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Your ref: Docket No. 52-006
Our ref: DCP/NRC2177

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Subject: AP1000 Response to Requests for Additional Information (SRP9.1.4)

Westinghouse is submitting a response to the NRC requests for additional information (RAIs) on SRP Section 9.1.4. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in the response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

A response is provided for RAI-SRP9.1.4-SBPB-01 through -04, as sent in an email from Perry Buckberg to Sam Adams dated May 7, 2008. This response completes all requests received to date for SRP Section 9.1.4.

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 Requests for Additional Information on SRP Section 9.1.4

D063
NRO

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ENCLOSURE 1

Response to Requests for Additional Information on SRP Section 9.1.4

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP9.1.4-SBPB-01
Revision: 0

Question:

Sections of the DCD Revision 16 (Sections 9.1.1.2.1.D and 9.1.2.2.1.E) state that "The new fuel handling crane is a seismic Category II component. The crane is evaluated to show that it does not collapse into the spent fuel pool as a result of a seismic event." The new fuel handling crane handles new fuel and loads the new fuel into the spent fuel pool.

Regulatory Position C2 of Regulatory Guide 1.29, "Seismic Design Classification" and section 3.2.1.1.2. of the DCD Revision 16 describe the guidance for seismic Category II systems, structure and components (SSC). This guidance states, in part, that seismic Category II SSC are designed to preclude their structural failure during a safe shutdown earthquake or interaction with seismic Category I items which could degrade the functioning of a safety-related structure, system, or component to an unacceptable level.

Although the new fuel handling crane will not collapse into the spent fuel pool as stated above, DCD Sections 9.1.1.2.1.D and 9.1.2.2.1.E do not state that the new fuel handling crane will continue to hold its maximum load (not drop the load) during the seismic event. Considering the maximum load carried by the crane, please explain how this crane will meet seismic Category II criteria in that seismic Category II SSC are designed to preclude their structural failure during a safe shutdown earthquake or interaction with seismic Category I items which could degrade the functioning of a safety-related structure, system, or component to an unacceptable level.

Westinghouse Response:

A design change is being implemented related to the Fuel Handling Machine (FHM). The design change eliminates the need for the "New Fuel Handling Crane". The FHM is being changed from a sigma style machine to a bridge style machine with two overhead hoists. The hoist designated for handling new fuel is a 2 ton, single failure proof hoist. This hoist, along with the use of the new fuel handling tool, will transport new fuel from the new fuel shipping container located in the truck bay of the auxiliary building to the new fuel storage rack and the new fuel elevator.

For normal conditions plus SSE loading, the stresses in any load bearing component shall not exceed the allowable seismic stresses in the AISC Code. The FHM will not drop a fuel assembly under these conditions. The FHM will still remain a seismic Category II component meeting the requirements of section 3.2.1.1.2 of the DCD and Reg. Guide 1.29.

Design Control Document (DCD) Revision:

DCD Tier 2, Section 9.1.1.1, pg 9.1-2

~~The new fuel handling crane is used to load new fuel assemblies into the new fuel rack and transfer new fuel assemblies from the new fuel pit into the spent fuel pool. The capacity of the new fuel handling crane is limited to lifting a fuel assembly, control rod assembly, and handling tool. The new fuel pit is not accessed by the fuel handling machine or by the cask handling crane.~~ *The fuel handling machine is used to load new fuel assemblies into the new fuel rack and transfer new fuel assemblies from the new fuel storage vault into the spent fuel pool. The capacity of the fuel handling machine, while over the new fuel storage rack, is limited to lifting a fuel assembly, control rod assembly, and handling tool. The new fuel storage vault is not accessed by the cask handling crane.* This precludes the movement of loads greater than fuel components over stored new fuel assemblies.

DCD Tier 2, Section 9.1.1.2.1, pg 9.1-4

D. Failure of the Fuel Handling ~~Crane~~ *Machine*

The fuel handling ~~crane~~ *machine* is a seismic Category II component. The ~~crane and the attachment to the building structure~~ *fuel handling machine* is evaluated to show that the ~~crane~~ *machine* does not fall into the new fuel storage pit during a seismic event.

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP9.1.4-SBPB-02
Revision: 0

Question:

In APP-GW-GLN-106 Revision 1, Westinghouse reclassified the FHM and the spent fuel handling tool as non-safety related, seismic Category II. The non safety classification of FHM and the spent fuel handling tool is consistent with ANS 57.1, "Design Requirements for Light Water Reactor Fuel Handling Systems" which is invoked as acceptance criteria by SRP 9.1.4. The staff also concurs in the reclassification of the FHM and the spent fuel handling tool to seismic Category II, which is consistent with Regulatory Guide 1.29, Regulatory Position C1 and C2.

a) However, AP1000 DCD Rev 16 in Table 3.2-3 calls out seismic category II and non seismic for FHS-FH-02. This is the only SSC in the Table 3.2-3 that has a dual seismic classification and no reason is given by the applicant. Please explain the dual seismic classification of the Fuel Handling Machine in Table 3.2-3 (Sheet 5 of 65).
b) With the reclassification of the FHM from seismic category I to seismic category II, verify that the FHM and the spent fuel handling tool will continue to hold its design load, such that these SSCs are designed to 1) preclude their structural failure during a safe shutdown earthquake and 2) preclude interaction with seismic Category I items which could degrade the functioning of a safety-related SSC to an unacceptable level.

Westinghouse Response:

a) The FHM is a seismic Category II component. Table 3.2-3 will be updated in Rev. 17 of the DCD.
b) The FHM will be designed to maintain its structural integrity and load carrying ability during a safe shutdown earthquake.

Design Control Document (DCD) Revision:

TABLE 3.2-3 (SHEET 5 OF 65)

AP1000 CLASSIFICATION OF MECHANICAL AND FLUID SYSTEMS, COMPONENTS, AND EQUIPMENT

Tag Number	Description	AP1000 Class	Seismic Category	Principal Construction Code	Comments
Fuel Handling and Refueling System (FHS)			Location: Containment and Auxiliary Building		
FHS-FH-01	*Refueling Machine*	*D*	*II*	*AISC*	
FHS-FH-02	Fuel Handling Machine	D	II~~/NS~~	AISC	
FHS-FH-04	*New Fuel Elevator*	*D*	*II*	*AISC*	
FHS-FH-05	*Fuel Transfer System*	*D*	*II*	*AISC*	
FHS-FH-52	Spent Fuel Assembly Handling Tool	D	II	AISC	

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP9.1.4-SBPB-03
Revision: 0

Question:

Section 9.1.4.3.3 states that the fuel handling machine (FHM) "has the same design functions as the refueling machine (RFM) and includes the same safety features." DCD Revision 16, Sections 9.1.4.2.4 and 9.1.4.2.2.3 state that the RFM services the core including the function to latch and unlatch control rods. No such function is attributed to the FHM. Additionally, DCD Revision 16, Section 9.1.4.2.3 states that the FHM is used to load spent fuel into the shipping casks. No such function is attributed to the RFM. Additionally, the RFM operates exclusively in containment, whereas the FHM operates exclusively in the fuel handling area. Please explain how the FHM has the same design functions as the RFM.

Westinghouse Response:

A design change proposal (DCP) is being processed to change the FHM design from a "Sigma" type RFM to a bridge/gantry style handling machine with two 2-ton overhead hoists. The features of this bridge/gantry style handling machine are described in the proposed DCD markup below.

Design Control Document (DCD) Revision:

DCD Tier 2, Section 9.1.4.3.3, pg 9.1-34

Section 9.1.4.3.3 Fuel Handling Machine

~~The fuel handling machine has the same design functions as the refueling machine and includes the same safety features.~~
The fuel handling machine design includes the following provisions to provide for safe handling of fuel assemblies and other components within the spent fuel handling area:

A. Safety Interlocks

Operations which could endanger the operator or damage the fuel, designated below by an asterisk (*), are prevented by mechanical or failure tolerant electrical interlocks or by redundant electrical interlocks. Other interlocks are intended to provide equipment protection and may be implemented either mechanically or by electrical interlock and are not required to be fail safe.

Fail safe electrical design of a control system interlock is applied according to the following rules:

1. *Fail safe operation of an electrically operated brake is such that the brake engages on loss of power.*

2. *Fail safe operation of a relay is such that the de-energized state of the relay inhibits unsafe operation.*

3. *Fail safe operation of a switch, termination, or wire is such that breakage or high resistance of the circuit inhibits unsafe operation.*

Those parts of a control system interlock which are not or cannot be operated in a fail safe mode as defined in the preceding rules are supplemented by a redundant component or components to provide the requisite protection. Required fail safe operations are:

1. The fuel handling machine can only place a fuel assembly in the new fuel rack, spent fuel racks, fuel transfer system upender, new fuel elevator, spent fuel cask, fuel inspection/repair station or truck bay traveler.

2. When the hoist load weighing system detects a load greater than the spent fuel assembly handling tool, the machine cannot traverse unless the hoist is at the up limit. For new fuel handling, the load is greater than a new fuel handling tool.

3. Simultaneous traversing and hoisting operations are prevented.

4. The fuel handling machine is restricted to raising a fuel assembly to a height at which the water provides a safe radiation shield.

5. When a fuel assembly is raised or lowered, interlocks provide confidence that the fuel handling machine can only apply loads which are within safe operating limits.

6. Lowering of the hoist is not permitted if slack cable exists.

7. The fuel transfer system container is prevented from moving unless the fuel handling machine and the long handled tool and/or fuel assembly is out of the fuel transfer zone. An interlock is provided from the fuel handling machine to the fuel transfer system to accomplish this.

B. Bridge Hold-Down Devices

The fuel handling machine bridge is horizontally restrained on the rails by guide rollers on either side of the rail. Hold down devices are used to prevent the bridge from leaving the rails in the event of a seismic event.

C. Hoist Braking System

The hoists are equipped with solenoid activated motor brake. Brake is rated at 125 percent of the hoist design load.

D. Fuel Assembly Support System.

The hoists are supplied with redundant paths of load support such that failure of any one component will not result in free fall of the fuel assembly. When redundant paths are not practical, conservative safety factors shall be applied.

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP9.1.4-SBPB-04
Revision: 0

Question:

Section 9.1.4.3.7 of the DCD states, "The three fuel handling devices used to lift spent fuel assemblies are the refueling machine, fuel handling machine, and the spent fuel handling tool. Both the refueling machine and fuel handling machine contain positive stops which prevent the fuel assembly from being raised above a safe shielding height."

Section 9.1.4.3.3 invokes the design of the refueling machine for the FHM, which in 9.1.4.3.1 states that "mechanical or failure tolerant electrical interlocks or redundant electrical interlocks" cause the "refueling machine is restricted to raising a fuel assembly or core component to a height at which the water provides a safe radiation shield."

The implication of these statements is that when using the spent fuel handling tool there are no positive stops to prevent the fuel assembly from being raised above a safe shielding height. Use of the spent fuel handling tool with an auxiliary hoist will apparently be used for at least 25% of the SFP storage cells based on the information in TR-121. In TR-121, "Spent Fuel Pool Water Level and Dose," APP-GW-GLN-121, Revision 0, states:

> ...due to the radius of the FHM manipulator mast and the proximity to the SFP walls, approximately 25% of the SFP storage cells cannot be serviced by the mast crane. Also, there are instances where fuel inspection and/or fuel repair require the fuel to be moved from the SFP storage racks to the designated fuel inspection or fuel repair workstation. These non-normal fuel transfer operations are performed using the Spent Fuel Handling Tool (SFHT). The SFHT is a long handled tool which latches onto the fuel assembly top nozzle via manually actuated grippers. Lifting of the SFHT and attached fuel assembly is performed using an auxiliary hoist on the FHM.

Regulatory Guidance:

Standard Review Plan 9.1.4 "Light Load Handling System (related to Refueling)" invokes GDC 61 for avoidance of excessive personnel radiation exposure. Acceptance criteria for meeting the relevant aspects of GDC 61 are based in part on the guidelines of ANSI/ANS 57.1-1992, Section 6.1.1 of this standard states:

> Mechanical or electrical safety devices shall be designed into the system to prevent damage to fuel units and conditions that pose a radiation hazard or an unintentional radiation exposure risk to personnel.

Section 6.4.1.2 states:

> The design shall include provisions to test mechanical safety features and controls to verify at least the following: devices are within specifications. ..... (4) The following applies to fuel preparation equipment only: (a) Check of mechanical stops

to limit hoist travel when a fuel preparation machine is used for fuel preparation (e.g., stops to prevent a spent fuel unit from being raised above the recommended minimum water depth for shielding). (b) Check of special mechanical stops to limit hoist travel when equipment is used for spent fuel inspection and nondestructive testing.

ANSI/ANS 57.1-1992, Section 6.3 lists Safety Requirements for fuel handling systems, which include underload, overload, nonsimultaneous motion, et al to prevent fuel damage and to provide for personnel safety.

1) Please explain how you implement the requirements of ANSI/ANS 57.1-1992 (sections 6.1.1 and 6.4.1.2) which require you to have mechanical or electrical safety devices and mechanical stops to limit hoist travel to prevent unintentional radiation exposure, damage to fuel, and prevention of a spent fuel unit from being raised above the minimum water depth for shielding when you use the SFHT with the auxiliary hoist of the FHM.
2) Explain what ITAAC, similar to Design Commitments 4 and 5 of Table 2.2.2-1 in Tier 1, will inspect, test and accept the function of the SFHT with the auxiliary hoist of the FHM when used to move a spent fuel assembly.
3) Explain how the Safety Requirements listed in ANSI/ANS 57.1-1992, Section 6.3 are met when using the auxiliary hoist of the FHM to move spent fuel.
4) Clarify why the use of the SFHT with the auxiliary hoist of the FHM to move spent fuel, as stated in TR-121, is not described in the DCD.

Westinghouse Response:

1) Section 9.1.4.3.3 of the DCD, Rev 16, will be revised as shown on the attached mark-up. Each FHM hoist will have a mechanical limit based on maximum hoist up travel and spent fuel handling tool length. This limit is established to prevent raising a fuel assembly above the minimum water depth. The FHM will also have dual hoist encoders on each hoist that will monitor hoist position and stop the hoist prior to reaching the mechanical limit. The FHM hoists will also be equipped with a redundant geared rotary position switch that will be set at a hoist position prior to reaching the mechanical up limit. The mechanical limit will be verified using a dummy fuel assembly during preoperational testing of the FHM. See DCD section 14.2.9.1.15 c). Operation of the two electrical hoist travel limits will be verified during preoperational testing.

   Section 9.1.4.3.7 of the DCD, Rev 16, will also be revised as shown on the attached mark-up.

2) ITAAC 2.1.1 Design Commitment 5 and Table 2.1.1-1 wording will be revised as shown on the attached mark-up.

3) As discussed previously, the FHM design is being revised to eliminate the mast and auxiliary hoist. The new FHM will be a bridge style machine with two overhead trolley/hoists. Both FHM hoists will be equipped with the safety devices identified in ANSI/ANS 57.1-1992, Section 6.3.1 with the exception of (9) Grapple Release. Grapple release is a manual operation performed by a trained operator using fuel handling tools designed to support this operation. The single failure proof hoist and the new fuel handling tool will be used to handle new fuel, the non-single failure proof hoist and the spent fuel handling tool will be used to handle spent fuel. The single failure proof hoist and the spent fuel handling tool may be used to handle spent fuel as well. However, the single failure proof hoist will not have access to all spent fuel handling/storage locations.

4) The FHM design is being changed as addressed previously. There will no longer be an "Auxiliary Hoist". See the attached DCD markup for Section 9.1.4.3.3

Design Control Document (DCD) Revision:

9.1.4.3.3 Fuel Handling Machine

~~The fuel handling machine has the same design functions as the refueling machine and includes the same safety features.~~

The fuel handling machine design includes the following provisions to provide for safe handling of fuel assemblies and other components within the spent fuel handling area:

A. Safety Interlocks

Operations which could endanger the operator or damage the fuel, designated below by an asterisk (*), are prevented by mechanical or failure tolerant electrical interlocks or by redundant electrical interlocks. Other interlocks are intended to provide equipment protection and may be implemented either mechanically or by electrical interlock and are not required to be fail safe.

Fail safe electrical design of a control system interlock is applied according to the following rules:

1. Fail safe operation of an electrically operated brake is such that the brake engages on loss of power.

2. Fail safe operation of a relay is such that the de-energized state of the relay inhibits unsafe operation.

3. Fail safe operation of a switch, termination, or wire is such that breakage or high resistance of the circuit inhibits unsafe operation.

Those parts of a control system interlock which are not or cannot be operated in a fail safe mode as defined in the preceding rules are supplemented by a redundant component or components to provide the requisite protection. Required fail safe operations are:

1. The fuel handling machine, and its associated fuel handling tool, can only place a fuel assembly in the new fuel rack, spent fuel racks, fuel transfer system, new fuel elevator, spent fuel cask or truck bay traveler.

2. When the hoist load weighing system detects a load greater than the spent fuel assembly handling tool, the machine cannot traverse unless the hoist is at the up limit. For new fuel handling, the load is greater than a new fuel handling tool.

3. Simultaneous traversing and hoisting operations are prevented.

4. The fuel handling machine is restricted to raising a fuel assembly to a height at which the water provides a safe radiation shield.

5. When a fuel assembly is raised or lowered, interlocks provide confidence that the fuel handling machine can only apply loads which are within safe operating limits.

6. Lowering of the hoist is not permitted if slack cable exists.

7. The fuel transfer system container is prevented from moving unless the fuel handling machine and the long handled tool and/or fuel assembly is out of the fuel transfer zone. An interlock is provided from the fuel handling machine to the fuel transfer system to accomplish this.

9.1.4.3.7 Radiation Shielding

During spent fuel transfer, the gamma dose rate at the surface of the water is 20 millirem/hour or less. This is accomplished by maintaining a minimum of 9.5 feet of water above the top of the active fuel height during handling operations.

The ~~three~~ fuel handling devices used to lift spent fuel assemblies are the refueling machine *and the* fuel handling machine *using* the spent fuel handling tool. Both the refueling machine and fuel handling machine contain positive stops which prevent the fuel assembly from being raised above a safe shielding height.

DCD Tier 1, Section 2.1.1, pg 2.1.1-1

~~*4. The RM and FHM gripper assemblies are designed to prevent opening while the weight of the fuel assembly is suspended from the gripper.*~~

The RM and FHM/SFHT gripper assemblies are designed to prevent opening while the weight of the fuel assembly is suspended from the grippers.

5. The lift height of the RM *mast* and FHM ~~masts is~~ *hoist(s) are* limited such that the minimum required depth of water shielding is maintained.

DCD Tier 1, Table 2.1.1-1, pg 2.1.1-2

Table 2.1.1-1 Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the FHS is as described in the Design Description of this Section 2.1.1.	Inspection of the as-built system will be performed.	The as-built FHS conforms with the functional arrangement as described in the Design Description of this Section 2.1.1.
2. The FHS has the refueling machine (RM), the fuel handling machine (FHM), and the new and spent fuel storage racks.	Inspection of the system will be performed.	The FHS has the RM, the FHM, and the new and spent fuel storage racks.
3. The FHS preserves containment integrity by isolation of the fuel transfer tube penetrating containment.	See Tier 1 Material, Table 2.2.1-3, items 1 and 7.	See Tier 1 Material, Table 2.2.1-3, items 1 and 7.
4. ~~The RM and FHM gripper assemblies are designed to prevent opening while the weight of the fuel assembly is suspended from the gripper.~~ *The RM and FHM/SFHT gripper assemblies are designed to prevent opening while the weight of the fuel assembly is suspended from the grippers.*	The RM and FHM*/SFHT gripper assemblies* will be tested by operating the open controls of the gripper while suspending a dummy fuel assembly.	The RM and FHM*/SFHT gripper assemblies* will not open while suspending a dummy test assembly.

5. The lift height of the RM *mast* and FHM ~~masts is~~ *hoist(s) are* limited such that the minimum required depth of water shielding is maintained.	The RM and FHM will be tested by attempting to raise a dummy fuel assembly.	The bottom of the dummy fuel assembly cannot be raised to within 25 ft, 3 in of the operating deck floor.
6. The RM and FHM are designed to maintain their load carrying and structural integrity functions during a safe shutdown earthquake.	i) Inspection will be performed to verify that the RM and FHM are located on the nuclear island. ii) Type test, analysis, or a combination of type tests and analyses of the RM and FHM will be performed.	i) The RM and FHM are located on the nuclear island. ii) A report exists and concludes that the RM and FHM can withstand seismic design basis dynamic loads without loss of load carrying or structural integrity functions.

PRA Revision:
None

Technical Report (TR) Revision:
None