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.:	**122-8053**
SRP Section:	**10.03 – Main Steam Supply System**
Application Section:	**10.03**
Date of RAI Issue:	**07/27/2015**

Question No. 10.03-1

Conformance to GDC 4, as related to environmental and dynamic effects, requires that the safety-related portions of the main steam supply system (MSSS) design should adequately consider water (steam) hammer and relief valve discharge loads to assure that system safety functions can be performed and should assure that operating and maintenance procedures include adequate precautions to prevent water (steam) hammer and relief valve discharge loads.

DCD Tier 2, Section 10.3.2.4.5 addresses the issue of water (steam) hammer, relief valve discharge loads, and water entrainment effects as described in GDC 4 (“SRP Acceptance Criteria,” Item II of SRP Section 10.3). The applicant also included a COL Item 10.3(1) for the COL applicant(s) to provide operating and maintenance procedures including adequate precautions to prevent water (steam) hammer and relief valve discharge loads and water entrainment effects in accordance with NUREG-0927 and a milestone schedule for implementation of the procedure.

The staff finds the information provided in COL Item 10.3(1) is not clarifying enough to support a COL application and, for this reason, the applicant is requested to revise the COL item to include the following information:

a. Prevention of rapid valve motion

b. Introduction of voids into water-filled lines and components

c. Proper filling and venting of water-filled lines and components

d. Introduction of steam or heated water that can flash into water-filled lines and components

e. Introduction of water into steam-filled lines or components

f. Proper warmup of steam-filled lines

g. Proper drainage of steam-filled lines

h. Effects of valve alignments on line conditions

The applicant is to provide a DCD markup of its response.

Response

NUREG-0927 describes the operating and maintenance procedures for water (steam) hammer that the staff is requesting above.

Therefore, DCD Tier 2, Subsection 10.3.2.3.5 and COL Item 10.3(1) will be revised to state that the COL applicant will provide operating and maintenance procedures that are in accordance with NUREG-0927.

Impact on DCD

DCD Tier 2, Subsection 10.3.2.3.5, 10.3.7, and Table 1.8-2 (16 of 29) will be revised as indicated on the attached markups.

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.

For an evaluation of a main steam line break (MSLB) and steam generator tube rupture (SGTR), refer to Section 15.0.

10.3.2.3.5 Water (Steam) Hammer Prevention

The MSS is designed to minimize the potential for steam hammer. The MSS is designed to accommodate steam hammer dynamic loads and relief valve discharge loads resulting from the rapid closure of system valves and safety/relief valve operation without compromising safety functions. Refer to Section 3.12 for a description of piping design and piping supports design. Loads from relief valve openings and sudden closure of valves are included in the piping analyses.

The MSS design includes protection against water entrainment, which includes provisions for drain pots, line sloping, and valve operation. The main steam nozzle vertical connection lines of the SGs are the highest point in the main steam piping and all main steam lines slope away from the SGs.

Low-point drains are provided on the main steam pipes for startup and for prevention of turbine water induction and water hammer. Main steam drain valves are provided with position indications. Main steam drain valves can be manually controlled in the MCR and RSR. Main steam drain valves are automatically opened and closed by drip pot level switches. Level alarms are provided in the MCR and RSR to warn the operator of main steam line drain pot high-high level.

The discharge piping from the TBVs to the condenser is arranged without low points or includes drains to prevent water from collecting in the piping. The discharge piping from each valve is not headered together prior to its connection to the condenser. These precautions will eliminate potential water hammer damage to condenser internals and other TBVs upon valve opening.

The COL applicant is to provide operating and maintenance procedures including adequate precautions to prevent water (steam) hammer and relief valve discharge loads and water entrainment effects in accordance with NUREG-0927 and a milestone schedule for implementation of the procedure (COL 10.3(1)).

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For the safety/non-safety carbon steel piping with relatively mild FAC degradation, the FAC monitoring program is prepared and implemented using knowledge acquired from experience in pipe wall thinning management of the operating nuclear power plants in Korea. The FAC monitoring program includes preservice thickness measurements of as-built piping considered susceptible to FAC and erosion/corrosion. By performing this preservice measurement, the piping thickness margin that is used as a wall thinning margin is known. By combining the measurement with regular inspections, the frequency of the pipe replacement can be predicted. Reasonable assurance of the integrity and safety of plants is provided by conducting inspection and maintenance during the service life of the plant and replacing piping if necessary. The type of fluid, flow rates, fluid temperatures, and pressure of ASME Class 2 and 3 piping for steam and feedwater system are given in Table 10.3.2-5.

The COL applicant is to provide a description of the FAC monitoring program for carbon steel portions of the steam and power conversion systems that contain water or wet steam and are susceptible to erosion-corrosion damage. The description is to address consistency with GL 89-08 and NSAC-202L-R3 and provide a milestone schedule for implementation of the program (COL 10.3(3)).

10.3.7 Combined License Information

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COL 10.3(1) The COL applicant is to provide operating and maintenance procedures including adequate precautions to prevent water (steam) hammer and relief valve discharge loads and water entrainment effects in accordance with NUREG–0927 and a milestone schedule for implementation of the procedure.

COL 10.3(2) The COL applicant is to establish operational procedures and maintenance programs as related to leak detection and contamination control.

COL 10.3(3) The COL applicant is to provide a description of the FAC monitoring program for carbon steel portions of the steam and power conversion systems that contain water or wet steam and are susceptible to erosion-corrosion damage. The description is to address consistency with GL 89-08 and NSAC-202L-R3 and provide a milestone schedule for implementation of the program.

Table 1.8-2 (16 of 29)

Item No.	Description
COL 9.5(7)	The COL applicant is to provide the fire brigade radio systems.
COL 9.5(8)	The COL applicant is to provide the LAN and VPN system.
COL 9.5(9)	The COL applicant is to provide the emergency offsite communication system including dedication hotline, local law enforcement radio equipment, and wireless communication system.
COL 9.5(10)	The COL applicant is to specify that adequate and acceptable sources of fuel oil are available, including the means of transporting and recharging the fuel storage tank, following a design basis accident.
COL 9.5(11)	The COL applicant is to provide a description of the offsite communication system that interfaces with the onsite communication system, including type of connectivity, radio frequency, normal and backup power supplies, and plant security system interface.
COL 9.5(12)	The COL applicant is to provide the security radio system that consists of a base unit, mobile units, and portable units.
COL 9.5(13)	The COL applicant is to provide the local law enforcement communications including dedicated conventional telephone and radio-transmitted two-way communication system.
COL 9.5(14)	The COL applicant is to provide electric power for the security lighting system.
COL 9.5(15)	The COL applicant is to provide the system design information of AAC GTG building HVAC system including flow diagram, if the AAC GTG building requires the HVAC system.
COL 10.2(1)	The COL applicant is to identify the turbine vendor and model.
COL 10.2(2)	The COL applicant is to identify how the functional requirements for the overspeed protection system are met and provide a schematic of the TGCS and protection systems from sensors through valve actuators.
COL 10.2(3)	The COL applicant is to provide a description of how the turbine missile probability analysis conforms with Subsection 10.2.3.6 to ensure that requirements for protection against turbine missiles (e.g., applicable material properties, method of calculating the fracture toughness properties per SRP Section 10.2.3 Acceptance Criteria, preservice inspections) will be met.
COL 10.3(1)	The COL applicant is to provide operating and maintenance procedures including adequate precautions to prevent water (steam) hammer and relief valve discharge loads and water entrainment effects in accordance with NUREG–0927 and a milestone schedule for implementation of the procedure.
COL 10.3(2)	The COL applicant is to establish operational procedures and maintenance programs as related to leak detection and contamination control.
COL 10.3(3)	The COL applicant is to provide a description of the FAC monitoring program for carbon steel portions of the steam and power conversion systems that contain water or wet steam and are susceptible to erosion-corrosion damage. The description is to address consistency with GL 89-08 and NSAC-202L-R3 and provide a milestone schedule for implementation of the program.

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Question No. 10.03-2

Conformance to GDC 4, as it relates to residual heat removal (RHR), requires that the safetyrelated portion of the main steam supply system (MSSS) is to remove residual and sensible heat from the reactor coolant system (RCS) in pressurized water reactor (PWR) plants (Item 3, Section IV, Evaluation Findings," of SRP Section 10.3).

In DCD Tier 2, Section 10.3.1, "Design Bases," the applicant states that the MSSS meets the requirements of GDC 34 to provide sufficient cooldown capacity and suitable power supply and redundancy to provide reasonable assurance of functionality during a loss of offsite power (LOOP). Also, DCD Tier 2, Section 10.3.2.2.4 states that a main steam atmospheric dump valve (MSADV) is provided on each main steam line upstream of the main steam safety valves (MSSVs) to allow cooldown of the steam generators (SGs) when the main steam isolation valves (MSIVs) are closed or when the main condenser is not available as a heat sink. Further, the DCD describes that these MSADVs are connected to the main steam piping, and isolation valves are provided in the steam line upstream of each MSADV.

However, the staff finds that, according to DCD Tier 2, Section 10.3.2.3, "System Arrangement," there are no isolation valves in the main steam lines between the SGs and the MSSVs.

The applicant is requested to clarify whether these isolation valves exist and, if so, where/what they are. The applicant is also requested to clarify whether MSADVs can be operated by a local manual control in the event of total loss of power, including information regarding the local manual control station and its location.

Response

There are no isolation valves in the main lines between the SGs and the MSSVs. DCD Tier 2, Subsection 10.3.2.2.3 will be revised to clarify there are no isolation valves in the main lines between the SGs and MSSVs.

Each MSADV can be operated with hand wheel or manual control provision to enable manual operation of the electro-hydraulic actuator mounted on the valve upon total loss of power. DCD Tier 2, Subsection 10.3.2.2.4 will be revised.

Impact on DCD

DCD Tier 2, Subsection 10.3.2.2.3 and 10.3.2.2.4 will be revised as indicated on the attached markups.

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.

Safety valve set pressure is calculated in accordance with Article NC-7000 of ASME Section III. The MSSVs have a proven design and consistently open fully at the set pressure within acceptable limits during operability tests.

The MSSVs and their supports are designed to withstand loads arising from various operating and design basis events, specified in Subsection 3.9.3. The piping and valve arrangement and design analysis are performed in accordance with ASME Section III, Division 1, Appendix O.

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There are no isolation valves in the main ~~steam~~ lines between the SGs and MSSVs.

The data for the MSSV are provided in Table 10.3.2-1.

10.3.2.2.4 Main Steam Atmospheric Dump Valves

One MSADV is provided on each main steam line upstream of the MSSVs to allow cooldown of the RCS through a controlled discharge of steam to the atmosphere when the MSIVs are closed or when the main condenser is not available as a heat sink. Each valve is capable of holding the plant at hot standby, dissipating core decay and RCP heat, and allowing controlled cooldown from hot standby to shutdown cooling system initiation conditions in conjuction with AFWS.

Each valve is sized to allow a controlled plant cooldown in the event of a line break or tube rupture that renders one SG unavailable for heat removal, concurrent with a single active failure of one of the remaining two MSADVs. During hot standby, each MSADV is capable of controlling required flow at SG pressure of 70.31 kg/cm^2 A (1,000 psia).

MSADVs are designed so that the valves close automatically on loss of motive power or loss of control signal. Each MSADV can be operated manually with a handwheel in the event of total loss of power.

The steam through the MSADV is discharged directly to the atmosphere, with a separate vertical vent stack and silencer provided for each valve. A block valve is provided for each MSADV to allow isolation of steam leakage due to a stuck-open or inadvertently opened MSADV. The block valve is manually operated from the MCR or RSR.

Each MSADV can be operated with hand wheel or manual control provision to enable manual operation of the hydraulic actuator mounted on the valve upon total loss of power.

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Question No. 10.03-3

10 CFR 50.63 indicates that "… a standard design certification … under Part 52 of this chapter must be able to withstand for a specified duration and recover from a station blackout as defined in § 50.2."

DCD Tier 2, Section 10.3.1 describes the safety-related portions of the MSSS designed to provide decay heat removal capability necessary for core cooling and safe shutdown during a station blackout (SBO) event. Also stated is a discussion of the SBO event and conformance with the guidance in Reg Guide 1.155 is provided in Section 8.4.

The staff finds there is a lack of details in the description on how he APR1400 copes with an SBO event.

The applicant is requested to provide design and operating details for the MSSS and its components, as related to the SBO event.

Response

DCD Tier 2, Subsection 10.3.2.2.4 states "One MSADV is provided on each main steam line upstream of the MSSVs to allow cooldown of the RCS through a controlled discharge of steam to the atmosphere when the MSIVs are closed or when the main condenser is not available as a heat sink. Each valve is capable of holding the plant at hot standby, dissipating core decay and RCP heat, and allowing controlled cooldown from hot standby to shutdown cooling system initiation conditions in conjuction with AFWS."

DCD Tier 2, Subsection 8.4.1 states "The SBO involves the loss of offsite power (LOOP) concurrent with a turbine trip and failure of the onsite emergency as power system, but it does not include the loss of available ac power to buses fed by station batteries through invertors or the loss of the power from the alternate ac (AAC) source."

DCD Tier 2, Subsection 8.4.1.3 states “The 4.16kV non-class 1E AAC GTG is provided as an AAC source to mitigate the SBO in accordance with Position C.3.3 of NRC RG 1.155.”

During an SBO event, Class 1E onsite DC power, which is backed by station batteries, is available and an AAC source will be connected to the shutdown bus (train A or train B, as appropriate) within 10 minutes from the onset of the SBO.

Also, each MSADV can be operated with hand wheel or manual control provision to enable manual operation of the hydraulic actuator mounted on the valve upon total loss of power.

Therefore, the safety-related portions of the MSSS are designed to provide decay heat removal capability necessary for core cooling and safe shutdown during a station blackout (SBO) event.

Impact on DCD

There is no impact on the DCD.

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.