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June 16, 2010

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Jeffrey A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-10173

Subject: **Amended MHI's Responses to US-APWR DCD RAI No. 555-4385 Revision 0**

Reference: [1] "Request for Additional Information No. 555-4385 Revision 0, SRP Section: 09.01.04 – Light Load Handling System (Refueling) - Design Certification and New License Applicants, Application Section: 9.1.4," dated March 22, 2010.
[2] "MHI's Responses to US-APWR DCD RAI No. 555-4385 Revision 0, UAP-HF-10158,dated June 4, 2010.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Amended Response to Request for Additional Information No. 555-4385 Revision 0".

Enclosure 1 is the responses to 4 questions that are contained within Reference [1].

This response amends the previously transmitted answers submitted under MHI Reference UAP-HF-10158, dated June 4, 2010 (Reference [2]) due to the lack of necessary attachment in the previous transmittal.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of the submittals. His contact information is below.

Sincerely,

Y. Ogata

Yoshiki Ogata,
General Manager- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

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NRO

Enclosures:

1. Amended Responses to Request for Additional Information No. 555-4385 Revision 0

CC: J. A. Ciocco
C. K. Paulson

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Docket No. 52-021
MHI Ref: UAP-HF-10173

Enclosure 1

UAP-HF-10173
Docket No. 52-021

Amended Responses to Request for Additional Information No. 555-4385 Revision 0

June 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

06/16/2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 555-4385 REVISION 0**

SRP SECTION: **9.1.4 – Light Load Handling System (Refueling)**

APPLICATION SECTION: **9.1.4**

DATE OF RAI ISSUE: **03/22/2010**

QUESTION NO.: 09.01.04-17

The fuel handling machine (section 9.1.4.2.1.2) has an auxiliary hoist, but the purpose of the hoist was not clear. The auxiliary hoist has the load capacity to lift a fuel assembly, but is configured to preclude latching on to fuel assembly. Therefore, the staff submitted RAI 09.01.04-06 asking the applicant to explain the purpose and uses of the auxiliary hoist on the fuel handling machine and revise the DCD accordingly. In response to RAI 200-1983, 09.01.04-06, the applicant detailed the purpose and use of the auxiliary hoist on the fuel handling machine as being limited to handling inserts for spent fuel assemblies and pool-separating gates. However, the applicant failed to propose any DCD revision to define the purpose and use of the auxiliary hoist on the fuel handling machine for inclusion in the DCD.

In addition, the applicant has used the term "Hooks" and "Hoists" throughout the DCD on the various cranes. The staff is unclear which crane components are being referred to by the use of the term "hooks". For example, both "auxiliary hoist" and "auxiliary hook" are used in Section 9.1.4 and it is not clear whether these terms are being used to describe the same component. Or, whether they are referring to hoists that contain multiple hooks. ASME codes contain separate requirements for hooks and hoists, therefore it is important to clearly define each. The applicant should address the following. The response should include DCD markup pages which show the planned revisions.

- Define "hook" and "hoist" as they relate to the cranes components and update the DCD to indicate them consistently.
- Provide descriptive language to clearly define the function of the auxiliary hoist and update the DCD accordingly.

Reference: MHI's Responses to US-APWR DCD RAI No. 200-1983; MHI Ref: UAP-HF-09197; dated April 23, 2009; ML091170060.

ANSWER:

MHI agrees that current DCD includes the terms "hook" which shall correctly be read as "hoist" (or "hoisting system"). The "hoist" or "hoisting systems" consist of the reeving, hoisting mechanisms, and hooks used on a crane.

MHI also agrees that the response to RAI 9.1.4-6 might mislead the NRC. The auxiliary hoist of the fuel handling machine is provided to handle, using appropriate handling tool, not only the inserts for spent fuel assembly but also the inserts for new fuel assembly. In addition, the auxiliary hoist of the fuel handling machine is capable to handle new and spent fuel assembly using spent fuel assembly handling tool as discussed in subsection 9.1.4.2.1.7. Further, as replied to RAI 9.1.4-6, the auxiliary hoist also handles the gates separating the various pits (pools).

MH will revise the DCD to replace the term "hook" with "hoist" consistently among the DCD sections. In addition, MHI will revise the DCD to state the function of the auxiliary hoist of fuel handling machine. MHI will also revise voluntary the DCD to correct other misleading words found in the section 9.1.4 and 9.1.5. See "Impact on DCD" for proposed changes.

Impact on DCD

a) The second paragraph in the DCD section 9.1.4.2.1.2 on "Fuel Handling Machine" will be modified as follows:

The fuel handling machine also has an auxiliary hoist which is provided to handle the inserts for a new or a spent fuel assembly using appropriate handling tool. The auxiliary hoist also handles the gates separating the various pits (pools). The auxiliary hoist has the load capacity to lift a new or a spent fuel assembly using a spent fuel assembly handling tool, as backup the mast tube assembly. The auxiliary hoist has a load limiting device to prevent the hoist from exerting excessive force. ~~**The auxiliary hoist has the load capacity to lift a fuel assembly, but is configured to preclude latching on to fuel assembly.**~~

b) The second sentence in the DCD section 9.1.4.2.1.7 on "Spent Fuel Assembly Handling Tool" will be modified as follows:

"The tool is suspended from the **auxiliary** hoist of the fuel handling machine."

c) The second sentence in the DCD section 9.1.4.2.1.9 on "Rod Control Cluster (RCC) Handling Tool" will be modified. The "spent fuel machine" shall be read as "fuel handling machine", as follows:

"Once the ~~**spent**~~ fuel **handling** machine is positioned over the fuel assembly of interest, the handling tool is lowered onto the fuel assembly."

d) The first sentence in second paragraph in the DCD section 9.1.4.2.2.1 on "New Fuel Receipt" will be modified as follows:

"The new fuel shipping container is raised from the truck using the auxiliary ~~**hook**~~ **hoist** on the spent fuel cask handling crane through the access hatch in the refueling area floors at elevations 25 ft - 3 in and 76 ft - 5 in."

e) The second sentence in third paragraph in the DCD section 9.1.5.2.2 on "Spent Fuel Cask Handling Crane" will be modified as follows:

"In the fuel handling area, once the RCP motor is in position, it is lifted by the main ~~**hook**~~ **hoist** of the spent fuel handling crane and transferred to the truck access area using the path shown on Figure 9.1.5-3."

f) The first bullet, fourth paragraph in the DCD section 9.1.5.2.2 on "Spent Fuel Cask Handling Crane" will be modified as follows:

"The spent fuel handling cask crane range of movement is limited; in general, to the fuel handling area defined by the ~~hook~~ **hoist** coverage ranges shown in Figure 9.1.5-1."

g) The first sentence in first paragraph in the DCD section 9.1.5.2.3 on "Polar Crane" will be modified as follows:

"During refueling, the integrated reactor vessel head assembly and the reactor core upper and lower internals are transferred using the main ~~hook~~ **hoist** and a lifting rig."

h) The first sentence in second paragraph in the DCD section 9.1.5.2.3 on "Polar Crane" will be modified as follows:

"The RCP motors and other similar sized equipment are transferred using the auxiliary ~~hook~~ **hoist** from their installed location to the PCCV equipment hatch area where they are loaded onto a transporter for transfer to the fuel handling area or other designated areas."

i) The first bullet, third paragraph in the DCD section 9.1.5.2.3 on "Polar Crane" will be modified as follows:

"The polar crane range of movement is limited, in general, area defined by the ~~hook~~ **hoist** coverage ranges shown in Figures 9.1.5-4."

j) Table 9.1.5-1 "Specification of the Spent Fuel Cask Handling Crane" and Table 9.1.5-2 "Specification of the Polar Crane" will be modified as follows:

Table 9.1.5-1 Specification of the Spent Fuel Cask Handling Crane

1. Type		Overhead bridge crane		
2. Operating device		Radio remote control unit and cab on crane		
3. Component supplied electric power		Trolley		
4. Electric power supply		Power	: 460V ac, 60 Hz, 3 Phase	
		Space Heater	: 230V ac, 60 Hz, Single Phase	
5. Bridge Span		47'-3"		
6. Top level of the rail		Elevation 125'-8"		
		Main ~~Hook~~ **Hoist**	Auxiliary ~~Hook~~ **Hoist**	Suspension Hoist
7. Capacity	Metric ton	150	20	2
8. Lift	ft-in (m)	124'-9" (38.003 m)	124'-9" (38.003 m)	69'-3" (21.0886 m)
9. ~~Hook~~ **Hoist** Coverage	ft-in (m)	Refer to Figure 9.1.5-1 and 9.1.5-2		
10. Hoisting Speed	m/min	0.12, 0.6, 1.2	0.45, 1.8, 4.5	2.1, 6.3
11. Traveling Speed	m/min	Bridge: 0.6, 1.5, 6.0		Suspension Crane: 3.0, 9.0
		Trolley: 0.6, 1.5, 6.0		Hoist: 3.0, 9.0
12. Wire Material		Stainless Steel (ATSM A 492 Type 304)		

Table 9.1.5-2 Specification of the Polar Crane

1. Type		Overhead bridge crane	
2. Operating device		Portable wireless control box on operating floor, Cab on crane	
3. Component supplied electric power		Trolley	
4. Electric power supply		Power : 460V ac, 60 Hz, 3 Phase	
		Space Heater : 230V ac, 60 Hz, Single Phase	
5. Bridge Span		142'-1"	
6. Top level of the rail		Elevation 145'-6"	
		Main ~~Hook~~ **Hoist**	Auxiliary ~~Hook~~ **Hoist**
7. Capacity	Metric ton	250	50
8. Lift	ft-in (m)	67'-9" (20.650 m)	119'-1" (36.296 m)
9. ~~Hook~~ **Hoist** Coverage	ft-in (m)	Refer to Figure 9.1.5-4	
10. Hoisting Speed	m/min	0.12, 0.6, 1.2	1.2, 6.0, 12.0
11. Traveling Speed	m/min	Bridge: 0.9, 1.8, 18.0	
		Trolley: 0.6, 3.42, 12.0	
12. Wire Material		Carbon Steel	

k) Figure 9.1.5-1 "Traveling Route of Spent Fuel Cask" will be modified as follows:

"**Spent Fuel** Cask Handling Crane ~~Hook~~ **Hoist** 150 ~~t~~ **(Metric ton)** Coverage"

"**Spent Fuel** Cask Handling Crane (Overhead)"

l) Figure 9.1.5-2 "Traveling Route of Irradiation Sample Container" will be modified as follows:

"**Spent Fuel** Cask Handling Crane ~~Hook~~ **Hoist** 20 ~~t~~ **(Metric ton)** Coverage"

"**Spent Fuel** Cask Handling Crane (Overhead)"

m) Figure 9.1.5-3 "Traveling Route of Equipment Maintenance" will be modified as follows:

"**Spent Fuel** Cask Handling Crane (Overhead)"

n) Figure 9.1.5-4 "Traveling Route of Heavy Load Inside Containment" will be modified as follows:

"Polar Crane Main ~~Hook~~ **Hoist 250 (Metric ton)Coverage**"

"Polar Crane Auxiliary ~~Hook~~ **Hoist 50 (Metric ton)Coverage**"

See Attachment 1 for a mark-up of associated DCD changes to be incorporated.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

06/16/2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 555-4385 REVISION 0**

SRP SECTION: **9.1.4 – Light Load Handling System (Refueling)**

APPLICATION SECTION: **9.1.4**

DATE OF RAI ISSUE: **03/22/2010**

QUESTION NO.: 09.01.04-18

DCD Section 9.1.4.2.2.2 specifies that irradiated and new fuel assemblies are individually lifted from a spent fuel rack by using the fuel handling machine, transferred to the up-ender and then to inside containment. However, it is not clear how new fuel is placed in the spent fuel racks, nor is there a clear description of the integrated use of the new fuel storage pit, fuel inspection pit and the spent fuel pit in the processes that accept new fuel and for the refueling operation. There is no description of the purpose of the fuel inspection pit.

In response to RAI 200-1983, 09.01.04-07, the applicant provided a description of the process for transferring new fuel assemblies from the new fuel storage pit to the reactor as requested. The RAI response included a statement that the new fuel assembly is lifted using the fuel handling machine auxiliary hoist. This appears to contradict the answer provided for RAI 09.01.04-06, which limits the use of the auxiliary hoist of the fuel handling machine (FHM) to handling inserts for spent fuel assemblies and pool separating gates. The staff cannot fully evaluate the balance of the new fuel movement process until the confusion involving the exact purpose and uses, including specific limitations, of the auxiliary hoist are fully explained. The applicant also described the purpose of the fuel inspection pit as an avenue to allow underwater visual inspection of irradiated fuel, but failed to propose any descriptive language for inclusion in the DCD as directed.

- The staff requests clarification of FHM auxiliary hoist use and proposals for detailed language with respect to new fuel transfer and the fuel inspection pit for inclusion in the DCD.
- The staff requests the submission of a complete, detailed, and reviewable answer with appropriate language for inclusion in the DCD regarding the handling process of new fuel after its receipt into the new fuel storage pit, including the role the fuel inspection pit and new fuel elevator play during new fuel receipt.

Reference: MHI's Responses to US-APWR DCD RAI No. 200-1983; MHI Ref: UAP-HF-09197; dated April 23, 2009; ML091170060.

ANSWER:

MHI agrees that the response to RAI 9.1.4-6 might mislead the NRC, and will revise the DCD to state the use of the auxiliary hoist of fuel handling machine. Refer our response to RAI 9.1.4-17 for proposed changes on the DCD to describe the use and purpose of auxiliary hoist of fuel handling machine.

MHI agrees that the response to RAI 9.1.4-7 described the purpose of the fuel inspection pit, but failed to include the description in the DCD. MHI will revise the DCD section 9.1.4.2.2.2 on "Reactor Refueling Operations – Phase-III Fuel Handling" to describe that the as-needed underwater visual inspections at fuel inspection pit is performed for spent fuel removed from reactor, during refueling and/or after completion the refueling.

MHI also agrees that the DCD section 9.1.4.2.2.1 on "New Fuel Receipt" did not provide the handling process of new fuel after its receipt into the new fuel storage pit. MHI will revise the DCD to add handling procedure from new fuel storage pit (racks) to spent fuel storage pit for preparing the reactor refueling operations.

Impact on DCD

a) The sixth bullet in section 9.1.4.2.2.2 on "Reactor Refueling Operations – Phase-III Fuel Handling", will be modified as follows:

   "The irradiated fuel is grasped by the fuel handling machine. The fuel is then transferred to the spent fuel rack. **If needed, the spent fuel is transferred to fuel inspection pit to perform underwater visual inspections before transferring to the spent fuel rack, or inspected after completion the refueling (during normal operation).** This process is continued until the core is off loaded. SFP level is maintained at normal throughout the refueling process to assure adequate radiation protection for personnel."

b) Following paragraphs will be added after third paragraph in the DCD section 9.1.4.2.2.1 on "New Fuel Receipt":

   "A new fuel assembly stored in the new fuel storage racks is transferred to the spent fuel pit to prepare for refueling.

   A new fuel assembly stored in the new fuel racks is lifted using the suspension hoist of the spent fuel cask handling crane, and transferred to the new fuel elevator located in the fuel inspection pit. The new fuel assembly is then lowered using the new fuel elevator for access by the fuel handling machine. The new fuel assembly is latched by the spent fuel assembly handling tool on the fuel handling machine, and is lifted using the fuel handling machine mast tube or auxiliary hoist and then transferred to the spent fuel pit for temporary storage in the spent fuel rack."

See Attachment 1 for a mark-up of associated DCD changes to be incorporated.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

06/16/2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 555-4385 REVISION 0**

SRP SECTION: **9.1.4 – Light Load Handling System (Refueling)**

APPLICATION SECTION: **9.1.4**

DATE OF RAI ISSUE: **03/22/2010**

QUESTION NO.: 09.01.04-19

In response to RAI 200-1983, 09.01.04-11, the applicant acknowledged that the reference to a "decontamination pit" is incorrect and should be replaced by "cask washdown pit". The applicant proposed replacing the "decontamination pit" language with "cask washdown pit" in Tier 2, Section 9.1.4.2.2.4, ninth bullet. The change was made in Revision 2. However, the eleventh bullet of the same section also references a "decontamination pit."

The staff requests the applicant to:

- Propose corrective language to the Tier 2, Section 9.1.4.2.2.4, eleventh bullet, with respect to the "decontamination pit" for revision of the DCD.
- Confirm that "decontamination pit" name change has been revised throughout the complete DCD.

Reference: MHI's Responses to US-APWR DCD RAI No. 200-1983; MHI Ref: UAP-HF- 09197; dated April 23, 2009; ML091170060.

ANSWER:

MHI agrees that it was not replaced "decontamination pit" in the eleventh bullet in the section 9.1.2.2.4 as pointed. MHI will revise the DCD to correct the pit name as well. In addition, The change will also be made in fifth bullet in Tier 2, section 3.8.4.1.1 on "R/B". MHI confirmed that there is no other "decontamination pit" stated throughout the whole DCD.

Impact on DCD

a) The eleventh bullet in the section 9.1.2.2.4 will be modified as follows:

"The cask is removed from the ~~decontamination~~ **cask washdown** pit, and lower through the access hatch in the fuel handling area operating floor to a cask transporter at elevation 3 ft - 7 in."

b) The fifth bullet in the section 3.8.4.1.1 will be modified as follows:

"~~Decontamination~~ **Cask washdown** pit"

Other terns in the list are also proposed to change voluntary for consistency as follows:

"~~Spent fuel pit crane~~ **Fuel handling machine**"

"Cask ~~loading~~ pit with the **spent** fuel **cask** handling ~~area~~ crane"

See Attachment 1 for a mark-up of associated DCD changes to be incorporated.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

06/16/2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 555-4385 REVISION 0**

SRP SECTION: **9.1.4 – Light Load Handling System (Refueling)**

APPLICATION SECTION: **9.1.4**

DATE OF RAI ISSUE: **03/22/2010**

QUESTION NO.: 09.01.04-20

In its response to RAI 200-1983, 09.01.04-13, the applicant proposed an additional ITAAC requirement in Table 2.7.6.4-2 (Design Commitment 7) of DCD that provides a reference to Design Commitment numbers 1, 2b, 3b, and 4b of DCD Tier 1 Table 2.11.2-2, "Containment Isolation System Inspections, Tests, Analyses, and Acceptance Criteria," to describe the ITAAC for the fuel transfer tube as part of the primary reactor containment.

This is an inappropriate use of ITAAC Table 2.7.6.4-2 of Tier 1, since the additional design commitment 7 does not include any inspection or acceptance criteria for acceptable closure of the proposed ITAAC. A more appropriate location to include a reference to ITAAC in Table 2.11.2-2 would be in Section 2.7.6.4.2 (similar to that done in Section 2.7.6.9.2)

Therefore, the applicant is requested to revise Table 2.7.6.4-2 and Tier 1 to properly define any necessary reference.

Reference: MHI's Responses to US-APWR DCD RAI No. 200-1983; MHI Ref: UAP-HF- 09197; dated April 23, 2009; ML091170060.

ANSWER:

MHI understood the NRC expectation. Similar discussion between the NRC and MHI was made at the phone call on December 19, 2009. (See Reference) The ITAAC Table 2.7.6.4-2 (Design Commitment 7) of the DCD has already been proposed for change to state appropriate design commitment and ITAAC.

Reference: Transmittal of US-APWR DCD Tier 1 Revision 2 Update; MHI Ref: UAP-HF-10043; dated February, 2010; ML100480252.

Impact on DCD

See Attachment 2 for change which was proposed to the NRC in the cited MHI Letter UAP-HF-10043.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

The refueling machine transport fuel assemblies between the fuel transfer system (FTS) and the reactor core within the confines of the refueling cavity. The refueling machine consists of a bridge with two motorized end trucks which traverse the length of the refueling cavity. Mounted atop the bridge, is a vertical mast tube assembly which traverses the bridge perpendicular to the direction of the motorized end trucks. This provides an arrangement wherein the mast can be precisely indexed over a fuel assembly in the reactor core. The mast tube assembly contains a gripper mechanism which is lowered to latch onto a fuel assembly. The fuel assembly is then raised into the mast tube to protect the fuel assembly during transport. The mast tube also contains a sipping system used to detect leaking fuel.

The refueling machine also has an auxiliary hoist which is used in the control rod drive shaft unlatching operation.

Electrical interlocks, limit switches, and mechanical stops are utilized to prevent damage to a fuel assembly to assure appropriate radiation shielding depth below the water level in the refueling cavity, and to monitor the fuel assembly load for imparted loads greater than the nominal weight of the fuel assembly. Imparted loads could result from unidentified movement restrictions such as binding of the fuel assembly in the core.

9.1.4.2.1.2 Fuel Handling Machine

The fuel handling machine transport fuel assemblies between the fuel elevator and the SFP within the confines of the refueling area pits and fuel transfer canal. The fuel handling machine consists of a bridge with two motorized end trucks which traverse the length of the spent fuel pit, the cask pit and the fuel inspection pit. Mounted atop the bridge, is a vertical mast tube assembly which traverses the bridge perpendicular to the direction of the motorized end trucks. This provides an arrangement wherein the mast can be precisely indexed over a fuel assembly in the spent fuel rack. The mast tube assembly contains a gripper mechanism which is lowered to latch onto a fuel assembly which is then raised into the mast tube to protect the fuel assembly during transport.

DCD_09.01.04-17

The fuel handling machine also has an auxiliary hoist which is provided to handle the inserts for a new or a spent fuel assembly using appropriate handling tool. The auxiliary hoist also handles the gates separating the various pits (pools). The auxiliary hoist has the load capacity to lift a new or a spent fuel assembly using a spent fuel assembly handling tool, as backup the mast tube assembly. The auxiliary hoist has a load limiting device to prevent the hoist from exerting excessive force. ~~The auxiliary hoist has the load capacity to lift a fuel assembly, but is configured to preclude latching on to fuel assembly.~~

As for electrical interlock, limit switches, and mechanical stops, which is same function for refueling machine, are also provided for fuel handling machine.

9.1.4.2.1.3 Suspension Hoist on the Spent Fuel Cask Handling Crane

The suspension hoist on the spent fuel cask handling crane (Subsection 9.1.5) has a load limit interlock. This interlock precludes the suspension hoist from lifting a load greater than its rated capacity. In addition, administrative procedure defined in Subsection 13.5.1

is to be developed to preclude the suspension hoist from being utilized for activities other than for new fuel assembly handling.

9.1.4.2.1.4 New Fuel Elevator

The new fuel elevator, located in the fuel inspection pit, accepts new fuel assemblies which have been removed from the new fuel assembly container. The new fuel elevator is used to lower the new fuel assembly for access by the fuel handling machine. The elevator winch has a load sensing device which prevents a fuel assembly from being raised.

9.1.4.2.1.5 Fuel Transfer System

The fuel transfer system consists of a rail mounted transfer container car which transports the fuel assembly between the refueling area of the R/B and the refueling cavity in the C/V. The transfer car has an integral up ender mechanism which facilitates translating the fuel assembly from the vertical position in the refueling area or the C/V to a horizontal position for transport through the transfer tube. Once in the C/V, the transfer car is then translated into the vertical position again. The up ender on each side is manually actuated to raise and lower the transfer car. As back up to the normal drive mechanism, the transfer car is provided with a wire rope to facilitate movement should the drive mechanism fail.

9.1.4.2.1.6 Fuel Transfer Tube

Transfer of fuel assemblies between the R/B refueling area and the refueling cavity of the C/V is through a mechanical pipe penetration identified as the fuel transfer tube. The fuel transfer tube has a gate valve on the refueling area end of the transfer tube and a blind flange on the C/V end. The blind flange assures the containment pressure boundary integrity outside of refueling operations.

9.1.4.2.1.7 Spent Fuel Assembly Handling Tool

The spent fuel assembly handling tool handles new and irradiated fuel assemblies at the appropriate depth below the shielding water. The tool is suspended from the auxiliary hoist of the fuel handling machine. It has four latching fingers to grip the fuel assembly top nozzle in an interlocking fashion. When the fingers are latched, a locking pin is inserted into the operating handle, thereby preventing the fingers from being unlatched inadvertently during fuel handling operations. DCD_09.01.04-17

9.1.4.2.1.8 New Fuel Assembly Handling Tool

The new fuel assembly handling tool is used to transfer new fuel from the shipping container to the new fuel rack or new fuel elevator. The tool is used in conjunction with the suspension hoist on the spent fuel cask handling crane. It has four latching fingers to grip the fuel assembly top nozzle in an interlocking fashion. When the fingers are latched, a locking pin is inserted into the operating handle, thereby preventing the fingers from being unlatched inadvertently during fuel handling operations.

9.1.4.2.1.9 Rod Control Cluster (RCC) Handling Tool

The rod control cluster handling tool is used to remove a rod control cluster from one fuel assembly and insert it into another fuel assembly. This operation is performed within the SFP. Once the ~~spent~~ fuel handling machine is positioned over the fuel assembly of interest, the handling tool is lowered onto the fuel assembly. The latching mechanism is lowered to the rod control cluster, the rod control cluster is latched, and then the latching mechanism and rod control cluster are pulled up into the guide tube. The tool is then raised, the crane is repositioned over the target fuel assembly, and the tool is lowered onto the fuel assembly. The latching mechanism and the rod control cluster are then lowered through the guide tube until the rod control cluster is resting in the target fuel assembly. The rod control cluster is then unlatched and the tool is lifted from the target fuel assembly. DCD_09.01.04-17

9.1.4.2.1.10 Thimble Plug Handling Tool

The thimble plug handling tool is utilized to remove and transfer a thimble plug from one fuel assembly to another. This operation is performed from the bridge of the fuel handling machine by hand.

9.1.4.2.1.11 Burnable Poison Rod Assembly Handling Tool

The burnable poison rod assembly handling tool is used to transfer a burnable poison rod assembly between fuel assemblies and/or burnable poison rod assembly storage fixture.

9.1.4.2.1.12 Control Rod Drive Shaft Handling Tool

The control rod drive shaft handling tool is used to latch and unlatch the control rod drive shaft from the rod control cluster. It is suspended from the auxiliary hoist of the refueling machine.

9.1.4.2.2 Fuel Handling Operations

9.1.4.2.2.1 New Fuel Receipt

New fuel is shipped to the site in a new fuel shipping container. The new fuel shipping container is received into the R/B by way of the refueling area truck access bay at elevation 3 ft - 7 in.

DCD_09.01.04-17

The new fuel shipping container is raised from the truck using the auxiliary ~~hook~~hoist on the spent fuel cask handling crane through the access hatch in the refueling area floors at elevations 25 ft - 3 in and 76 ft - 5 in. Elevation 76 ft - 5 in is the operating level of the refueling area.

The new fuel container is set on the operating floor. Using the suspension hoist on the spent fuel cask handling crane, new fuel is removed from the shipping container and stored in the new fuel storage pit. During this operation, the new fuel assemblies are suspended using a short fuel handling tool to permit surface inspection prior to being placed into a new fuel storage rack.]

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"A new fuel assembly stored in the new fuel storage racks is transferred to the spent fuel pit to prepare for refueling.

A new fuel assembly stored in the new fuel racks is lifted using the suspension hoist of the spent fuel cask handling crane, and transferred to the new fuel elevator located in the fuel inspection pit. The new fuel assembly is then lowered using the new fuel elevator for access by the fuel handling machine. The new fuel assembly is latched by the spent fuel assembly handling tool on the fuel handling machine, and is lifted using the fuel handling machine mast tube or auxiliary hoist and then transferred to the spent fuel pit for temporary storage in the spent fuel rack."

General arrangement figures for the US-APWR are presented in Subsection 1.2.1.7.

9.1.4.2.2.2 Reactor Refueling Operations

Reactor refueling operations are divided into four phases: preparation, reactor disassembly, fuel handling, and reactor assembly. Refueling operations are outlined below and performed in accordance with operating procedures defined in Subsection 13.5.2.

- Phase I - Preparation

  The reactor is placed into cold shutdown mode as defined in the Technical Specifications, Chapter 16. The refueling water and reactor coolant are borated to assure the core remains approximately 5% below criticality during refueling operations based on the maximum reactivity of the fuel to be cycled through an US-APWR.

  The water level in the refueling cavity and the spent fuel handling pit and interconnected pits is maintained at an elevation sufficient to keep radiation levels within personnel access limits when the fuel assemblies are being removed and transported from the core to the spent fuel racks in accordance with RG 1.13. The radiation and environmental levels are monitored to assure levels do not exceed personnel access limits.

  Upon achieving safe radiation and environmental conditions, the LLHS system is tested and the refueling machine overload is verified to be within operable. This is accomplished by using the mockup fuel assembly nozzle attached to the floor of the refueling cavity.

- Phase II – Reactor Disassembly

  The reactor vessel head assembly is prepared for refueling by disconnecting electrical cabling, seismic support tie rods, in-core instrumentation, and cooling duct work. The refueling cavity is prepared by:

  - Closing the reactor cavity drain line

- The refueling machine loaded with an irradiated fuel assembly traverses the reactor cavity until it is indexed over the vertical FTS fuel container. The irradiated fuel assembly is lowered into the container and unlatched.

- The fuel container is pivoted to the horizontal position. The fuel transfer car is moved back through the transfer tube to the refueling area in R/B. The fuel container is pivoted to the vertical position again.

- The irradiated fuel is grasped by the fuel handling machine. The fuel is then transferred to the spent fuel rack. If needed, the spent fuel is transferred to fuel inspection pit to perform underwater visual inspections before transferring to the spent fuel rack, or inspected after completion the refueling (during normal operation). This process is continued until the core is off loaded. SFP level is maintained at normal throughout the refueling process to assure adequate radiation protection for personnel. DCD_09.01.04-18

- The rod control clusters, the thimble plugs, and the burnable poison rod assemblies are shuffled in the SFP by using long handled tools on the fuel handling machine bridge.

- Irradiated and new fuel assemblies are individually lifted from a spent fuel rack by using the fuel handling machine, transferred to the up ender, and transferred to inside containment by reversing the core unloading process.

- Phase IV – Reactor Assembly

  The reactor assembly is accomplished by reversing the process described in Phase II – Reactor Disassembly.

9.1.4.2.2.3 Spent Fuel Storage

The spent fuel assemblies are stored in the SFP until fission product activity is low enough to permit shipment from the site or to be placed in dry storage. Spent fuel storage and cooling is discussed in Subsections 9.1.2 and 9.1.3, respectively.

9.1.4.2.2.4 Spent Fuel Shipment

The procedure for the spent fuel shipment is as follows:

- The spent fuel cask is received into the R/B by way of the refueling area truck access bay at elevation 3 ft - 7 in. The spent fuel cask is raised from the truck using the spent fuel cask handling crane through the access hatch in the floors at elevation 25 ft - 3 in and 76 ft - 5 in the R/B refueling area.

- The cask is moved to the cask washdown pit and washed to clean off dust and adhered material from the outside surface of the cask.

- The cask lid is removed and lay down on the operating floor. Then, O-ring of the lid is visually inspected.

- The cask is then placed into an encapsulating flexible barrier (baggy) to the top flange to prevent surface contamination. Additionally, the cask is filled with clean demineralized water.
- The water levels are raised in the refueling canal and the cask pit. The water is supplied from the refueling water auxiliary tank. Prior to opening the SFP and cask pit gates, the SFP water level is confirmed to be equalized with the refueling canal and cask pit water levels.
- The cask is transferred from the cask washdown pit to the cask pit using the cask handling tool to prevent crane wire rope oil from contaminating the cask pit water. When the cask is being lifting down in the filled cask pit, the baggy is filled by demineralized water to prevent the SFP water from entering in the baggy. The gate between cask pit and refueling canal is closed until the cask is completely settled on the pit floor.
- The fuel handling machine is indexed over the spent fuel asembly to be transported out of the spent fuel rack. The spent fuel is picked up to a designated height clearing the rack top and maintaining sufficient water depth for radiation shielding, transferred, and inserted into the cask whose flange level is the same as the rack top elevation.
- After the cask is fully loaded, the lid is installed for radiation shielding. The lid installation is verified for proper installation.
- The cask is lifted, the baggy is removed and properly stored and/or disposed in accordance with operating procedures defined in Subsection 13.5.2. It is then moved to the cask washdown pit.
- Swipes of the outside surface of the cask are taken to verify the out side surface of the cask has not been contaminated. When the swipes are found to be below the specified limits of Title 49 "Transportation" CFR Chapter I, Subpart I Pipeline and Hazardous Materials Safety Administration, Department of Transportation, Part 173 "Shippers--general requirements for shipments and packagings", (Ref. 9.1.7-17) and Title 10 "Energy" CFR Chapter I Nuclear Regulatory Commission Part 71 "Packaging and Transportation of Radioactive Material" (Ref. 9.1.7-18) as specified in the operating procedures defined in Subsection 13.5.2.

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- The cask is removed from the ~~decontamination~~cask washdown pit, and lower through the access hatch in the fuel handling area operating floor to a cask transporter at elevation 3 ft - 7 in.

9.1.4.3 Safety Evaluation

The LLHS is evaluated as to its ability to assure there are no unacceptable releases of radiation as a result of mechanical damage to fuel, to prevent damage that could compromise the ability to maintain an adequate degree of subcriticality, to maintain an SSE. The OHLHS is seismic category II and Equipment Class 5, as described in Section 3.2.

Other than the single-failure-proof OHLHS, miscellaneous hoists and cranes with heavy load capacities are installed in safety-related areas of the US-APWR plant. Descriptions and data for all cranes and hoists that have heavy load capacities and are installed over safe shutdown equipment are given in Table 9.1.5-3. The safety evaluations for those cranes and hoists are discussed in Subsection 9.1.5.3.

The OHLHS also includes equipment accessories (e.g., slings, and hooks, etc.) instrumentation, physical stops and/or electrical interlocks, and associated administrative controls

The applicable Codes and Standards are identified in Section 9.1.5.1.

9.1.5.2.1 Physical Arrangement

The areas of the plant in which the spent fuel cask handling crane and polar crane operate are shown in Figures 9.1.5-1 through 9.1.5-4. The specifications for the spent fuel cask handling crane and the polar crane are given in Table 9.1.5-1 and 9.1.5-2. As shown, the spent fuel handling crane has three load handling hooks, the main, the auxiliary, and the suspension crane. The suspension crane is only used for new fuel assembly handling between a new fuel container to the new fuel storage area or between the new fuel storage rack and the basket on the new fuel elevator. Because of this limitation, the suspension crane is considered part of the light load handling system. Its operation and control is detailed in Section 9.1.4.

9.1.5.2.2 Spent Fuel Cask Handling Crane

A spent fuel cask filled with spent fuel assemblies is lifted and transferred using the main hoist of the spent fuel cask handling crane and the spent fuel cask lift rig. The cask's path is from the cask loading pit to the truck access area on the ground floor as shown on Figure 9.1.5-1.

Neutron source containers and Irradiation sample containers are transferred using the auxiliary hoist through the path shown on Figure 9.1.5-2.

A reactor coolant pump (RCP) motor is transferred from the PCCV into the fuel handling area. In the fuel handling area, once the RCP motor is in position, it is lifted by the main ~~hook~~hoist of the spent fuel handling crane and transferred to the truck access area using the path shown on Figure 9.1.5-3. DCD_09.01.04-17

Miscellaneous equipment is transferred from the PCCV using the same path as the RCP motors. The spent fuel cask handling crane movement and storage is handled as follows:

- The spent fuel handling cask crane range of movement is limited; in general, to the fuel handling area defined by the ~~hook~~hoist coverage ranges shown in Figure DCD_09.01.04-17

9.1.5-1. The limitation is controlled by the configuration of the spent fuel handling cask crane and by permanent rail stops installed on the crane rails.

- For the RCP motors and miscellaneous equipment, movement is design limited to exclude the new fuel storage, cask, and fuel inspection pits. The movement of the spent fuel handling crane is limited by removable rail stops.
- The crane is stored on the truck access hatch side of the fuel handling area when not in service.

9.1.5.2.3 Polar Crane

During refueling, the integrated reactor vessel head assembly and the reactor core upper and lower internals are transferred using the main ~~hook~~hoist and a lifting rig. These components are transferred from the reactor vessel to their respective lay down area as shown on Figure 9.1.5-4. DCD_09.01.04-17

The RCP motors and other similar sized equipment are transferred using the auxiliary ~~hook~~hoist from their installed location to the PCCV equipment hatch area where they are loaded onto a transporter for transfer to the fuel handling area or other designated areas. The transporter is not covered in this section because it does not operate overhead and it is not a critical load handling component DCD_09.01.04-17

The polar crane movement and storage is handled as follows:

- The polar crane range of movement is limited, in general, area defined by the ~~hook~~hoist coverage ranges shown in Figures 9.1.5-4. The limitation is controlled by the configuration of the polar crane and by the fact, travel is limited by the circumferential rail on which the polar crane travels. DCD_09.01.04-17
- For the heavy loads, polar crane movement is limited to exclude the area bounded by the reactor cavity by way of administrative control procedures.
- The polar crane has a seismic restraint system which precludes derailment of the either the hoist trolley or the main bridge box girders during a seismic event.

The polar crane is stored in the parked position during plant operation. The parked position for the polar crane is parallel to the centerline of the C/V running between azimuth 0° and azimuth 180° with the hoist trolley located over the roof of the pressurizer room. The polar crane is designed to be used as a structural component during steam generator (SG) replacement. The driven components are not used during SG replacement.

9.1.5.3 Safety Evaluation

The OHLHS is evaluated as to its ability to, assure there is no unacceptable release of radiation through mechanical damage to fuel, prevent damage that could compromise ability to maintain adequate degree of sub criticality, uncovering of fuel in the reactor

Table 9.1.5-1 Specification of the Spent Fuel Cask Handling Crane DCD_09.01.04-17

1. Type		Overhead bridge crane		
2. Operating device		Radio remote control unit and cab on crane		
3. Component supplied electric power		Trolley		
4. Electric power supply		Power	: 460V ac, 60 Hz, 3 Phase	
		Space Heater	: 230V ac, 60 Hz, Single Phase	
5. Bridge Span		47'-3"		
6. Top level of the rail		Elevation 125'-8"		
		Main ~~Hook~~Hoist	Auxiliary ~~Hook~~Hoist	Suspension Hoist
7. Capacity	Metric ton	150	20	2
8. Lift	ft-in (m)	124'-9" (38.003 m)	124'-9" (38.003 m)	69'-3" (21.0886 m)
9. ~~Hook~~Hoist Coverage	ft-in (m)	Refer to Figure 9.1.5-1 and 9.1.5-2		
10. Hoisting Speed	m/min	0.12, 0.6, 1.2	0.45, 1.8, 4.5	2.1, 6.3
11. Traveling Speed	m/min	Bridge: 0.6, 1.5, 6.0		Suspension Crane: 3.0, 9.0
		Trolley: 0.6, 1.5, 6.0		Hoist: 3.0, 9.0
12. Wire Material		Stainless Steel (ATSM A 492 Type 304)		

Table 9.1.5-2 Specification of the Polar Crane DCD_09.01.04-17

1. Type		Overhead bridge crane	
2. Operating device		Portable wireless control box on operating floor, Cab on crane	
3. Component supplied electric power		Trolley	
4. Electric power supply		Power : 460V ac, 60 Hz, 3 Phase	
		Space Heater : 230V ac, 60 Hz, Single Phase	
5. Bridge Span		142'-1"	
6. Top level of the rail		Elevation 145'-6"	
		Main ~~Hook~~Hoist	Auxiliary ~~Hook~~Hoist
7. Capacity	Metric ton	250	50
8. Lift	ft-in (m)	67'-9" (20.650 m)	119'-1" (36.296 m)
9. ~~Hook~~Hoist Coverage	ft-in (m)	Refer to Figure 9.1.5-4	
10. Hoisting Speed	m/min	0.12, 0.6, 1.2	1.2, 6.0, 12.0
11. Traveling Speed	m/min	Bridge: 0.9, 1.8, 18.0	
		Trolley: 0.6, 3.42, 12.0	
12. Wire Material		Carbon Steel	