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.: **89-8052**

SRP Section: **10.04.05 – Circulating Water System**

Application Section: **10.4.5**

Date of RAI Issued: **07/20/2015**

Question No. 10.04.05-1

GDC 4 requires, in part, that SSCs important to safety be “appropriately protected against dynamic effects, including the effects of discharging fluids.” According to SRP 10.4.5, the requirements of GDC 4 are met when the circulating water (CW) system design includes provisions to accommodate the effects of discharge water. The SRP further states that means should be provided to detect leakage in the CW system in order not to adversely affect when there is failure of a component (e.g., expansion joint) or piping in the CW system.

In the review of DCD Tier 2, Section 10.4.5, the staff could not find any provision to meet the GDC 4 criteria, as it relates to dynamic effects such as water hammer, during plant startup and shutdown, and accident conditions. Also lacking from the DCD was information related to dealing with flood in the turbine building.

Therefore the applicant is requested revise the DCD in order to provide information on how to meet the GDC 4 criteria; specifically, how to avoid water (steam) hammer effects. The applicant is also requested to identify how, in the case of a flooding, the floodwater in the turbine building is released from building.

Response – (Rev.2)

The circulating water (CW) pumps are started or stopped manually at intervals of at least 20 seconds during plant startup and shutdown to minimize hydraulic transients. The hydraulic transient analysis shows that the transient condition, which includes the failure of all circulating water pumps due to loss of offsite power, would result in a system pressure that is well below the system design pressure in the intake conduit, condenser and discharge conduit. Also, the hydraulic transient test will verify that the circulating water system is designed to accommodate the worst case pressure transients. A COL applicant is to provide the system design information to satisfy GDC 4 in regard to the design provisions that are implemented to accommodate the effects of discharging water that could result from a malfunction or failure of a component or piping in the system.

The floodwater due to a CW piping failure in the turbine generator (TG) building is bounded by a postulated CW pump discharge piping break, when six CW pumps are operating with runout conditions. The flood height due to the postulated CW piping failure in the TG building is determined to be 4.0 ft from El. 100 ft 0 in the TG building. The floodwater is drained to the outside of the TG building through the emergency flood relief opening (flood relief panel), which is installed at El. 100 ft 0 in of the building. Flooding of the TG building does not affect the auxiliary building because there is no opening on the auxiliary building wall that connects to the TG building below the El. 104 ft 0 in. The DCD will be revised to include additional information regarding to flood relief path.

The DCD Tier 2 for COL10.4 (11) will be revised to correct a typo.

In addition, COL 10.4 (11) will be revised to specify what design information will need to be confirmed by the COL applicant.

Impact on DCD

DCD Tier 2, Subsection Table 1.8-2, 10.4.5.2.5 and 10.4.11 will be revised as indicated on the attached markup.

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.

RAI 89-8052 Question 10.04.05-1 Rev. 1

RAI 89-8052 Question 10.04.05-1 Rev. 2

Table 1.8-2 (17 of 29)

Item No.	Description
COL 10.4(1)	The COL applicant is to establish operational procedures and maintenance programs for leak detection and contamination control
COL 10.4(2)	The COL applicant is to maintain the complete documentation of system design, construction, design modifications, field changes, and operations
COL 10.4(3)	The COL applicant is to provide the location and design of the cooling tower, basin, and CW pump house
COL 10.4(4)	The COL applicant is to provide elevation drawings
COL 10.4(5)	The COL applicant is to address the design features for the prevention of contamination
COL 10.4(6)	The COL applicant is to provide operating and maintenance procedures for the following items in accordance with NUREG-0927 and a milestone schedule for implementation of the procedures.
COL 10.4(7)	The COL applicant is to describe the nitrogen or equivalent system design for SG drain
COL 10.4(8)	The COL applicant is to prepare the Site Radiological Environmental Monitoring Program
COL 10.4(9)	The COL applicant is to determine the wet bulb temperature correction factor to account for potential interference and recirculation effects
COL 11.2(1)	The COL applicant is to prepare the site-specific ODCM in accordance with NEI 07-09A.
COL 11.2(2)	The COL applicant is to prepare operational procedures and programs related to operations, inspection, calibration, and maintenance of the contamination control program.
COL 11.2(3)	The COL applicant is to determine whether contaminated laundry is sent to an offsite facility for cleaning or for disposal.
COL 11.2(4)	The COL applicant is to prepare and provide the P&IDs.
COL 11.2(5)	The COL applicant is to perform a site-specific cost-benefit analysis following the guidance in the regulatory requirements of NRC RG 1.110.
COL 11.2(6)	The COL applicant is to provide reasonable assurance that the mobile or temporary equipment and interconnections to plant systems conform with the regulatory requirements and guidance of 10 CFR 50.34a, 10 CFR 20.1406, NRC RG 1.143, and ANSI/ANS 40.37.
COL 11.2(7)	The COL applicant is to develop the procedure for the collection and shipment of mixed wastes, if and when they are generated, for offsite treatment. The generation of mixed liquid wastes is minimized by process control and the controlled use of hazardous chemicals.
COL 11.2(8)	The COL applicant is to develop the interface design and provide the site-specific information for the LWMS effluent discharge, including radioactive release points, effluent temperature, the design (type, shape, and size) of flow orifices, and the sampling requirements following the guidance of NRC RG 1.21 and RG 4.15 and the standards incorporated therein by reference.

GDC

COL 10.4(~~10~~) 11

The COL applicant is to ~~provide the system design information~~ to satisfy ~~SDC~~ 4 in regard to the design provisions that are implemented to accommodate the effects of discharging water that could result from a malfunction or failure of a component or piping in the system.

confirm that the water hammer events are bounded by the system design pressure value with a hydraulic transient analysis or otherwise demonstrate that the design is acceptable

adds chemicals to the CW to minimize fouling.]] Ball recirculation pumps inject sponge rubber balls upstream of each waterbox. After passing through the condenser tubes, the balls are collected in the strainer section and recirculated.

[[The cooling water makeup system and blowdown system operate continuously during normal operation. The operation of cooling water makeup system is interlocked with the water level of cooling tower basin.]]

The CWS is not required to operate during plant shutdown, anticipated operational occurrences (AOOs), or accident conditions such as LOOP. However, the CWS may operate until the power and condenser are available during shutdown. [[The cooling tower chemical injection system is removed from service automatically when the CW pumps are not in operation.]]

~~The design of the CWS satisfies GDC 4 in regard to the design provisions that are implemented to accommodate the effects of discharging water that could result from a malfunction or failure of a component or piping in the system.~~

If flooding in the yard area occurs due to a failure in a portion of the CWS, the sloped yard will drain the water away from the auxiliary building and compound building, and [[the cooling towers are located sufficiently far from equipment or structures important to nuclear safety.]] The safe shutdown capability would therefore not be compromised by flooding in the yard area. The COL applicant is to provide elevation drawings (COL 10.4(4)).

The flood height due to CW piping failure in the T/G building is determined as 4.0 ft from El. 100 ft 0 in of the building. Floodwater is drained to the outside of the T/G building through the emergency flood relief opening (flood relief panel) which is installed at El. 100 ft 0 in of the building.

A postulated failure in the CWS in the T/G building would flood the T/G building basement floor. The only access to the auxiliary building from the T/G building is sufficiently above the T/G building grade elevation, and the floodwater would therefore not enter the auxiliary building. Because there is no safety-related equipment in the T/G building, no safety-related equipment is affected.

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A CW line leak is detected with high-high condenser pit water level switches in the condenser pit sump. In the event of gross leakage into the condenser pit, the condenser pit alarm is initiated and the CW pumps are manually stopped to prevent flooding of the T/G building. When CW inleakage to the main condenser exceeds the design value, the

GDC

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COL 10.4(9) The COL applicant is to determine the wet bulb temperature correction factor to account for potential interference and recirculation effects.

10.4.12 References

1. HEI "Standards for Steam Surface Condensers," 9th Edition, Heat Exchanger Institute, 2006.

2. NRC RG 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," Rev. 4, U.S. Nuclear Regulatory Commission, March 2007.

3. NRC RG 1.28, "Quality Assurance Program Criteria (Design and Construction)," Rev. 4, U.S. Nuclear Regulatory Commission, June 2010.

4. ASME Boiler and Pressure Vessel Code, Section III, "Rules for Construction of Nuclear Facility Components," The American Society of Mechanical Engineers, the 2007 Edition with 2008 Addenda.

5. ASME B31.1, "Power Piping," The American Society of Mechanical Engineers, 2010.

6. NUREG-0800, Standard Review Plan, Section 10.4.2, "Main Condenser Evacuation System," Rev. 3, U.S. Nuclear Regulatory Commission, March 2007.

7. 10 CFR 20.1406, "Radiological Criteria for Unrestricted Use," U.S. Nuclear Regulatory Commission.

8. NRC RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," U.S. Nuclear Regulatory Commission, June 2008.

9. HEI "Performance Standards for Liquid Ring Vacuum Pumps," 3rd Edition, Heat Exchange Institute, 2005.

10. ASME B16.34, "Valves-Flanged, Threaded, and Welding End," The American Society of Mechanical Engineers, 2009.

11. ASME Boiler and Pressure Vessel Code, Section V, "Nondestructive Examination," The American Society of Mechanical Engineers, 2010.

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GDC

COL 10.4(~~10~~) The COL applicant is to ~~provide the system design information~~ to satisfy ~~SDC~~ 4 in regard to the design provisions that are implemented to accommodate the effects of discharging water that could result from a malfunction or failure of a component or piping in the system.

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