REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**284-8234**
SRP Section:	**14.02 – Initial Plant Test Program**
Application Section:	**14.2**
Date of RAI Issue:	**11/02/2015**

Question No. 14.02-65

10 CFR 50 Appendix I as it relates to the effluent release to a member of the public, in being able to monitor and control effluent release.

10 CFR 20 Appendix B as it relates to monitoring and complying with the effluent concentration limits specified.

10 CFR 20.1301 and 1302 as it relates to monitoring public dose limits.

In review of DCD Chapter 14.2, the staff was unable to verify inclusion of several inspection test programs. In review of regulatory guide 1.68 rev 4, which the applicant commits to, the staff notes a list of systems, components and features for which the test program should demonstrate operability in section A-1.m. The staff requests the following information be addressed:

- Describe or provide reference to the (Initial Test Program) ITP that addresses the power cycle off-gas system monitoring and controlling the presence of explosive gas mixture (H2/O2) in gaseous waste management subsystems;
- Describe or provide reference to the ITP that addresses the isolation features for steam generator blow down, for both the presence of radioactivity and thermal protection of demineralizer beds;
- Describe or provide reference to the ITP that addresses the isolation features for condenser off-gas systems and diversion of process flow to appropriate subsystems;
- Describe or provide reference to the ITP that addresses the isolation features for ventilation systems and diversion of exhaust flows to HEPA/charcoal filtration subsystems;

- Describe or provide reference to the ITP that addresses the testing of liquid and wet waste solidification subsystems in verifying that residual amounts of free liquid present in process packaged wastes conform with regulatory requirements and waste acceptance criteria;

- Describe or provide reference to the ITP that addresses the for waste processing system supplemented with mobile skid-mounted processing equipment, as equipped, testing should include the hydraulic integrity of connections carrying radioactive fluids between mobile processing equipment and permanently installed plant subsystems.

Please address these items and provide a markup for the proposed DCD changes.

Response

KHNP has reviewed the subject question and understands the staff's request. KHNP is in the process of upgrading the test plans presented in Section 14.2 of the DCD. This effort is focused on adding additional SSCs that are important to safety and risk significant as well as increasing the level of detail described in the DCD for test prerequisites, test methods and acceptance criterial for the various tests. It has been determined that the actions to be taken as a result of this question is within the scope of the upgrade effort. Therefore, KHNP will address the noted items in the upgrade effort, which is scheduled to be completed by February 1, 2016. A revised response to this question that incorporates the results of the upgrade effort will be submitted to the NRC after completion.

Response - (Rev. 1)

Information regarding each aspect of the question posed above is as follows:

- Section 14.2.12.1.105 of DCD Tier 2 will be revised to describe testing of the ability to monitor and control the presence of explosive gas mixtures (H2/O2) and isolation features for gaseous effluent discharge lines to demonstrate operability of systems, components, and features, as stated in Regulatory Guide 1.68, Rev 4. DCD Tier 2, Subsection 14.2.12.1.105 will be revised as indicated in Attachment 1 to this response.

- The details of isolation features for the steam generator blowdown system, for both the presence of radioactivity and thermal protection of demineralizer beds, are discussed in Section 10.4.8 of DCD Tier 2. Subsection 10.4.8.1.2, Item f. and g. state:

  "f. Control the blowdown water temperature to protect the demineralizer resin from high emperature

  g. Monitor the radiation level downstream of the post-filter"

  Upon detection of high temperature located downstream of the regenerative heat exchanger (TEW 038), the blowdown flash tank level control valve downstream of the post-filter (V050) is isolated. Upon detection of high radiation upstream of the post-filter, the respective isolation valve upstream of the flash tank in each steam generator (V007/V008) is isolated. The revised DCD Tier 2, Section 14.2.12.1.66 submitted by KHNP (ref. letter MKD/NW-16-0156L, dated February 24, 2016; ML16056A003) will be

revised to address testing of the features described above in the revised response to RAI 277-8227, Question 14.02-38.

- As described in the fourth and fifth paragraphs of DCD Tier 2, Subsection 10.4.2.2.2, the condenser vacuum system is designed to prevent an uncontrolled release of radioactive material to the environment. If radioactivity in the exhaust flow exceeds acceptable level, the condenser vacuum pump vent effluent monitor actuates an alarm in the MCR and automatically diverts the exhaust flow from vacuum pumps to the containment drain sump area in reactor containment building. The air vent valve to atmosphere is closed and the containment isolation valve is opened and the booster fan is started to divert the exhaust flow to the containment drain sump area. Section 14.2.12.1.67 of DCD Tier 2 will be upgraded for testing of the isolation of the air vent valve for condenser off-gas, the opening of the containment isolation valve, and the starting of the booster fan when a radiation high signal from the radiation monitoring system occurs. Refer to Attachment 2 to this response.

- As described in DCD Tier 2, Subsection 9.4.2, the fuel handling area HVAC system is designed to prevent the spread of airborne radioactivity within the plant and to maintain the airborne radioactivity levels in the fuel handling area below the derived air concentration (DAC) values specified in 10 CFR Part 20, Appendix B by supplying and exhausting sufficient airflow. The system is also designed to maintain the gaseous effluent release to a value less than the dose and concentration criteria specified in 10 CFR Part 50, Appendix I and 10 CFR Part 20, Appendix B. The fuel handling area HVAC system consists of one 100 percent capacity normal exhaust air cleaning unit (ACU) with HEPA filter only, and two 100 percent capacity emergency exhaust ACUs which each have a carbon adsorber. A radiation monitor is provided at the common outlet duct of the fuel handling area normal and emergency exhaust ACUs to monitor the airborne radioactivity of the exhaust air from the fuel handling area. The fuel handling area normal exhaust ACU operates while the radiation levels are below a preset value. Upon receipt of the high radiation signal, the two safety-related isolation dampers installed downstream of the fuel handling area normal exhaust ACU are closed automatically. The fuel handling area normal exhaust ACU subsequently stops. In addition, the fuel handling area emergency exhaust ACU starts automatically. The exhaust air is diverted from the normal exhaust ACU to the emergency exhaust ACU. DCD Tier 2, Subsection 14.2.12.1.98 will be revised for clarity. Refer to Attachment 3 to this response.

  As described in DCD Tier 2, Subsection 9.4.7, the compound building HVAC system is designed to maintain the airborne radioactivity levels in the compound building controlled area below the DAC values specified in 10 CFR Part 20, Appendix B by supplying and exhausting sufficient airflow. The system is also designed to maintain the gaseous effluent release to a value less than the dose and concentration criteria specified in 10 CFR Part 50, Appendix I and 10 CFR Part 20, Appendix B. The compound building controlled area HVAC system consists of two 50 percent capacity HEPA filter exhaust ACUs each with a HEPA filter only, and two 50 percent capacity exhaust ACUs each with a carbon adsorber. A radiation monitor is provided at the common inlet duct of the HEPA filter exhaust ACUs and the carbon adsorber exhaust ACUs to monitor the airborne radioactivity of the exhaust air from the compound building controlled area. Two HEPA filter exhaust ACUs operate while the radiation

levels are below a preset value. Upon receipt of the high radiation signal, the HEPA filter exhaust ACUs stop and the two associated carbon adsorber exhaust ACUs start automatically. The isolation dampers upstream of the HEPA filter exhaust ACUs are automatically closed and isolation dampers upstream of the carbon adsorber exhaust ACUs are automatically opened. The exhaust air is diverted from the HEPA filter exhaust ACUs to the carbon adsorber exhaust ACUs. DCD Tier 2, Subsection 14.2.12.1.99 will be revised for clarity. Refer to Attachment 3 to this response.

- Section 14.2.12.1.104 of DCD Tier 2 will be revised to describe testing of the liquid and wet waste solidification subsystems to verify that residual amounts of free liquid present in process packaged wastes conform with regulatory requirements and waste acceptance criteria. Subsection 14.2.12.1.104, Section "5.0 ACCEPTANCE CRITERIA," will be revised to describe the waste solidification system and its compliance with 10 CFR 61.56 as described in Attachment 4 to this response.
- Section 14.2.12.1.104 of DCD Tier 2 will be revised to describe testing of the hydraulic integrity of connections carrying radioactive fluids between mobile processing equipment and permanently installed plant subsystems. Subsection 14.2.12.1.104, Section "5.0 ACCEPTANCE CRITERIA," will be revised to state leakage will not occur between such equipment, as shown in Attachment 4 to this response.

Impact on DCD

Section 14.2.12.1.105 will be revised, as indicated Attachment 1 to this response.

Section 14.2.12.1.67 will be revised, as indicated in Attachment 2 to this response.

Section 14.2.12.1.98 and 14.2.12.1.99 will be revised, as indicated in Attachment 3 to this response.

Section 14.2.12.1.104 will be revised as indicated in Attachment 4 to this response.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

5.0 ACCEPTANCE CRITERIA

5.1 ~~The SWMS operates as~~Specified valves shall be manually opened and closed by their respective hand switches located at Information FPD on the radwaste control console and at local.

5.2 Specified valve strokes full open and full close in response to FIK-003 located at information FPD on the radwaste control console, and status is properly indicated.

5.3 System alarms shall be operated per design.

5.4 New resin tank shall be capable of charging the specified equipment with new resin.

5.5 Spent resin shall be transferred from specified equipment to low activity spent resin Tanks.

5.6 Specified valves fail in the required position on loss of control power and loss of air, and return to the connect position on restoration of air or control power. Inoperable status indicates properly.

5.7 Wet solid wastes shall be stabilized or dewatered and satisfied 10 CFR 61.56 in described in Section 11.4.1.4.

5.8 No leakage shall be satisfied in at where fluid carrying is proceed between mobile processing equipment and permanently installed plant subsystems.

14.2.12.1.105 Gaseous Waste Management System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate the ~~ability~~manual/auto operation of GRS equipment and components including valves

1.2 To demonstrate the verification of manual and automatic response to normal control, alarms, and indications.

1.3 ~~1.2~~ To demonstrate the capability of the controlling the explosive gas mixture

1.4 ~~1.3~~ To demonstrate the operation of isolation function for gaseous ~~waste management system (GWMS) to collect and process radioactive gases vented from plant equipment~~effluent discharge line

2.0 PREREQUISITES

2.1 Construction activities on the ~~GWMS~~GRS have been completed.

2.2 ~~GWMS~~Initial loading of the charcoal into the charcoal beds has been completed, and types and actual amounts of charcoal have been verified before the initial loading to ensure that the gaseous releases are within the regulatory limits.

2.3 GRS instrumentation has been calibrated.

2.~~3~~4 Support systems required for operation of the ~~GWMS~~GRS are completed and operational.

2.~~4~~5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 ~~Verify flow paths.~~

~~3.2 Demonstrate that discharge isolation features and other system controls function properly. Simulate a high radiation signal to the GWMS discharge radiation monitor.~~

~~3.3 Verify alarms, indicating instruments, and status lights are functional. Simulate a high radiation signal to the GWMS discharge radiation monitor and verify alarm actuation in the main control room.~~

~~3.4 Demonstrate the operation of the gas drying equipment.~~

~~3.5 Demonstrate proper holdup time of gas through the charcoal adsorbers.~~

~~3.6 Demonstrate the operation of the system gas analyzers.~~

~~3.7~~ Operate control valves from all appropriate control positions. Observe valve operation and position indication. ~~Measure opening and closing times, where required.~~

3.2 Verify that alarms, indicating instruments, and status lights are functional.

3.3 Verify that operations of equipment in gaseous radwaste system package are functional.

a high-high

3.4 The automatic nitrogen injection operation upon the receipt of ~~high~~ oxygen concentration signal is verified.

3.5 The automatic discharge isolation valve operation upon the receipt of high radiation condition is verified with simulated signal, RMS test will be performed as described in Section 14.2.12.1.106.

4.0 DATA REQUIRED

~~4.1~~4.1 The properties and verification data for loaded charcoal in charcoal beds.

4.2 Setpoints of alarms, interlocks, and controls

~~4.2 Gas dryer operating data~~

4.3 ~~Gas analyzer operating~~Gaseous radwaste system package design data

~~4.4 Gas transport times~~

5.0 ACCEPTANCE CRITERIA

5.1 The ~~GWMS~~GRS operates as described in Section 11.3.

5.5 GRS valves are opened and closed by their respective handswitches and by each setpoint as designed.

5.8 The GRS alarms, indicating instruments, and status lights are functional as designed.

5.2 The ~~GWMS~~GRS discharge valves are closed automatically upon receipt of high radiation ~~monitor operates~~signal. The verification for high radiation alarm actuation in main control room is conducted as described in ~~Table 11.5-~~Section 14.2.12.1.106.

5.3 The nitrogen injection valves are opened automatically upon receipt of ~~high~~ oxygen concentration signal. The verification for ~~high~~ oxygen concentration alarm actuation in main control room is conducted as described in Section 14.2.12.1.83.

5.4 Containment isolation valves are closed automatically upon receipt of a CIAS signal.

14.2.12.1.106 Process and Effluent Radiological Monitoring System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To verify that the ~~process and effluent radiological monitoring system (~~PERMS~~)~~ can detect and record specific radiation levels, and to verify all alarms and interlocks

1.2 To verify the power status of RMS computer, SRDC, Local units

1.3 To verify the Rate-meter Communication conditions

Delete

1.2 To demonstrate the operation of air vent valve to ~~provide a continuous heat sink for normal operation as well as a sink for~~atmosphere ~~and~~ containment isolation valve by high radiation signal.

, and booster fan

,

1.3 To demonstrate the ~~turbine bypass~~operation of vacuum pump inlet valves and containment isolation valve.

1.4 To demonstrate the correct fail position of MOVs.

1.5 To demonstrate the status lights and system ~~under certain conditions~~alarms.

1.6 To demonstrate the automatic and manual operation of booster fan.

1.7 To demonstrate valve and fan operation.

2.0 PREREQUISITES

2.1 Construction activities on the main condenser and condenser vacuum systems have been completed.

2.2 Main condenser and condenser vacuum systems instrumentation has been calibrated.

2.3 Support systems required for operation of the main condenser and condenser vacuum systems are complete and operational.

2.4 Test instrumentation is available and calibrated.

2.5 Steam seals and lagging are available.

~~2.6 Turbine is on turning gear.~~

~~2.7~~2.6 All electrical testing is complete on the vacuum pumps and condenser valves.

3.0 TEST METHOD

3.1 Verify the vacuum integrity of the condenser by performing both a water hydrostatic test and a vacuum test.

3.2 Operate control valves from all appropriate control positions. Observe valve operation and position indication and, where required, measure opening and closing times.

3.3 Demonstrate the proper operation of the vacuum pumps with design operating modes and flow paths.

3.4 Verify the proper operation of protective devices, controls, interlocks, instrumentation, and alarms, using actual or simulated inputs.

3.5 Demonstrate the operation of the condenser makeup and reject to the condensate storage tank controls.

3.6 Demonstrate the operation of the automatic condenser tube cleaning system.

4.0 DATA REQUIRED

4.1 Valve opening and closing times, where required

4.2 Valve position indication

4.3 Position response of valves to loss of motive power

4.4 Setpoints at which alarms and interlocks occur

4.5 Vacuum pump running data

3.7 Demonstrate the proper operation of the air vent valve to atmosphere, containment isolation valve, and booster fan on a high radiation signal.

changed

5.0 ACCEPTANCE CRITERIA

5.1 The main condenser and condenser vacuum systems perform as described in Subsections 10.4.1 and 10.4.2.

5.2 The condenser vacuum pumps are manually started and stopped using their respective hand switches.

5.3 When the condenser vacuum pumps start and stop, their associated recirculation pumps start and stop, respectively and their statuses are indicated.

5.4 The vacuum pump inlet valves are opened and closed when their associated condenser vacuum pumps are running and stop, respectively.

~~5.5~~ The booster fan is automatically started upon high radiation signal from radiation monitoring system and automatically stopped upon containment isolation valve closed signal.

5.7

14.2.12.1.68 Feedwater System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To ~~demonstrate that~~verify the operation of start-up feedwater ~~system (including startup~~pump and related auxiliary lube. oil pump

1.2 To verify the operation of feedwater~~) is capable of supplying~~ pump turbine and associated lube oil pumps

1.3 To verify the operation of feedwater ~~to the steam generators for normal operation~~booster and associated lube oil pumps

1.4 To verify the operation of feedwater pump turbine HPSV and LPSV

1.5 To verify the operation of all system valves

5.5 The air vent valve to atmosphere is closed on a high radiation signal from the radiation monitoring system.
5.6 The containment isolation valve is opened on a high radiation signal from the radiation monitoring system and closed on a containment isolation valve closed signal.

3.0 TEST METHOD

3.1 Verify all control logic.

3.2 Verify the proper operation, stroking speed, and position indication of all dampers.

3.3 Verify the system maintains the fuel handling area at a negative pressure.

3.4 Verify the proper operation of the fuel handling area supply air handling ~~units (AHUs~~unit (AHU) and cubicle coolers.

3.5 Verify the proper operation of the fuel handling area exhaust air cleaning units (ACUs).

3.6 Verify filter efficiency, carbon adsorber efficiency, and airflow capacity.

3.7 Verify the system is at rated airflow and is air balanced.

Delete

3.8 Verify the proper operation of all protective devices, controls, interlocks, instrumentation, and alarms, using actual or simulated inputs.

3.9 Verify the proper operation of the fuel handling area HVAC system radiation monitor ~~and system response to a high radiation signal~~.

3.10 Verify that the ACUs perform in accordance with RG 1.140 (Reference 10), RG 1.52 (Reference 11) and ASME ~~N510 (~~N511 (In-Service Testing of Nuclear Air~~-~~ Treatment, Heating, Ventilating, and Air Conditioning Systems).

3.11 Verify isolation of safety-related dampers installed upstream of ~~normal~~ supply AHU and downstream of normal exhaust ACU on a simulated fuel handling area emergency ventilation action signal (FHEVAS).

and high radiation signal.

3.12 Demonstrate the automatic transfer to emergency operation as a result of FHEVAS.

and high radiation signal.

4.0 DATA REQUIRED

4.1 Air balancing verification

4.2 Fan and damper operating data

4.3 Temperature data in the fuel handling area

4.4 Setpoints at which alarms, interlocks, and controls occur

4.5 Fuel handling area negative pressurization data during normal and postulated emergency conditions

4.6 Filter and carbon adsorber data

4.7 Fuel handling area HVAC system radiation monitor performance data

5.0 ACCEPTANCE CRITERIA

5.1 The fuel handling area HVAC system operates as described in Subsection 9.4.2.

~~5.2~~5.2 The manual and automatic operation of all units operates properly.

5.3 The operation of all isolation dampers operates properly.

5.4 ~~The operation of isolation damper and emergency exhaust ACUs operates properly by ESFAS-FHEVAS and Radiation High~~

5.5 All status, lights and system alarms are verified.

The fuel handling area HVAC system automatically transfers to emergency operation upon receipt of ESFAS-FHEVAS and a high radiation signal.

3.4 Verify the system maintains the radwaste controlled area at a negative pressure.

3.5 Verify the proper operation of the general supply air handling units (AHUs), fans, and cubicle coolers.

3.6 Verify the proper operation of the general exhaust air cleaning units (ACUs) and fans.

3.7 Verify filter efficiency and airflow capacity.

3.8 Verify the system is at rated airflow and is air balanced.

Delete

3.9 Verify the proper operation of all protective devices, controls, interlocks, instrumentation, and alarms, using actual or simulated inputs.

3.10 Verify the proper operation of the compound building HVAC system radiation monitor ~~system response to a high radiation signal~~.

3.11 Verify that the ACUs perform in accordance with RG 1.140 (Reference 10) and ASME ~~N510 (~~N511 (In-Service Testing of Nuclear Air~~-~~Treatment, Heating, Ventilating, and Air Conditioning Systems).

4.0 DATA REQUIRED

4.1 Air balancing verification

4.2 Fan and damper operating data

4.3 Temperature data

4.4 Setpoints of alarms interlocks and controls

4.5 Compound building negative pressurization

3.12 Demonstrate the automatic transfer to the carbon adsorber exhaust ACUs from the HEPA filter exhaust ACUs as a result of a high radiation signal.

4.6 Compound building HVAC system radiation monitor performance data

5.0 ACCEPTANCE CRITERIA

5.1 The compound building HVAC system operates as described in Subsection 9.4.7.

~~5.2~~ The compound building HVAC system radiation monitor performs as described in Table 11.5-1.

5.3

14.2.12.1.100 Balance of Control Room HVAC System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate that the control room HVAC system airflow is balanced for normal mode

2.0 PREREQUISITES

2.1 Construction activities in the control room are complete with all penetrations sealed in place.

2.2 Construction activities on the control room HVAC system have been completed.

2.3 Control room HVAC system instrumentation has been calibrated.

2.4 Support systems required for operation of the control room HVAC system are complete and operational.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

5.2 The carbon adsorber exhaust ACUs start and HEPA filter exhaust ACUs stop automatically upon receipt of a high radiation signal.

3.1 Verify control logic.

5.0 ACCEPTANCE CRITERIA

5.1 ~~The SWMS operates as~~Specified valves shall be manually opened and closed by their respective hand switches located at Information FPD on the radwaste control console and at local.

5.2 Specified valve strokes full open and full close in response to FIK-003 located at information FPD on the radwaste control console, and status is properly indicated.

5.3 System alarms shall be operated per design.

5.4 New resin tank shall be capable of charging the specified equipment with new resin.

5.5 Spent resin shall be transferred from specified equipment to low activity spent resin Tanks.

5.6 Specified valves fail in the required position on loss of control power and loss of air, and return to the connect position on restoration of air or control power. Inoperable status indicates properly.

5.7 Wet solid wastes shall be stabilized or dewatered ~~and satisfied~~ 10 CFR 61.56 in ~~described in~~ Section 11.4.1.4.

5.8 No leakage ~~shall be satisfied in at where fluid carrying is proceed~~ between mobile processing equipment and permanently installed plant subsystems.

in accordance with

as described

occurs

14.2.12.1.105 Gaseous Waste Management System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate the ~~ability~~manual/auto operation of GRS equipment and components including valves