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Your ref: Docket No. 52-006
Our ref: DCP/NRC2426

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Subject: AP1000 Response to Request for Additional Information (SRP 9)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 9. 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-SRP9.1.5-SBPB-01 R1
RAI-SRP9.1.5-SBPB-05 R1
RAI-SRP9.1.5-SBPB-06 R1
RAI-SRP9.1.5-SBPB-10 R2

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
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/Enclosure

1. Response to Request for Additional Information on SRP Section 9

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NRO

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ENCLOSURE 1

Response to Request for Additional Information on SRP Section 9

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP9.1.5-SBPB-01
Revision: 1

Question:

In AP1000 DCD Revision 16 it is stated on page 9.1-38 under section 9.1.5.1.2, "Codes and Standards," that the polar crane and cask handling cranes are designed according to NUREG-0554 supplemented by ASME NOG-1 for a Type I single failure proof (SFP) crane. This complies with SRP 9.1.5. Detailed descriptions of the polar crane and cask handling crane are also given in DCD Revision 16 section 9.1.5.

On page 9.1-37 of DCD Revision 16 under section 9.1.5.1.1, "Safety Design Basis," it is stated that the containment equipment hatch hoist and containment maintenance hatch hoist are SFP systems and are classified as seismic Category I. It is also stated that the components of SFP systems necessary to prevent uncontrolled lowering of a critical load are classified as safety-related. On page 9.1-38 of DCD Revision 16 under section 9.1.5.2, "System Description," it is stated that the containment equipment hatch hoist and maintenance hatch hoist incorporate SFP features based on NUREG-0612 guidelines. Additionally, Section 9.1.5.1.2 states that hoists are designed according to ASME NOG-1 and to the applicable ANSI standard. Table 3.2-3 lists the principle design code for MHS-MH-06 and 06 as manufacturers' standard. Unlike the polar crane and cask handling crane, there are no detailed descriptions of the containment equipment hatch hoist and maintenance hatch hoist in DCD section 9.1.5. nor are the design requirements as explicit as they are for the polar and cask handling cranes. Since the equipment and maintenance hatch hoists are SFP, they should have more specific design criteria similar to what is specified for the polar crane and cask handling cranes.

A) ASME NOG-1 for Type I cranes describes design details for SFP hoists. Explain why the DCD does not require the design requirements that are specified for single failure hoists in ASME NOG 1 for a Type 1 cranes to be implemented for the single failure proof equipment and maintenance hatch hoists.

B) Describe the design of the containment equipment hatch hoist and maintenance hatch hoist and the single failure proof features that make them single failure proof systems. Explain if any and which components of these two single failure proof systems prevent uncontrolled lowering of a critical load and are classified safety-related.

Westinghouse Response:

A) The Design Specification of the Maintenance Hatch Hoist system and Equipment Hatch Hoist system will follow the guidelines of NUREG-0554 supplemented by ASME NOG-1. The AP1000 DCD Revision 16, Table 3.2-3 will be revised to reflect this change.

B) The Maintenance Hatch Hoist system and Equipment Hatch Hoist system will adhere to NUREG-0554 supplemented by ASME NOG-1 by the detailed designs following these standards.

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

Westinghouse noted that the ASME NOG-1, Type I designation is not applicable for Equipment Hatch Hoists and Maintenance Hatch Hoists, as it applies to the design of overhead and gantry cranes (i.e., cranes that run on top of rails) from the rails to the load hook.

Single failure proof hatch hoists are designed, fabricated, examined and tested in accordance with CMAA 70 and the guidelines of NUREG 0554, supplemented by provisions of ASME NOG-1 as it relates to single failure proof hoists.

Hatch hoist components that are necessary to prevent uncontrolled lowering of a critical load following a single credible failure will be classified as safety related.

References:

i) NUREG-0554, "Single Failure Proof Cranes For Nuclear Power Plants"
ii) ASME NOG-1, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)"

Design Control Document (DCD) Revision: (Revision 0)

Revise DCD Rev.16 Table 3.2-3 as follows:

MHS-MH-05	Equipment Hatch Hoist	C	I	~~Manufacturer Std.~~ NUREG-0554 supplemented by ASME NOG-1	
MHS-MH-06	Maintenance Hatch Hoist	C	I	~~Manufacturer Std.~~ NUREG-0554 supplemented by ASME NOG-1	

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP9.1.5-SBPB-05
Revision: 1

Question:

SRP 9.1.5 and NUREG 0612 provide guidance that state that safe load paths should be defined for movement of heavy loads to minimize the potential to impact irradiated fuel in the reactor vessel and in the spent fuel pool and safe shutdown equipment. These load paths should be defined in procedures, and shown on equipment layout drawings.

A) Please explain where equipment layout drawings are provided in the DCD that show safe load paths for moving heavy loads
B) A COL Action item should be developed to ensure that the COL applicant will provide procedures that define safe load paths.

Westinghouse Response:

A) These drawings are not provided in the DCD. This information is part of the operational programs and is covered by Section 13.4 of the DCD.

B) Operations programs and procedures are discussed in Sections 13.4 and 13.5 of the DCD respectively. Existing COL Information Items are provided in these sections. No further COL Items are necessary.

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

A COL information item is incorporated stating the COL applicant will provide such a heavy load handling program.

DCD Section 9.1.5 is modified to include the statement "DCD Section 13.5.1 addresses the development of heavy lift safe load paths."

In keeping with the guidance in SRP 9.1.5 and NUREG 0612, DCD Section 13.5.1 is modified to include the statement "The COL Combined License applicants referencing the AP1000 certified design will also provide a heavy load handling program. This program will include safe load paths for movement of heavy loads, to be referenced in procedures and shown on equipment layout drawings. This will minimize the potential to impact irradiated fuel in the reactor vessel and in the spent fuel pool, and safe shutdown equipment, from movement of heavy loads.".

Westinghouse is currently developing drawings identifying safe load paths for the handling of heavy loads. These drawings will be provided to the COL for incorporation into their heavy load handling program.

Design Control Document (DCD) Revision:

~~None~~

Incorporate the following change in DCD Section 9.1.5:

9.1.5 Overhead Heavy Load Handling Systems

Heavy load handling systems consist of equipment which lift loads whose weight is greater than the combined weight of a single spent fuel assembly and its handling device. This equipment is part of the mechanical handling system (MHS) and is located throughout the plant. The principal equipment is the containment polar crane and the cask handling crane. Other such equipment includes the reactor coolant pump handling machine, bridge cranes, miscellaneous monorail hoists and fixed hoists. Table 9.1-5 lists the heavy load handling systems located in the safety-related areas of the plant, specifically the nuclear island.

For AP1000, a heavy load is a load whose weight is greater than the combined weight of a fuel assembly with rod cluster control, and the associated handling device. This combined weight is about 3100 pounds. Thus, a heavy load is defined as a load weighing more than 3100 pounds.

Section 13.5.1 addresses the development of heavy lift safe load paths.

Incorporate the following change in DCD Section 13.5.1:

13.5.1 Combined License Information Item

The Combined License information requested in this subsection has been partially addressed in APP-GW-GLR-040 (Reference 10), and the applicable changes are incorporated into the DCD. No additional work is required by the Combined Operating License applicant to address the aspects of the Combined License information requested in this subsection as delineated in the following paragraph:

> The process to manage the development, review, and approval of AP1000 Normal Operating, Abnormal Operating, Emergency Operating, Refueling and Outage Planning, Alarm Response, Administrative, Maintenance, Inspection, Test, and Surveillance Procedures, as well as the procedures which address the operation of post-72 hour equipment, is delineated in APP-GW-GLR-040. In addition, APP-GW-GLR-040 provided submitted to the NRC the Writer's Guidelines for Normal Operating and Two-Column Format Procedures, APP-GW-GJP-100 and APP-GW-GJP-200, respectively.

The Combined Operating License applicant will address Operational and Maintenance Programmatic issues, as well as training in the AP1000 COL licensing process.

The following words represent the original Combined Operating License Information Item commitment:

> Combined License applicants referencing the AP1000 certified design will address plant procedures including the following:
>
> - Normal operation
> - Abnormal operation
> - Emergency operation
> - Refueling and outage planning
> - Alarm response
> - Maintenance, inspection, test and surveillance
> - Administrative
> - Operation of post-72 hour equipment

The COL Combined License applicants referencing the AP1000 certified design will also provide a heavy load handling program. This program will include safe load paths for movement of heavy loads, to be referenced in procedures and shown on equipment layout drawings. This will minimize the potential to impact irradiated fuel in the reactor vessel and in the spent fuel pool, and safe shutdown equipment from movement of heavy loads.

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP9.1.5-SBPB-06
Revision: 1

Question:

SRP 9.1.5 and NUREG 0612 provide guidance for applicants to describe a heavy load handling program for design, operation, testing, maintenance and inspection of heavy load handling systems.

A COL Action item should be developed to ensure that the COL applicant will provide such a heavy load handling program.

Westinghouse Response:

Westinghouse will provide the COL holder with the Operations and Maintenance Manuals for the heavy load handling systems so that they can be used when they create their programs. Operations programs and procedures are discussed in Sections 13.4 and 13.5 of the DCD to include existing COL Information Items. No further COL Information Items are necessary.

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

This item is addressed in the response to RAI-SRP9.1.5-SBPB-05, Revision 1.

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-SRP9.1.5-SBPB-10
Revision: 2

Question:

Section 9.1.5.1.2 "Codes and Standards" of the AP1000 DCD Revision 16 states that, "the polar crane and the cask handling crane are designed according to NUREG-0554 supplemented by ASME NOG-1 for a Type 1 single failure proof crane." Section 9.1.5.2 "System Description," of the AP1000 DCD Revision 16 states that, "the containment equipment hatch hoist and the containment maintenance hatch hoist incorporate single failure proof features based on NUREG-0612 guidelines." The AP1000 DCD/ Tier 1 Section 2.3.5 does not list "single failure proof" as certified design information with ITAAC for either the polar crane, the cask handling crane, the containment equipment hatch hoist or the containment maintenance hatch hoist. The staff believes that "single failure proof" design criteria for the above listed cranes and hoists should be listed in Tier 1 as described below.

One design criteria, among several design criteria for Tier 1 information, is that it should include features and functions which could have a significant effect on the safety of a nuclear plant or are important in preventing or mitigating severe accidents. A drop of the reactor vessel head or a spent fuel cask could affect plant safety. Therefore, design features that reduce the risk and/or analyses that provide assurance of safety after a dropped load are important to safety. The staff considers "single failure proof" design criteria for the polar crane and the cask handling crane as Tier 1 safety significant design criteria. As a minimum, the following analyses would have to be performed in order to not consider "single failure proof" design criteria as safety significant criteria for the polar crane and the cask handling crane:

- A heavy load analysis proving that a heavy load drop in safety related areas of the plant will not be the cause any of Items I through IV of section 5.1 of NUREG 0612, "Control of Heavy Loads at Nuclear Power Plants." [Section 9.1.5.3 of the AP1000 DCD clearly states that no heavy load analyses were performed for critical loads carried by the containment polar crane, the cask handling crane, the containment equipment hatch hoist and the containment maintenance hatch hoist.]

- SRP 9.1.5, "Overhead Heavy Load Handling Systems," Section III. 4, states that without "single failure proof" design criteria, analyses are required for a dropped load on the reactor vessel, among other analyses. The DCD does not describe results of this analysis.

- Regulatory Guide 1.13, Regulatory Position C.5 states that an alternative to an "single failure proof" crane is that the spent fuel cask loading area be designed to withstand a drop of the heaviest load at the maximum height. Whereas, AP1000 DCD Section 15.7.5 states a Spent Fuel Cask Drop Accident Analysis was not performed.

As a minimum, the following analysis would have to be performed in order to not consider "single failure proof" design criteria as safety significant criteria for the containment equipment hatch hoist and the containment maintenance hatch hoist:

- A heavy load analysis proving that a heavy load drop in safety related areas of the plant will not be the cause any of Items I through IV of section 5.1 of NUREG 0612, "Control of Heavy Loads at Nuclear Power Plants." [Section 9.1.5.3 of the AP1000 DCD clearly states that no heavy load analyses were performed for critical loads carried by the containment polar crane, the cask handling crane, the containment equipment hatch hoist and the containment maintenance hatch hoist.]

Without the analyses and design criteria stated above, the "single failure proof" design feature of the polar crane, cask handling crane, containment maintenance hatch crane and containment equipment hatch crane becomes safety significant design criteria.

The staff notes that the applicant prevents the cask handling crane from moving over the spent fuel pool because the crane rails do not extend over the pool. Mechanical stops prevent the cask handling crane from going beyond the end of the rails. However, Regulatory Guide 1.13, Regulatory Position C.5 specifies that the spent fuel cask loading area be designed to withstand, without significant leakage of the adjacent spent fuel storage, the impact of the heaviest load to be carried by the crane from the maximum height to which it can be lifted or the spent fuel storage facility should have cranes designed to single failure proof criteria. Since the DCD did not declare that the spent fuel cask loading area is designed to withstand the impact of the heaviest load to be carried from the maximum height to which it can be lifted, without significant leakage of the adjacent spent fuel storage, the single failure proof design criteria for the cask handling crane is safety significant design criteria.

RAI SRP 9.1.5-SBPB-10

Section 9.1.5.3, "Safety Evaluation" of the AP1000 DCD in the first bulleted item, states that "Postulated load drops are evaluated in the heavy load analysis." The last sentence of that section states, "The heavy load analysis is to confirm that a postulated load drop analysis does not cause unacceptable damage to reactor fuel elements, or loss of safe shutdown or decay heat removal capability." Please describe what heavy load drop analyses were performed and the results of the analyses.

Westinghouse Response:

The Polar Crane, Cask Handling Crane, Equipment Hatch Hoist, and Maintenance Hatch Hoist are single failure proof which satisfies the requirements for moving heavy loads. No analysis needs to be performed. The Criteria has been added to the ITAAC (See RAI-SRP9.1.5-SBPB-09).

The Main Steam Isolation Valve (MSIV) Monorail Hoists A and B are used to perform maintenance on the MSIV. The hoists will not be used during plant operation. Failure of the hoists will not prevent the plant from shutting down safely because the plant will already be shut down.

References:

1. NUREG-0612 section 5.1.2 (Spent Fuel Area - PWR) and section 5.1.3 (Containment Building - PWR)
2. RAI-SRP9.1.5-SBPB-09

Additional Question:

For the MSIV monorail hoists A and B, please address the effect of a load drop on equipment needed for decay heat removal.

Additional Westinghouse Response:

[From DCD Rev 17, Technical Specification 3.7.1 Basis, APPLICABILITY]

In MODE 1, 2, 3, or 4 (without the normal residual heat removal system in service), six MSSVs per steam generator are required to be OPERABLE. In MODES 4 (with the normal residual heat removal system in service) and 5, there are no credible transients requiring the MSSVs. The steam generators are not normally used for heat removal in MODES 5 and 6, and thus cannot be overpressurized. There is no requirement for the MSSVs to be OPERABLE in these MODES.

[From DCD Rev 17, Technical Specification 3.7.2 Basis, APPLICABILITY]

The MSIVs, turbine stop or associated turbine control valves, turbine bypass valves, and moisture separator reheater 2nd stage steam isolation valves must be OPERABLE in MODE 1 and MODES 2, 3, and 4, except when steam flow is isolated when there is significant mass and energy in the RCS and steam generators. Therefore, these valves must be OPERABLE or closed. When these valves are closed, they are already performing their required function. In MODE 5 or 6, the steam generators do not contain much energy because their temperature is below the boiling point of water; therefore, the MSIVs and alternate downstream valves are not required for isolation of potential high energy secondary system pipe breaks in these MODES.

Response:

In the AP1000, safety related decay heat removal is accomplished by natural circulation of reactor coolant through the Passive Residual Heat Removal (PRHR) heat exchanger in the containment. Based on the original Westinghouse response, the use of a single-failure proof polar crane results in the exclusion of possible impacts from a load drop on the safety-related decay heat removal equipment. Additionally, since the PRHR heat exchanger is located in containment, there is no impact potential from a failure of the MSIV monorail hoists on the safety-related decay heat removal mode.

Non-safety decay heat removal is accomplished by boiling in the steam generators and steam flow to the condenser or atmospheric steam dumps. Both of these flow paths will require the function of the MSIVs and the MSSVs (Main Steam Safety Valves) in either the OPERABLE or CLOSED position based on the plant operating configuration.

Because the MSIVs and MSSVs have to be OPERABLE or CLOSED during MODES 1, 2, 3, and 4, the MSIV monorail hoists shall not be used to service the MSIVs or MSSVs during MODES 1, 2, 3, or 4.

During MODES 5 and 6 the reactor coolant and the steam generator shells are below the boiling point of water. Therefore, in these operating modes, the steam generators are not utilized for non-safety related decay heat removal. A load drop by the MSIV monorail hoists during MODES 5 or 6 will not affect decay heat removal capability of the AP1000.

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

Equipment and components required for decay heat removal during MODES 5 or 6 are not located in the load path for the MSIV monorail hoists. A statement to that effect is added to DCD Rev 17 Section 9.1.5.3, "Safety Evaluation."

Design Control Document (DCD) Revision:

~~None~~

Modify DCD Section 9.1.5.3, "Safety Evaluation" as shown:

9.1.5.3 Safety Evaluation

The design and arrangement of heavy load handling systems promotes the safe handling of heavy loads by one of the following means:

- A single-failure-proof system is provided so that a load drop is unlikely.

- The arrangement of the system in relationship to safety-related plant components is such that the consequences of a load drop are acceptable per NUREG 0612. Postulated load drops are evaluated in the heavy loads analysis.

The polar crane, the cask handling crane, the containment equipment hatch, and the maintenance hatch hoists are single failure proof. These systems stop and hold a critical load following the credible failure of a single component. Either redundancy or double design factor is provided for load bearing components such as the hoisting ropes, sheaves, equalizer assembly, hooks, and holding brakes. These systems are designed to support a critical load during and after a safe shutdown earthquake. The seismic Category I equipment and maintenance hatch hoist systems are designed to remain operational following a safe shutdown earthquake. The polar crane is designed to withstand rapid pressurization of the containment during a design basis loss of coolant accident or main steam line break, without collapsing.

The cask loading pit is separated from the spent fuel pool. The cask handling crane cannot move over the spent fuel pool because the crane rails do not extend over the pool. Mechanical stops prevent the cask handling crane from going beyond the ends of the rails.

A heavy loads analysis is performed to evaluate postulated load drops from heavy load handling systems located in safety-related areas of the plant, specifically the nuclear island. No evaluations are required for critical loads handled by the containment polar crane, the cask handling crane, the containment equipment hatch hoist, and the containment maintenance hatch hoist since a load drop is unlikely.

The heavy loads analysis is to confirm that a postulated load drop does not cause unacceptable damage to reactor fuel elements, or loss of safe shutdown or decay heat removal capability.

For the MSIV monorail hoists, equipment and components required for decay heat removal during MODES 5 or 6 are not located in the load path.

PRA Revision:
None

Technical Report (TR) Revision:
None