS flow through the core is greater than or equal to the LCO 3.4.8 value of 3000 gpm. The 3000 gpm in the LCO is associated with the initial condition in the analysis of a possible Boron Dilution Event (BDE) in MODE 3, 4, or 5 for minimum mixing flow in the RCS. One RCP in operation at ≥10% rated speed will result in RCS flow through the core greater than or equal to 3000 gpm. The expected flow through the RCP itself at 10% rated speed is 7875 gpm. RCP flow of 7875 gpm will result in flow through the core greater than 3000 gpm.

As stated in the response to RAI-SRP16-CTSB-62 the expected operating limit on the RCP minimum speed is expected to be higher than 10%. This results in design margin to the 3000 gpm LCO value. Operating limits take into account minimizing stress and wear, and increasing equipment life, not the input assumptions for the Boron Dilution Analysis.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None