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June 15, 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-10171

Subject: MHI's Responses to US-APWR DCD RAI No. 563-4386 Revision 0

Reference: [1] "Request for Additional Information No. 563-4386 Revision 0, SRP Section: 09.01.05 – Overhead Heavy Load Handling System - Design Certification and New License Applicants, Application Section: 9.1.5," dated Mar 29, 2010.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 563-4386 Revision 0".

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

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. Responses to Request for Additional Information No. 563-4386 Revision 0

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-10171
Docket No. 52-021

Responses to Request for Additional Information No. 563-4386 Revision 0

June 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

06/15 /2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 563-4386 REVISION 0

SRP SECTION: 9.1.5 – Overhead Heavy Load Handling System

APPLICATION SECTION: 9.1.5

DATE OF RAI ISSUE: 03/29/2010

QUESTION NO.: 09.01.05-14

COL Information Items 9.1(3) through 9.1(8) in Section 9.1.6 were deleted in Revision 1 of DCD. DCD Revision 1 provided a reason for deletion in the description of change list (located in "Rev1_Change_List" page 18 of 75) which stated, "Editorial: This COL item is programmatic, and as a part of plant procedures and administrative procedures those has been defined in Subsection 13.5. Since these procedures has already been identified as COL item in Subsection 13.5, the item described in Section 9.1 was deleted to avoid duplicate description in the DCD."

SRP Section 9.1.5 and NUREG-0612 provides guidance for applicants to describe a heavy load handling program for design, operation, testing, maintenance and inspection of heavy load handling systems. In addition, US-APWR DCD Chapter 1, page 1.9-364, Table 1.9.3-1, "Conformance with Generic Issues (sheet 19 of 30)" provides a discussion of the minimum amount of details needed for heavy load handling procedures. The applicant was asked to determine whether a COL information item should be developed to ensure that the COL applicant will provide such a heavy load handling program. [RAI 292-2232, question 9.1.5-12]

In its response, the applicant agreed to the addition of a COL information item. The applicant proposed language containing specific guidance directing a COL applicant to establish a heavy load handling program, including associated procedural and administrative controls, for addition to DCD Tier 2 Section 9.1.6 as COL 9.1(6). The staff agrees with the addition of COL 9.1(6), since this will provide a more detailed definition of the content that the COL applicants will include in development of their heavy load handling program. However, Section C.I.9.1.5 of Regulatory Guide (RG) 1.206 contains specific guidance for the COL applicant to include in the heavy load handling program and the proposed US-APWR COL items do not seem to specify all the items specified in RG 1.206 for inclusion into the handling program. In addition, the response to RAI 9.1.5-01 specifically declared the essential service water pump pit cranes associated with the ultimate heat sink related structures (UHSRS) as outside the scope of the DCD. Thus, the staff finds the RG 1.206 item instructing the COL applicant to list all the heavy load handling equipment outside the scope of the certified design especially important to fully address this scope.

Therefore, the applicant is requested to revise and/or replace COL 9.1(6) to clearly specify all of the load handling items found in RG 1.206 C.I.9.1.5.

Reference: MHI's Responses to US-APWR DCD RAI No. 292-2232; MHI Ref: UAP-HF-09260; dated May 25, 2009, ML091490219.

ANSWER:

A revised and updated version of COL 9.1(6) will be added to DCD Tier 2 Section 9.1.6 to have the COL Applicant include the load handling items from RG 1.206 C. I. 9.1.5 in the site specific heavy load handling program. As stated in the original response to RAI 9.1.5-01, he existing Table 9.1.5.3 lists all permanent cranes and hoists installed over safe shutdown equipment for the US-APWR standard plant design.

Impact on DCD

See Attachment 1 for a mark-up of DCD, Tier 2, Chapter 9, for changes to be incorporated.

- Revise Col 9.1(6) in Subsection 9.1.6 by revising the existing paragraph and adding a second paragraph as shown below:

  "To assure proper handling of heavy loads during the plant life, the COL Applicant is to establish a heavy load handling program, including associated procedural and administrative controls, that satisfies commitments made in Subsection 9.1.5 of the DCD, and that meets the guidance of ANSI/ASME B30.2, ANSI/ASME B30.9, ANSI N14.6, ASME NOG-1, CMAA Specification 70-2000, NUREG-0554, NUREG-0612, and NUREG-0800, Section 9.1.5, and RG 1.206 C.I.9.1.5. During the operating life of the plant, it is anticipated that temporarily installed hoists and mobile cranes will also be used for plant maintenance. The heavy load handling program will include all cranes and hoists on site capable of handling heavy loads, including temporary cranes and hoists . The heavy load handling program will adopt a defense-in-depth strategy to enhance safety when handling heavy loads. For instance, the program will restrict lift heights to practical minimums and limit lifting activities as much as practical to plant modes in which load drops have the smallest potential for adverse consequences, particularly when critical loads are being handled. Further, prior to the lifting of heavy loads after initial fuel loading, the program will institute any additional reviews as necessary to assure that potential drops of these loads due to inadvertent operations or equipment malfunctions, separately or in combination, will not jeopardize safe shutdown functions, cause a significant release of radioactivity, a criticality accident, or inability to cool fuel within the reactor vessel or spent fuel pool.

  "The COL Applicant will prepare a heavy load procedure that includes sections, on the Design Bases, System Descriptions, Safety Evaluation, Inspection and Testing Requirements, and Instrumentation Requirements for the program. The heavy load program will include requirements for sufficient operator training, system design, load handling instructions, and equipment inspections. Safe load paths will be defined so that heavy loads avoid being moved over or near irradiated fuel or critical equipment. Mechanical stops or electrical interlocks to prevent movement of heavy loads near irradiated fuel or safe shutdown equipment may also be employed."

- Add Reference 9.1.7-27 to Section 9.1.7 as shown below.

  "9.1.7-27 Combined License Applications for Nuclear Power Plants (LWR Edition), Regulatory Guide (RG) 1.206, U.S. Nuclear Regulatory Commission, Washington, DC, June 2007."

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

06/15 /2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 563-4386 REVISION 0**

SRP SECTION: **9.1.5 – Overhead Heavy Load Handling System**

APPLICATION SECTION: **9.1.5**

DATE OF RAI ISSUE: **03/29/2010**

QUESTION NO.: 09.01.05-15

The applicant described in DCD Tier 2 Section 9.1.5.1 that the Overhead Heavy Load Handling Systems (OHLHS) may be used to handle non-critical loads of greater weight than the maximum critical load. In RAI 9.1.5-05, the staff asked the applicant to provide examples of non-critical loads and the methodology used to determine what constitutes a non-critical load.

In its response, the applicant provided an example of the use of the OHLHS for handling non-critical loads of greater weight than the maximum critical load as the, "special lifting of heavy loads during construction or plant shutdown". The RAI 9.1.5-05 response further indicated the following:

> "One example is the special lifting of heavy loads during construction or plant shutdown conditions. Prior to the lifting of non-critical loads after initial fuel loading, it would be demonstrated that the potential load drops due to inadvertent operations or equipment malfunctions, separately or in combination, would not jeopardize safe shutdown functions, cause a significant release of radioactivity, a criticality accident, or inability to cool fuel within the reactor vessel or spent fuel pool."

Although the RAI response is acceptable, the staff requests the applicant to include the details of the response to RAI 9.1.5-05 regarding the use and demonstration of safe handling prior to non-critical lifts in the DCD accordingly.

Reference: MHI's Responses to US-APWR DCD RAI No. 292-2232; MHI Ref: UAP-HF- 09260; dated May 25, 2009, ML091490219.

ANSWER:

Section 9.1.5.1 of the DCD will be revised to include the additional discussion of the use of the OHLHS for handling non-critical lifts, including the discussion provided in the response to RAI 292-2232, Question 5. The definition of "non-critical load" is contained in the fourth paragraph of DCD Section 9.1.5.1 and will be clarified in the addition of a new paragraph shown below.

Impact on DCD

See Attachment 1 for a mark-up of DCD, Chapter 9, for changes to be incorporated.

- Add the following as the fifth paragraph of Subsection 9.1.5.1:

  "One example is the special lifting of heavy loads during construction or plant shutdown conditions. Prior to the lifting of non-critical loads after initial fuel loading, it would be documented that the potential load drops due to inadvertent operations or equipment malfunctions, separately or in combination, would not jeopardize safe shutdown functions, cause a significant release of radioactivity, a criticality accident, or inability to cool fuel within the reactor vessel or spent fuel pool. Non-critical lifts are those lifts that involve non-critical heavy loads, as defined in Section 9.1.5 above, that, because of their location, timing, and the load path could not cause a significant release of radioactivity, cause a loss of margin to criticality, uncover irradiated fuel in the reactor vessel or spent fuel pool, or damage equipment essential to achieve or maintain safe shutdown. Non-critical lifts would be evaluated and documented in a manner similar to a critical heavy load lift, as required by the heavy load handling program to be developed by the COL applicant as required by COL 9.1(6) and Subsection 9.1.5.3 of this DCD."

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

06/15 /2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 563-4386 REVISION 0

SRP SECTION: 9.1.5 – Overhead Heavy Load Handling System

APPLICATION SECTION: 9.1.5

DATE OF RAI ISSUE: 03/29/2010

QUESTION NO.: 09.01.05-16

US-APWR DCD, Revision 1, Section 2.7.6.5.1 of Tier 1 (subpart "Numeric Performance Values") provided the statement, "The safety analysis states that because the spent fuel cask handling crane is prohibited from traveling directly over the spent fuel, a spent fuel cask drop accident is an implausible event and is not required to be analyzed in the safety analysis." The staff asked applicant to provide additional details of this safety analysis in RAI 292-2232, 9.1.5-10.

In its response, the applicant clarified that there is no safety analysis as the cranes in question have a single-failure-proof main hook design. The applicant proposed removing the sentence regarding safety analysis from the Tier 1 Section 2.7.6.5.1 bullet titled "Numeric Performance Values" and replacing it with language to indicate, "The main hooks of the PCCV polar crane and the spent fuel cask handling crane are designed as single-failure-proof cranes". Similar wording was also proposed as an additional bullet under the "Key Design Features" heading of DCD Tier 1 Section 2.7.6.5.1. The applicant submitted Revision 2 of the DCD, dated October 2009 that have incorporated the proposed RAI response. The staff is unclear what is meant by the use of the term "hooks". It is not clear whether this reference to hook is referring to the "hoist" or only the hoists hook that has incorporated the single-failure proof feature.

In addition, the applicant added the following statement to Tier 1 Section 2.7.6.5.1: "Crane axle failure may result in limited slip of the lifted load, causing impact on the floor, which has been accounted for in the structural design". All information in Tier 1 needs to be provided in Tier 2 and the staff is unable locate a similar statement in Tier 2. The staff also can not locate any definition of "limited slip" and the applicant is asked to provide additional details on the potential cause and amount of slip allowed. The applicant is requested to address the following and update the DCD accordingly:

- Clarify which portions of the cranes (i.e. hooks, hoist, etc..) are designed with single failure proof feature for consistency and update the term throughout the DCD accordingly.
- Revise Tier 2 to include the all information that is in Tier 1 in order to properly support Tier 1 statements.
- Provide definition of limited slip and provide the referenced structural design analysis used to justify the amount of slip allowed.

Reference: MHI's Responses to US-APWR DCD RAI No. 292-2232; MHI Ref: UAP-HF- 09260;

dated May 25, 2009, ML091490219.

ANSWER:

DCD, Tier 2, Section 9.1.5, will be revised to identify that the main hoisting systems are designed to conform to single failure proof criteria. Hoisting systems consist of the reeving, hoisting mechanisms, and hooks used on a crane. As noted in the second paragraph of DCD Section 9.1.5.1, the suspension hoist of the spent fuel cask handling crane and the auxiliary hoists of the polar crane and the spent fuel cask handling crane are not designed as single failure proof.

Pertinent material currently in Tier 1 have been reviewed for consistency with Tier 2 and revised or updated as required and added to Tier 2 to ensure the Tier 1 statements are supported by Tier 2 material.

The third paragraph of DCD, Tier 2, Revision 2, Subsection 9.1.5.1, identifies that ASME NOG-1 allows a drop of 1 inch for axle failure and defines a stopping distance (i.e. limited slip) not to exceed 5 inches. In determining the appropriate level of detail for DCD Tier 1, Subsection 2.7.6.5.1, paragraph titled "Numeric Performance Values," MHI considers the following guidance in NUREG-0800 Section 14.3 (March 2007), Appendix A, Subsection IV.2.4.A (page 14.3-17):

> "Numeric performance values and key parameters in safety analyses should be specified in the design descriptions based on their safety significance; however, numbers for all parameters need not be specified unless there is a specific reason to include them (e.g., important to be maintained for the life of the facility)."

The limits on drop distance due to axle failure and maximum stopping distance are appropriately addressed in DCD Tier 2 as summarized above, and are being removed from the Numeric Performance Values portion of DCD Tier 1 Subsection 2.7.6.5.1. There are no OHLHS numeric performance values used in the US-APWR safety analyses. As stated in DCD Tier 2 Subsection 15.7.5, no accident analysis is necessary for the spent fuel cask drop accident, because of the single-failure-proof OHLHS cranes and restrictions on spent fuel cask handling crane travel over the spent fuel pool.

As noted in the second paragraph of DCD Section 9.1.5.1, the auxiliary hoist of the Spent Fuel Cask Handling Crane is non-single-failure-proof. Preventive design measures and administrative controls as stated in the DCD and as listed below are included to prevent the auxiliary hoist from carrying a heavy load over the spent fuel poof (SFP).

- The auxiliary hoist will not handle critical or heavy loads that could have adverse nuclear safety consequences (DCD Subsections 9.1.5.1 second paragraph and 9.1.5.3 third bullet)

- The "lift envelope" of the auxiliary hoist and its limited travel range are shown on DCD Figures 9.1.5-1 through 9.1.5-3. The crane with its auxiliary hoist cannot travel over the SFP since the supporting crane runway rails, with physical stops, stops before the SFP and limits the crane range of movement, in general, to the spent fuel cask handling area (DCD Subsection 9.1.5.2.2 fourth paragraph, first bullet).

- The Overhead Heavy Load Handling System (OHLHS) is equipped with mechanical and electrical limit devices to disengage power to the motors as the load hook approaches its travel limits (DCD Subsection 9.1.5.5 first paragraph).

- COL 9.1(6) requires the COL Applicant to establish a heavy load handling program, including associated procedural and administrative controls, to assure proper handling of heavy loads during the plant life (DCD Subsections 9.1.5.3 and 9.1.6).

Impact on DCD

See Attachment 1 for a mark-up of DCD, Tier 2, Subsection 9.1.5, and Attachment 2 for a mark-up DCD, Tier 1, subsection 2.7.6.5.1, respectively, for changes to be incorporated.

- Add an additional paragraph after the bullet items of the first paragraph of Subsection 9.1.5 of the DCD, Tier 2:

  "The OHLHS exists in the reactor building, specifically the fuel storage and handling area, and in the pre-stressed concrete containment vessel (PCCV) of the reactor building. The functional arrangement and design characteristics of the OHLHS are discussed in the subsections provided below."

- Add the following second sentence to the first bullet in the Key Design Features paragraph of Subsection 2.7.6.5.1.of the DCD, Tier 1:

  "The main hoisting systems of these two cranes are designed as single failure proof components. Special lifting devices and slings used for critical load handling operations in conjunction with these cranes have dual load paths or double safety factors. The hoisting systems consist of reeving, wire rope, hoisting mechanisms, and hooks."

- Replace the Numeric Performance Values paragraph of Subsection 2.7.6.5.1 of the DCD, Tier 1, as follows:

  Numeric Performance Values

  "The PCCV polar crane and the spent fuel cask handling crane are designed as single failure proof to prevent uncontrolled lowering of heavy loads. Therefore, no load drop accident analysis is required."

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

06/15 /2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 563-4386 REVISION 0**

SRP SECTION: **9.1.5 – Overhead Heavy Load Handling System**

APPLICATION SECTION: **9.1.5**

DATE OF RAI ISSUE: **03/29/2010**

QUESTION NO.: 09.01.05-17

In response to RAI 9.1.5-11, the applicant proposed to provide additional ITAAC to address OHLHS single-failure feature and special lifting device design.

The applicant also submitted Revision 2 of the DCD, dated October 2009. This revision contained the corrections detailed in the applicant's response to RAI 9.1.5-11. The staff reviewed the response to RAI 9.1.5-11 and DCD Revision 2 and found that the proposed ITAAC for declaration of single failure proof appeared too broad and the acceptance criteria related to the existence of a report is considered unacceptable.

For the single failure proof cranes, the ITAAC should be used to verify certain key attributes of the single failure proof crane using acceptance criteria from the licensing standard (i.e., NUREG-0554 or ASME NOG-1).

As a minimum the ITAAC should address a set of tests that include:

(1) NDE of critical welds in the crane structure (Paragraph 4251.4 of ASME NOG-1 or Article 2.6 of NUREG-0554) with acceptance criteria from AWS D1.1;

(2) Static and dynamic load testing (Paragraph 7422 of ASME NOG-1 or Articles 8.2 and 8.4 of NUREG-0554) with acceptance criteria related to bridge design deflection under load, ability to manually lower load, ability of holding brakes to individually stop and hold rated load, and proper operation of limiting and safety devices; and

(3) No-load test of two-blocking protection (either independent tests of redundant upper limit switches or test of energy absorbing device) (Paragraph 7421 of ASME NOG-1 or Article 8.3 of NUREG-0554).

In addition to ITAAC for the crane, there should be ITAAC for critical special lifting devices, which could be limited to the acceptance test in ANSI/ANS 14.6 (150% load test for 10 minutes followed by NDE of critical welds per Article 5.5).

The applicant is requested to resubmit the proposed ITAAC with a more defined acceptance criteria and details and update Tier 1 of the DCD accordingly.

Reference: MHI's Responses to US-APWR DCD RAI No. 292-2232; MHI Ref: UAP-HF- 09260; dated May 25, 2009, ML091490219.

ANSWER:

DCD, Tier 1, Subsection 2.7.6.5.2, including Table 2.7.6.5.1, will be revised to more specifically address single-failure-proof features of the Overhead Heavy Load Handling System (OHLHS). These include the items currently addressed in Table 2.7.6.5.1 as well as holding brakes and reeving, NDE of critical welds, static and dynamic load testing, and no-load testing per NUREG-0554 and ASME NOG-1. Further explanation follows:

Single Failure Proof Cranes

The Inspections, Tests and Analyses (ITA) of ITAAC item 2.c in DCD Tier 1 Table 2.7.6.5-1 will be revised to identify specific design features and actions to demonstrate the as-built PCCV polar crane and spent fuel cask crane main hoist are single-failure proof, including:

1. Reeving for the single-failure-proof cranes is designed such that no single rope failure will result in load drop.
2. Each single-failure-proof crane is provided with at least two holding brakes. Each of the two required brakes has a torque rating and setting of at least 125% of rated load hoisting torque at the point of brake application.
3. Static load test at 125% rated load. This test is also included in the preoperational test described in DCD Tier 2 Subsections 14.2.12.1.86 and 14.2.12.1.105 for the spent fuel cask handling crane and the polar crane, respectively, with reference to DCD Tier 2 Subsection 9.1.5, ASME NOG-1 and NUREG-0554 acceptance criteria. Specific acceptance criteria, such as acceptable bridge deflections during loading, are specified in accordance with the DCD Tier 2 criteria and are not included in the proposed ITAAC.
4. Dynamic test at 100% rated load to lift, transport, lower, stop and hold the test load. This test is also included in the preoperational tests described in DCD Tier 2 Subsections 14.2.12.1.86 and 14.2.12.1.105 for the spent fuel cask handling crane and the polar crane, respectively, with reference to DCD Tier 2 Subsection 9.1.5, ASME NOG-1 and NUREG-0554 acceptance criteria. These preoperational test descriptions will be revised to add details of the test consistent with the revised ITAAC.
5. Non-destructive examination (NDE) of critical welds. As stated in DCD Tier 2 Subsection 9.1.5.4, the crane manufacturer's test and inspection program conforms to Section 7200 of ASME NOG-1. Table 7200-1 of ASME NOG-1 includes specific weld NDE requirements, with reference to paragraph 4251.4. The NDE requirements of ASME NOG-1 invoke the acceptance criteria of AWS D1.1. DCD Tier 2 Subsection 9.1.5.4 is being revised to more specifically address these NDE requirements for critical welds.
6. No-load test including verification of limit switch, interlock and stop settings per ASME-NOG-1. As described in DCD Subsection 9.1.5, the criteria of ASME NOG-1 and NUREG-0554 are applicable to single failure-proof cranes. DCD Tier 2 Subsection 9.1.5.4 will be revised to refer to the no-load test of ASME NOG-1 Paragraph 7421. The ITAAC item for the no-load test does not specifically refer to a two-block test of the as-built OHLHS single-failure-proof cranes. NUREG-0554, Section 8.3 describes the two-block test, but also includes a provision for the crane manufacturer to suggest additional or substitute test procedures for protective overload devices.

The acceptance criteria (AC) referencing a report is consistent with Section 1.6 and ITAAC closure examples in NEI 08-01 Rev.3, endorsed by NRC RG 1.215. The AC will be further revised to more specifically align with the ITA. Also, ITAAC item 2.c in Tier 1 Table 2.7.6.5-1 currently applies to both the polar crane and the spent fuel handling cask crane main hoist. The ITAAC will be revised to address each crane separately.

Special Lifting Devices

ITAAC item 2.d in DCD Tier 1 Table 2.7.6.5-1 applies to special lifting devices used in conjunction with the PCCV polar crane and the spent fuel cask handling crane main hook during critical load handling operations. The ITA are being revised to add the 150% acceptance test and NDE of critical welds in accordance with ANSI N14.6 as referenced in DCD Tier 2 Subsection 9.1.5.4.

DCD Tier 2 Subsection 14.3.4.7, "ITAAC for Plant Systems," is being revised to include ITAAC for the OHLHS for completeness.

Impact on DCD

See Attachment 2 for a markup of changes to DCD, Tier 1, Subsection 2.7.6.5.1.

1. Revise the first bullet item in Tier 1 Subsection 2.7.6.5.1 Key Design Features as shown:

- The primary equipment used in the OHLHS are the spent fuel cask handling crane in the fuel handling area and the polar crane in the PCCV. The main hoisting systems of these two cranes are designed as single failure proof components. The hoisting systems consist of reeving, wire rope, hoisting mechanisms, and hooks. Reeving systems of the single-failure-proof cranes are designed such that a single rope failure will not result in a load drop. Each single-failure-proof crane is provided with at least two holding brakes.

- Special lifting devices and slings used for critical load handling operations in conjunction with these cranes have dual load paths or double safety factors.

2. Revise the fifth bullet item and add two new bullet items in Tier 1 Subsection 2.7.6.5.1 Key Design Features as shown:

    - The PCCV polar crane and the spent fuel cask handling crane main hoist are single-failure-proof cranes, and are subject to the following:

        1. Static load testing at a minimum of 125% rated load

        2. Dynamic testing to lift, transport, lower, stop and hold a test load of at least 100% of rated load. Each holding brake is capable of stopping and holding a minimum of 100% rated load.

        3. No-load testing to verify limit switches, interlocks and stops are properly adjusted and set.

        4. Non-destructive examination (NDE) of critical welds.

    - Special lifting devices and slings used for critical load handling operations in conjunction with these cranes have dual load paths or double safety factors.

    - Special lifting devices used in conjunction with the PCCV polar crane and spent fuel cask handling crane main hoist during critical load handling operations are subject to a load test followed by NDE of critical welds.

3. Revise Tier 1 Table 2.7.6.5-1 to reflect the "Answer" and "Impact to DCD" items 1 and 2 above. See Attachment 2 for the details on the revision of Table 2.7.6.5-1.

See Attachment 1 for a mark-up of DCD, Tier 2, Chapter 9, for changes to be incorporated.

- Add the following paragraph after the second paragraph in DCD Tier 2 Subsection 9.1.5.4:

  "Critical welds to support the polar crane and spent fuel cask handling crane main hoist are identified and subject to non-destructive examination in accordance with Section 7200 and Paragraph 4251.4 of ASME NOG-1"

- Add the following paragraph after the third paragraph in DCD Tier 2 Subsection 9.1.5.4:

  "No-load testing of the polar crane and spent fuel cask handling crane main hoist is performed in accordance with Paragraph 7421 of ASME NOG-1."

See Attachment 3 for a mark-up of DCD, Tier 2, Subsection 14.2.12.1.86, for changes to be incorporated.

- Fuel Handling System Preoperational Test, Acceptance Criteria Item D.3, will be revised as follows:

  "3.a The refueling machine, new fuel elevator, and fuel handling machine can lift 125% of rated load and satisfactorily pass an inspection, and can transfer the dummy fuel assembly (Subsection 9.1.4)."

  "b. The spent fuel cask handling crane can lift 125% of rated load and satisfactorily pass an inspection, and can raise the new fuel shipping container from the receipt truck (the only potentially heavy load handling for new fuel receipt described in Subsection 9.1.4)."

  "c. The spent fuel cask handling crane main hoist can lift, transport, lower, stop and hold a test load of at least 100% of rated load. Each spent fuel cask handling crane main hoist holding brake stops and holds the test load."

See Attachment 3 for a mark-up of DCD, Tier 2, Subsection 14.2.12.1.105, for changes to be incorporated.

- Vessel Servicing Preoperational Test, Test Method item C.3, will be revised as follows:

  "3. Perform operational (dynamic load) testing at 100% of rated load of the polar crane, reactor vessel head and internals lifting rigs, and associated equipment and accessories followed by appropriate inspections. The polar crane lifts, transports, lowers, stops and holds the test load. Each polar crane hoist holding brake's ability to stop and hold the test load is individually tested."

See Attachment 3 for a mark-up of DCD, Tier 2, Subsection 14.3.5, for changes to be incorporated.

- Revise Subsection 14.3.5 to add the following bulleted item after the eleventh bulleted item in Subsection 14.3.5:

  - Verifying the performance of the light load handling system and overhead heavy load handling system.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

ATTACHMENT 1
to RAI 563-4386

- Check of tools for proper functional operation

9.1.4.5 Instrumentation Requirements

The light load handling system has a system of instrumentation and controls (interlocks), alarms, and communication devices to assure the light load handling system meets the criterion discussed in Subsection 9.1.4.1. The interlocks provided are as defined in ANS 57.1, paragraph 6.3.1.1, and in Table 1 for the fuel handling machine, the new fuel elevator, the FTS including upenders, and the refueling machine.

The light load handling system has interlock actuation annunciation lamps on the control console to visually prompt the operator of interlock status. Additionally, movement of the fuel handling machine and the refueling machine bridge are audibly signaled.

The plant is designed with a public address system. The fuel handling machine, the new fuel elevator, the FTS including up enders, and the refueling machine is to have the capability to be interlinked with the public address system in the fuel handling area and the PCCV at a minimum. Additionally, administrative procedure defined in Subsection 13.5.1 provides communication devices not susceptible to a loss of power, offsite, or onsite, such as sound powered telephones or two-way radios. These are to be used to provide communication between operators at the fuel handling machine, the new fuel elevator, the FTS including upenders, and the refueling machine. These devices operate on channels or frequencies unique to the light load handling system within the plant, to minimize or preclude interference from operations other than fuel handling.

The light load handling system is designed such that should there be loss of control function or power function, the load remains in a safe condition.

9.1.5 Overhead Heavy Load Handling System

The overhead heavy load handling system (OHLHS) consists of devices used for critical load handling evolutions. A critical load handling evolution is defined as the handling of a heavy load where inadvertent operations or equipment malfunctions, separately or in combination, could:

- Cause a significant release of radioactivity
- Cause a loss of margin to criticality
- Uncover irradiated fuel in the reactor vessel or spent fuel pool
- Damage equipment essential to achieve or maintain safe shutdown

The OHLHS exists in the reactor building, specifically the fuel storage and handling area, and in the pre-stressed concrete containment vessel (PCCV) of the reactor building. The functional arrangement and design characteristics of the OHLHS are discussed in the subsections provided below.

Heavy loads are defined as a load weighing more than one fuel assembly and its handling device. For the US-APWR, a fuel assembly weighs approximately 2,000 lbs

New and spent fuel assemblies are handled using the light load handling system (light load handling system) defined in Section 9.1.4

9.1.5.1 Design Bases

The load that, if dropped, that would cause the greatest damage is a function of the area in which the OHLHS is operating. In the containment, this is defined as the integrated reactor head package/internals being lifted and transported to the lay down area. In the fuel handling area, this is defined as a full spent fuel cask being lifted and transported through the fuel handling area. In the area between the PCCV and the fuel handling area, this would be a reactor coolant pump motor.

The OHLHS cranes are designed to meet the criteria specified in CMAA-70, 2000, Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes (Ref. 9.1.7-25) and Chapter 2-1 of ASME B30.2-2005, Overhead and Gantry Cranes (Ref. 9.1.7-22). The PCCV polar crane and the spent fuel cask handling crane are also designed as single-failure-proof ASME NOG-1 Type I cranes in accordance with NUREG-0554, Single-Failure-Proof Cranes for Nuclear Power Plants, (Ref. 9.1.7-19) and ASME NOG-1, Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder) (Ref. 9.1.7-20), to handle the maximum critical loads for the area in which these cranes operate. The single-failure proof cranes each include at least two holding brakes. Each of the two required holding brakes has a torque rating of at least 125% of the rated load hoisting torque at the point of brake application. The reeving design of the single-failure-proof cranes is such that a single rope failure will not result in loss of the lifted load. Note that the suspension hoist of the spent fuel cask handling crane and the auxiliary hoists on these cranes will not handle critical loads and are not designed as single-failure-proof. However, they meet the electrical performance requirements of Type II cranes as required by Section 6320 (c) of ASME NOG-1.

The use of the single failure proof crane precludes the need to perform load drop evaluations with the one exception. Single-failure proof cranes are designed so that any credible failure of a single component will not result in the loss of capability to stop and hold a critical load. However, ASME NOG-1 allows a drop of 1 inch for axle failure. It further defines the acceptable stopping distance as not exceeding 5 inches while lowering the maximum critical load at its maximum speed unless specified otherwise by the purchaser. These distances, 1 inch to 5 inch, represent a case where a critical load be lowered to the floor could impose an impact load on the floor and associated structural features, should a failure event occur within this range.

On occasion, the OHLHS may be used to handle non-critical loads of greater weight than the maximum critical load. For those occasions, the maximum non-critical load is the design rated load. The design rated load does not have the safety factor limits of a single-failure-proof crane required by NUREG-0554. The design rated load utilizes standard commercial practice safety factor limits.

One example is the special lifting of heavy loads during construction or plant shutdown conditions. Prior to the lifting of non-critical loads after initial fuel loading, it would be documented that the potential load drops due to inadvertent operations or equipment malfunctions, separately or in combination, would not jeopardize safe shutdown functions, cause a significant release of radioactivity, a criticality accident, or inability to cool fuel within the reactor vessel or spent fuel pool. Non-critical lifts are those lifts that involve non-critical heavy loads, as defined in Section 9.1.5 above, that, because of theirlocation, timing, and the load path could not cause a significant release of radioactivity, cause a loss of margin to criticality, uncover irradiated fuel in the reactor vessel or spent fuel pool, or damage equipment essential to achieve or maintain safe shutdown. Non-critical lifts would be evaluated and documented in a manner similar to a critical heavy load lift, as required by the heavy load handling program to be developed by the COL applicant as required by COL 9.1(6) and Subsection 9.1.5.3 of this DCD.

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non-single-failure proof cranes and hoists is achieved by walls, slabs, and/or adequate physical distance between adjacent equipment trains to assure that redundancy of safe shutdown functions is maintained in the case of a single load drop.

- The non-single-failure proof cranes and hoists are dedicated to servicing particular pieces of safe shutdown equipment (such as pumps, valves, heat exchangers, and chillers) or systems that will be out-of-service when the cranes and hoists are used for handling heavy loads over them. The use of these cranes and hoists is administratively controlled by load handling procedures to prevent overhead load handling that could cause unacceptable damage to the dedicated equipment or systems when in service.

Therefore, load handling incidents involving non-single-failure-proof cranes and hoists listed in Table 9.1.5-3 will not jeopardize safe shutdown functions or cause a significant release of radioactivity, a criticality accident, or inability to cool fuel.

To assure proper handling of heavy loads during the plant life, the COL Applicant is to establish a heavy load handling program, including associated procedural and administrative controls, that satisfies commitments made in Subsection 9.1.5 of the DCD, and that meets the guidance of ANSI/ASME B30.2, ANSI/ASME B30.9, ANSI N14.6, ASME NOG-1, CMAA Specification 70-2000, NUREG-0554, NUREG-0612, and NUREG-0800, Section 9.1.5. During the operating life of the plant, it is anticipated that temporarily installed hoists and mobile cranes will also be used for plant maintenance. The heavy load handling program will include temporary cranes and hoists. The heavy load handling program will adopt a defense-in-depth strategy to enhance safety when handling heavy loads. For instance, the program will restrict lift heights to practical minimums and limit lifting activities as much as practical to plant modes in which load drops have the smallest potential for adverse consequences, particularly when critical loads are being handled. Further, prior to the lifting of heavy loads after initial fuel loading, the program will institute any additional reviews as necessary to assure that potential drops of these loads due to inadvertent operations or equipment malfunctions, separately or in combination, will not jeopardize safe shutdown functions, cause a significant release of radioactivity, a criticality accident, or inability to cool fuel within the reactor vessel or spent fuel pool.

9.1.5.4 Inspection and Testing Requirements

The OHLHS components are subjected to various tests and inspections prior to being placed in service and are the subject of an inspection, tests, analyses, and acceptance criteria (ITAAC) program, which is detailed in Chapter 14, Section 14.3.

During fabrication, the quality assurance program of the Manufacturer satisfies the requirements of ASME NQA-1. The manufacturer's inspection and testing program conforms to Sections 7100 and 7200 of ASME NOG-1, Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder, (Ref. 9.1.7-20)

Critical welds to support the polar crane and spent fuel cask handling crane main hoist are identified and subject to non-destructive examination in accordance with Section 7200 and Paragraph 4251.4 of ASME NOG-1.

Prior to operation, the OHLHS is received, stored, and installed in accordance with Sections 7100, 7300, and 7400 of ASME NOG-1, Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder, (Ref. 9.1. 7-20). Qualification of the assembled OHLHS is performed in accordance with Section 7500 of ASME NOG-1.

No-load testing of the polar crane and spent fuel cask handling crane main hoist is performed in accordance with Paragraph 7421 of ASME NOG-1.

Periodic tests and inspections of the OHLHS are performed in accordance with Chapter 2-2 of ANSI/ASME B30.2, Overhead and Gantry Cranes - Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist, (Ref. 9.1.7-22).

Inspection and testing of special lifting devices and slings used in conjunction with the polar crane and spent fuel cask handling crane, are performed in accordance with ANSI N14.6 (Ref. 9.1.7-23) and ASME B30.9 (Ref. 9.1.7-24), respectively.

9.1.5.5 Instrumentation Requirements

The OHLHS is equipped with mechanical and electrical limit devices to disengage power to the motors as the load hook approaches its travel limits or to prevent damage to other components when continued operation would potentially damage the OHLHS as required by NUREG-0554, Single-Failure-Proof Cranes for Nuclear Power Plants, (Ref. 9.1.7-19).

In addition to the limit devices, the control system is designed to include safety devices, which will assure the OHLHS returns to and/or maintains a secure holding position of critical loads in the event of a system fault. These safety devices are in addition to and separate from the control devices used for normal operation of the OHLHS. Emergency stop buttons are strategically placed at various locations to de-energize the OHLHS independent of the system controls. The overload sensing system is designed to be reset when switching the OHLHS between maximum critical load operations and design rate load operations. This resetting is performed remotely from the system controls and is governed by the OHLHS administrative control procedures.

The OHLHS driver control systems are designed using a combination of electrical and mechanical components. The control systems take into account the hoisting (raising and lowering) of the complete range of loads from the load hook itself up to and including the rated load in conjunction with the inertia of moving components, such as the motor armature, shafting and coupling, gear reducer, drum, etc. In general, the OHLHS is not contemplated to be used to lift individual spent fuel elements. The control system has been designed to be adaptable to include manual interlocks, which will preclude trolley and/or bridge movement while a spent fuel assembly is being hoisted free of the reactor vessel or a storage rack. The manual interlocks are controlled by administrative control procedures.

Instrumentation is installed within the motor control circuits to detect and react to malfunctions such as excessive electric current, excessive motor temperature, overspeed, overload, and overtravel. Control devices are installed to absorb the kinetic energy of the rotating components and arrest the hoisting movement should the load line

The complete operating control system, along with emergency control features is located in the cab on the OHLHS. Additional wireless remote control stations are also provided for remote operations of the OHLHS. The wireless remote control stations have the same control, including emergency, features as the cab mounted controls. The configuration of the controls stations are in accordance with Section 2-1.13 of ANSI/ASME B30.2, Overhead and Gantry Cranes - Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist, (Ref. 9.1.7-22). The individual control stations are interlocked to permit only one station to be operable at a time.

9.1.6 Combined License Information

COL 9.1(1) *Deleted*

COL 9.1(2) *Deleted*

COL 9.1(3) *Deleted*

COL 9.1(4) *Deleted*

COL 9.1(5) *Deleted*

COL 9.1(6) *To assure proper handling of heavy loads during the plant life, the COL Applicant is to establish a heavy load handling program, including associated procedural and administrative controls, that satisfies commitments made in Subsection 9.1.5 of the DCD, and that meets the guidance of ANSI/ASME B30.2, ANSI/ASME B30.9, ANSI N14.6, ASME NOG-1, CMAA Specification 70-2000, NUREG-0554, NUREG-0612, and NUREG-0800 Section 9.1.5, and RG 1.206 C.I.9.1.5. During the operating life of the plant, it is anticipated that temporarily installed hoists and mobile cranes will also be used for plant maintenance. The heavy load handling program will include all ~~temporary~~ cranes and hoists on site capable of handling heavy loads, including temporary cranes and hoists. The heavy load handling program will adopt a defense-in-depth strategy to enhance safety when handling heavy loads. For instance, the program will restrict lift heights to practical minimums and limit lifting activities as much as practical to plant modes in which load drops have the smallest potential for adverse consequences, particularly when critical loads are being handled. Further, prior to the lifting of heavy loads after initial fuel loading, the program will institute any additional reviews as necessary to assure that potential drops of these loads due to inadvertent operations or equipment malfunctions, separately or in combination, will not jeopardize safe shutdown functions, cause significant release of radioactivity, a criticality accident, or inability to cool fuel within the reactor vessel or spent fuel pool.*

"The COL Applicant will prepare a non-critical heavy load procedure that includes sections, on the Design Bases, System Descriptions, Safety Evaluation, Inspection and Testing Requirements, and Instrumentation Requirements for the program. The heavy load program will include requirements for sufficient operator training, system design, load handling instructions, and equipment inspections. Safe load paths will be defined so that heavy loads avoid being moved over or near irradiated fuel or critical

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equipment. Mechanical stops or electrical interlocks to prevent movement of heavy loads near irradiated fuel or safe shutdown equipment may also be employed."

COL 9.1(7) Deleted

9.1.7-14 "Occupational Safety and Health Standards," Labor. Title 29 Code of Federal Regulations, Part 1910, U.S. Nuclear Regulatory Commission,.

9.1.7-15 "Standards for Protection against Radiation," Energy. Title 10, Code of Federal Regulations, Part 20, U.S. Nuclear Regulatory Commission,

9.1.7-16 "Rules for Construction of Nuclear Facility Components," Boiler and Pressure Vessel Code Section III, American Society of Mechanical Engineers, 2001 Edition through the 2003 Addenda.

9.1.7-17 "Shippers – General Requirements for Shipments and Packagings," Transportation. Title 49, Code of Federal Regulations, Part 173, U.S. Nuclear Regulatory Commission, Washington, DC.

9.1.7-18 "Packaging and Transportation of Radioactive Material," Energy. Title 10, Code of Federal Regulations, Part 71, U.S. Nuclear Regulatory Commission, Washington, DC.

9.1.7-19 Single-Failure-Proof Cranes for Nuclear Power Plants. NUREG-0554, U.S. Nuclear Regulatory Commission, Washington, DC, May 1979.

9.1.7-20 Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder). ASME NOG-1, 2004, American Society of Mechanical Engineers.

9.1.7-21 Control of Heavy Loads at Nuclear Power Plants. NUREG-0612, U.S. Nuclear Regulatory Commission, Washington, DC, July 1980.

9.1.7-22 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist). ANSI/ASME B30.2-2005, American Society of Mechanical Engineers.

9.1.7-23 American National Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials. American National Standards Institute, ANSI N14.6-1993, American Nuclear Society, IL.

9.1.7-24 Slings. ANSI/ASME B30.9-2003, American Society of Mechanical Engineers.

9.1.7-25 Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes. CMAA Specification No.70, 2000, Crane Manufacturers Association of America, Inc.

9.1.7-26 Thermal-Hydraulic Analysis for US-APWR Spent Fuel Racks, MUAP-09014P (R0) and MUAP-09014NP (R0), Mitsubishi Heavy Industries, Ltd, June 2009.

9.1.7-27 Combined License Applications for Nuclear Power Plants (LWR Edition), Regulatory Guide (RG) 1.206, U.S. Nuclear Regulatory Commission, Washington, DC, June 2007.

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2.7.6.5 Overhead Heavy Load Handling System

2.7.6.5.1 Design Description

System Purpose and Functions

The purpose and function of the overhead heavy handling system (OHLHS) is to move heavy loads. For the US-APWR, a heavy load is defined as any load greater than approximately 2450 lbs. The OHLHS is non-safety related.

Location and Functional Arrangement

The OHLHS exists in the reactor building, specifically the fuel storage and handling area, and in the pre-stressed concrete containment vessel (PCCV) of the reactor building. The functional arrangement and design characteristics of the OHLHS are discussed below.

Key Design Features

Key design features of the OHLHS include:

- The primary equipment used in the OHLHS are the spent fuel cask handling crane in the fuel handling area and the polar crane in the PCCV. The main hoisting systems of these two cranes are designed as single failure proof components. The hoisting systems consist of reeving, wire rope, hoisting mechanisms, and hooks. Reeving systems of the single-failure-proof cranes are designed such that a single rope failure will not result in a load drop. Each single-failure-proof crane is provided with at least two holding brakes.

- Special lifting devices and slings used for critical load handling operations in conjunction with these cranes have dual load paths or double safety factors.

- The spent fuel handling crane has three load handling ~~hooks~~ hoists, the main, the auxiliary, and the suspension hoist.

- The suspension hoist 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 Handing System (LLHS) (Subsection 2.7.6.4).

- The polar crane has a seismic restraint system which precludes derailment of either the hoist trolley or the main bridge box girders during a seismic event.

- The ~~main hooks of the~~ PCCV polar crane and the spent fuel cask handling crane main hoist are designed as single-failure-proof cranes, and are subject to the following: ~~Special lifting devices and slings used for critical load handling~~

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~~operations in conjunction with these cranes have dual load paths or double safety factors.~~

1. Static load testing at a minimum of 125% rated load

2. Dynamic testing to lift, transport, lower, stop and hold a test load of at least 100% of rated load. Each holding brake is capable of stopping and holding a minimum of 100% rated load.

3. No-load testing to verify limit switches, interlocks and stops are properly adjusted and set.

4. Non-destructive examination of critical welds.

- Special lifting devices and slings used for critical load handling operations in conjunction with these cranes have dual load paths or double safety factors.

- Special lifting devices used in conjunction with the PCCV polar crane and spent fuel cask handling crane main hoist during critical load handling operations are subject to a load test followed by NDE of critical welds.

Seismic and ASME Code Classifications

The OHLHS is seismic Category II.

System Operation

The OHLHS operation includes:

- 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.

- During refueling, the reactor vessel head assembly and the upper and lower reactor internals are transferred using the polar crane's main hook and a lifting rig.

- Reactor coolant pump motors and other similar sized equipment are transferred using the polar crane's auxiliary hook.

Alarms, Displays, and Controls

There are no main control room alarms, displays, or controls associated with the OHLHS.

Logic

Not applicable.

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Interlocks

The OHLHS is equipped with mechanical and electrical limit devices to disengage power to the motors as the load hook approaches its travel limits or to prevent damage to other components when continued operation would potentially damage the OHLHS.

The control system includes safety devices which assure that the OHLHS returns to and/or maintains a secure holding position of critical loads in the event of a system fault.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

The PCCV polar crane and the spent fuel cask handling crane are designed as single-failure-proof to prevent uncontrolled lowering of heavy loads. Therefore, no load drop accident analysis is required. ~~Crane axle failure may result in limited slip of the lifted load, causing impact on the floor, which has been accounted for in the structural design.~~

2.7.6.5.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.6.5-1 describes the ITAAC for the OHLHS.

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Table 2.7.6.5-1 Overhead Heavy Load Handling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the OHLHS is as described in the Design Description of Subsection 2.7.6.5.1.	1. An inspection of the as-built OHLHS will be performed.	1. The as-built OHLHS conforms to the functional arrangement described in the Design Description of this Subsection 2.7.6.5.1.
2.a The seismic Category II OHLHS is designed so that the SSE could not cause unacceptable structural interaction or failure with seismic Category I SSCs.	2.a A combination of inspection, tests and/or analyses will be performed on the as-built seismic Category II OHLHS.	2.a A report exists and concludes that the as-built seismic Category II OHLHS equipment is designed so that the SSE could not cause unacceptable structural interaction or failure with seismic Category I SSCs.
2.b The polar crane has a seismic restraint system which precludes derailment of either the hoist trolley or the main bridge box girders during a seismic event.	2.b A combination of inspections, test and/or analyses will be performed on the as-built polar crane seismic restraint system.	2.b A report exists and concludes that the as-built polar crane seismic restraint system precludes derailment of either the hoist trolley or the main bridge box girders during a seismic event.

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2.c.i The PCCV polar crane ~~and the spent fuel cask handling crane main hook are designed as~~ is single-failure-proof ~~cranes~~.	2.c.i A combination of inspection, tests and analyses will be performed on the as-built polar crane ~~OHLHS~~. The PCCV polar crane: 1. reeving system design precludes a load drop in the event of a single rope failure 2. is equipped with at least two holding brakes 3. will be static load tested at a minimum of 125% of rated load 4. will be dynamically tested at a minimum of 100% of rated load. 5. will be no-load tested to include verification of limit switch, interlock and stop settings. 6. critical welds will be subject to non-destructive examination (NDE).	2.c.i A report exists and concludes that the as-built PCCV polar crane is single-failure-proof ~~and the spent fuel cask handling crane main hook are single failure proof.~~. The as-built PCCV polar crane: 1. can tolerate a single reeving system rope failure without load drop 2. is equipped with two holding brakes, each of which are set and rated at a minimum torque of 125% of rated hoisting torque at the point of brake application. 3. can withstand a static load of at least 125% of rated load. 4. can lift, transport, lower, stop and hold a test load of at least 100% of rated load. Each polar crane hoist holding brake is capable of stopping and holding a minimum of 100% rated load. 5. limit switches, interlocks and stops are properly adjusted and set. 6. critical welds meet ASME NOG-1 criteria for NDE.

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2.c.ii The spent fuel cask handling crane main hoist is single-failure-proof.	2.c.ii A combination of inspection, tests and analyses will be performed on the as-built spent fuel cask handling crane main hoist. The spent fuel cask handling crane main hoist: 1. reeving system design precludes a load drop in the event of a single rope failure 2. is equipped with at least two holding brakes 3. will be static load tested at a minimum of 125% of rated load 4. will be dynamically tested at a minimum of 100% of rated load. 5. will be no-load tested to include verification of limit switch, interlock and stop settings. 6. critical welds will be subject to non-destructive examination (NDE).	2.c.ii A report exists and concludes that the as-built spent fuel cask handling crane main hoist is single-failure-proof. The as-built spent fuel cask handling crane main hoist: 1. can tolerate a single reeving system rope failure without load drop 2. is equipped with two holding brakes, each of which are set and rated at a minimum torque of 125% of rated hoisting torque at the point of brake application. 3. can withstand a static load of at least 125% of rated load. 4. can lift, transport, lower, stop and hold a test load of at least 100% of rated load. Each polar crane hoist holding brake is capable of stopping and holding a minimum of 100% rated load. 5. limit switches, interlocks and stops are properly adjusted and set. 6. critical welds meet ASME NOG-1 criteria for NDE.

2.d.i Special lifting devices and slings used in conjunction with the PCCV polar crane and the spent fuel cask handling crane main hoist ~~hook~~ during critical load handling operations have dual load paths or double safety factors. 2.d.ii Special lifting devices used in conjunction with the PCCV polar crane and spent fuel cask handling crane main hoist during critical load handling operations are subject to a load test followed by NDE of critical welds.	2.d A combination of inspection, tests and/~~or~~ analyses will be performed on the as-built OHLHS.	2.d.i ~~A report exists and concludes that the~~ The as-built special lifting devices and slings used in conjunction with the PCCV polar crane and the spent fuel cask handling crane main hoist ~~hook~~ during critical load handling operations have dual load paths or double safety factors. 2.d.ii As-built special lifting devices used in conjunction with the PCCV polar crane and spent fuel cask handling crane main hoist during critical load handling operations satisfy ANSI N14.6 criteria for a 150% load test for a minimum of 10 minutes followed by NDE of critical welds.

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Table 2.7.6.5-1 Overhead Heavy Load Handling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3. The OHLHS is equipped with mechanical and electrical limit devices to disengage power to the motors as the load hook approaches its travel limits, to prevent damage to other components when continued operation would potentially damage the OHLHS or safety-related SSCs.	3. Tests of the as-built OHLHS mechanical and electrical limit devices to disengage power to the motors as the load hook approaches its travel limits will be performed.	3. The as-built OHLHS is equipped with mechanical and electrical limit devices to disengage power to the motors as the load hook approaches its travel limits or safety-related SSCs.
4. The control system includes safety devices which assure that the OHLHS returns to and/or maintains a secure holding position of critical loads in the event of a system fault.	4. Tests of the as-built OHLHS control system to assure that the as-built OHLHS returns to and/or maintains a secure holding position of critical loads in the event of a system fault will be performed.	4. The as-built control system includes safety devices which assure that the as-built OHLHS returns to and/or maintains a secure holding position of critical loads in the event of a system fault.

3. To perform static load testing at 125% of rated load and operational (dynamic) load testing at 100% of rated load on the refueling machine, new fuel elevator, fuel handling machine, and spent fuel cask handling crane.

4. To perform operational load testing using the dummy fuel assembly.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. A dummy fuel assembly and sufficient test weights are available.

C. Test Method

1. The refueling machine, new fuel elevator, fuel handling machine, and spent fuel cask handling building crane are static load tested at 125% of rated load, followed by an inspection.

2. A dummy fuel assembly is transferred from the new fuel pit to the refueling machine in the containment and back to the spent fuel pit to verify the operation of the fuel handling system.

3. Verify indications and alarms.

4. The refueling machine, new fuel elevator, fuel handling machine, and spent fuel cask handling building crane are dynamically load tested at 100% of rated load, followed by an inspection.

5. Spent fuel cask handling crane testing for handling of heavy loads includes test requirements specified by NUREG-0554 (Reference 14.2-24) and NUREG-0612 (Reference 14.2-21) as applicable.

6. The use and operation of fuel handling tools identified in Subsection 9.1.4.2.1 are demonstrated.

D. Acceptance Criteria

1. The fuel handling system interlocks and interlock bypasses perform in accordance with design specifications.

2. The fuel handling system is able to transfer a dummy fuel assembly in and out of containment in accordance with design specifications.

3. a. The refueling machine, new fuel elevator, and fuel handling machine can lift 125% of rated load and satisfactorily pass an inspection, and can transfer the dummy fuel assembly (Subsection 9.1.4).

b. The spent fuel cask handling crane can lift 125% of rated load and satisfactorily pass an inspection, and can raise the new fuel shipping container from the receipt truck (the only potentially heavy load handling for new fuel receipt described in Subsection 9.1.4).

c. The spent fuel cask handling crane main hoist can lift, transport, lower, stop and hold a test load of at least 100% of rated load. Each spent fuel cask handling crane main hoist holding brake stops and holds the test load.

4. Indications and alarms operate as described in Subsection 9.1.4.5.
5. Refueling machine, new fuel elevator, and fuel handling machine testing demonstrates compliance with test requirements specified by ASME NOG-1 (Reference 14.2-30) and ASME B30.20-2006 (Reference 14.2-31) as applicable.
6. Spent fuel cask handling building crane testing demonstrates compliance with test requirements specified by NUREG-0554 (Reference 14.2-24), ASME NOG-1 (Reference 14.2-30) and NUREG-0612 (Reference 14.2-21) as applicable.
7. Fuel handling tools perform their intended design function as identified in Subsection 9.1.4.2.1.

14.2.12.1.87 Component Cooling Water System Preoperational Test

A. Objectives

1. To verify the operation, interlock and alarm of CCW surge tank.
2. To demonstrate the capability of the CCW system to provide cooling water during normal operation, normal cooldown, and postulated loss-of-coolant accident (LOCA) modes of operation.
3. To verify operation of system valves and control circuitry.
4. To demonstrate the operation and verify the operating characteristics of the CCW pumps.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. Demineralized water is available for system makeup.
6. The CCW is aligned to cool the CCW motors.

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2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Verify manual and automatic system controls.

2. Verify alarms and indications are functional.

3. Verify system flowrates.

D. Acceptance Criterion

1. The non-essential chilled water system operates as described in Subsection 9.2.7.

14.2.12.1.105 Vessel Servicing Preoperational Test

A. Objectives

1. To demonstrate operation of the polar crane, including the control circuits, limit devices, safety devices and interlocks, and the reactor vessel head and internals lifting rigs, associated equipment and accessories (e.g., slings and hooks, etc.).

2. To verify the polar crane and the reactor head and internals lifting rigs, and associated equipment and accessories, have completed static testing at 125% and operational testing (dynamic load testing) at 100% of rated load.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The vessel servicing system is available to support testing.

C. Test Method

1. Verify control circuitry, limit devices, safety devices, and interlocks for the polar crane as described in Subsection 9.1.5.5.

2. Perform static load testing at 125% of rated load for the polar crane, reactor vessel head and internals lifting rigs, and associated equipment and accessories, followed by appropriate inspections.

3. Perform operational (dynamic load) testing at 100% of rated load of the polar crane, reactor vessel head and internals lifting rigs, and associated equipment and accessories followed by appropriate inspections. The polar crane lifts, transports, lowers, stops and holds the test load. Each polar crane hoist holding brake's ability to stop and hold the test load is individually tested.

4. Testing and inspection includes testing and inspection requirements specified by NUREG-0554 (Reference 14.2-24), ASME NOG-1 (Reference 14.2-30), and NUREG-0612 (Reference 14.2-21) as applicable.

D. Acceptance Criteria

1. The polar crane and its associated interlocks, limit devices, safety devices and control circuits perform as specified in Subsection 9.1.5.

2. The polar crane static testing at 125% of rated load and operational (dynamic load) testing at 100% of rated load is completed and the crane satisfactorily passes inspections in accordance with NUREG-0554 (Reference 14.2-24), ASME NOG-1 (Reference 14.2-30), and NUREG-0612, (Reference 14.2-21).

3. The reactor vessel head and internals lifting rigs and associated equipment and accessories satisfactorily pass an inspection following static and operational (dynamic load) testing in accordance with NUREG-0612 (Reference 14.2-21) and NUREG-0554 (Reference 14.2-24).

4. Testing and inspection demonstrates compliance with testing and inspection requirements specified by NUREG-0554 (Reference 14.2-24), ASME NOG-1 (Reference 14.2-30) and NUREG-0612 (Reference 14.2-21) as applicable.

14.2.12.1.106 Safety-Related Component Area HVAC System Preoperational Test

A. Objective

1. To demonstrate operation of the safety-related component area HVAC system.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing, including tests of the system dampers' loss of motive power position, and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Simulate interlock signals for each AHU and verify operation and annunciation.

2. Verify alarms and status indications are functional.

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Based on the above criteria, the systems identified in Table 14.3-5 are selected as electrical systems in Tier 1.

14.3.4.7 ITAAC for Plant Systems

Section 2.7 of Tier 1, which addresses plant systems, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 14.3.7 (Reference 14.3-11). As indicated in Table 14.3-6, plant systems comprise most of the fluid systems that are not part of the reactor systems, including power generation systems; air systems; cooling water systems; radioactive waste systems; and HVAC systems, along with auxiliary systems, fire protection systems, and fuel handling systems. ITAAC are specified for these systems to provide for, as applicable:

- As-built plant reports for reconciliation with flood analyses to assure consistency with design requirements of SSCs for flood protection and mitigation
- As-built plant reports for reconciliation with post-fire safe shutdown analyses to assure consistency with design requirements of SSCs for fire protection and mitigation
- Verifying heat removal capabilities for design-basis accidents as well as tornado and missile protection
- Verifying net positive suction head for key pumps
- Verifying physical separation for appropriate systems
- Verifying that the minimum inventory of alarms, controls, and indications – as derived from emergency procedure guidelines; RG 1.97(Reference 14.3-31); and PRA insights – is provided for the MCR and remote shutdown stations
- Commensurate with the importance of the design attribute to safety, verifying the following design attributes for plant systems:
  - Functional arrangement
  - Key design features of systems
  - Seismic and ASME code classifications
  - Weld quality and pressure boundary integrity, as necessary
  - Valve qualification and operation
  - Controls, alarms, and displays
  - Logic and interlocks
  - Equipment qualification for harsh environments

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- Required interfaces with other systems
- Numeric performance values

- Verifying the performance of the liquid waste management system (as permanently installed systems or in combination with mobile processing equipment)
- Verifying the performance of the gaseous waste management system (as permanently installed systems or in combination with mobile processing equipment)
- Verifying the performance of the solid waste management system (as permanently installed systems or in combination with mobile processing equipment)
- Verifying the performance of the process and effluent radiological monitoring instrumentation and sampling systems (as permanently installed systems or in combination with portable skid-mounted equipment)
- Verifying the performance of the light load handling system and overhead heavy load handling system.

ITAAC for plant piping systems follow NRC guidelines for fluid systems ITAAC in Appendix C.II.1-A of RG 1.206 (Reference 14.3-1), as summarized above.

Table 14.3-6 lists the systems which the design is addressed in Tier 1.

The COL applicant provides the ITAAC for the site specific portion of the plant systems specified in Subsection 14.3.5, Interface Requirements.

14.3.4.8 ITAAC for Radiation Protection

Section 2.8 of Tier 1, which addresses radiation protection, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 14.3.8 (Reference 14.3-12). ITAAC related to radiation protection are provided for those SSCs that provide radiation shielding, confinement or containment of radioactivity, ventilation of airborne contamination, or monitoring of radiation (or radioactivity concentration) for normal operations and during accidents. These ITAAC provide for the following:

- Verifying the adequacy of as-built walls, structures, and buildings as radiation shields, as applicable
- Verifying the plant airborne concentrations of radioactive materials through adequate design of ventilation and airborne monitoring systems
- Verifying the functional arrangement of ventilation systems