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.:	**246-8307**
SRP Section:	**09.02.02 – Reactor Auxiliary Cooling Water Systems**
Application Section:	**9.2.8**
Date of RAI Issue:	**10/14/2015**

Question No. 09.02.02-1

10CFR 20.1406(b) specifies that “Applicants for standard design certifications, standard design approvals, and manufacturing licenses under part 52 of this chapter, whose applications are submitted after August 20, 1997, shall describe in the application how facility design will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.”

Regulatory Guide 4.21 describes a method acceptable to the U.S. Nuclear Regulatory Commission (NRC) for use in the implementation of Title 10, Section 20.1406, “Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning.

COL Item 9.2(34) appears to be incomplete as it simply states “The COL applicant is either to prepare or include operational procedures and maintenance.” As written, the COL item does not specifically identify what it is for and what is required of the applicant. The COL item is also unclear as to what the procedures need to address and whether the guidance in Regulatory Guide 4.21 will be used in their development.

The applicant is requested to revise COL item 9.2(34) so that:

a) The system (or systems) to which the COL item is referring to is clearly identified. Such system may be the Turbine Building Closed Cooling Water (TBCCW) system, but that is not clear.

b) The operational procedures and maintenance the COL item is referring to are clearly identified. Such procedures could be: leak detection, contamination control, etc. Also inconsistent is the use of “either” in the COL Item. Such word is not found in other COL Items.

c) The COL item clearly indicates if the procedures will be developed to be consistent with Regulatory Guide 4.21.

Response

DCD Tier 2, OCL item 9.2(34) will be revised as indicated in the attachment to clarify what is required of the COL applicant.

Impact on DCD

DCD Tier 2, Subsection 9.2.8.2.3, 9.2.9.2.3, 9.2.10, 12.4.3, and Table 1.8-2 (14 of 29 and 21 of 29) will be revised as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on Technical Specifications.

Impact on Technical/Topical/Environmental Reports

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

b. Radiation monitoring is not provided for the TGBCCW system due to the low risk of radioactive contamination. Grab sampling is taken periodically for analysis to confirm that the cooling water return is not radioactively contaminated.

Reduction of Cross-Contamination, Decontamination, and Waste Generation

a. A sump is provided for collection of any leakage. The sump is designed with stainless steel liners and is equipped with level instruments to initiate alarm signal for operator actions.

b. Boron nitrite is added to control the pH of the system for corrosion inhibition.

c. Nitrogen gas is used to blanket the surge tank to minimize corrosion, thus minimizing waste generation.

Decommissioning Planning

a. The surge tank is a packaged unit for the full service life and is fabricated as an individual assembly for easy removal.

b. The TGBCCW system is designed with minimal embedded or buried piping.

Operations and Documentation

a. The TGBCCW system is designed for automated operations with manual initiation for the different modes of operation.

b. Adequate ingress and egress spaces are provided for prompt assessments and appropriate responses when and where they are needed.

c. The COL applicant is either to prepare or to include operational procedures and maintenance programs (COL 9.2(34)). Procedures and maintenance programs are to be completed before fuel is loaded for commissioning.

The COL applicant is to provide operational procedures and maintenance programs as related to leak detection and contamination control in accordance with RG 4.21 (COL 9.2(34)).

The COL applicant is to provide operational procedures and maintenance programs as related to leak detection and contamination control in accordance with RG 4.21 (COL 9.2(34)).

Operations and Documentation

a. The TGBOCWS is designed for automated operations with manual initiation for the different modes of operation in conjunction with the TGBCCW system.

b. Adequate ingress and egress spaces are provided for prompt assessments and appropriate responses when and where they are needed.

c. The COL applicant is either to prepare or to include operational procedures and maintenance programs (COL 9.2(34)). Procedures and maintenance programs are to be completed before fuel is loaded for commissioning.

d. Complete documentation of design, construction, design modifications, field changes, and operations is to be maintained by the COL applicant. documentation requirements are included as a COL information item.

Site Radiological Environmental Monitoring

The TGBOCWS is designed to prevent contamination through leakage in the heat exchangers. The integrity of the TGBCCW heat exchangers is expected to be well maintained, resulting in no contamination or a very low level of contamination of the system. Leakage from the system to the facility and the environment is captured by the design. Any residual contamination of the hydrogeology is not likely to be distinguishable from other contamination sources. Hence, the TGBOCWS has low risk and low radiological consequence, and radiological environmental monitoring for the TGBOCWS is not considered effective. The COL applicant is to include a site-wide radiological environmental monitoring program to monitor both the horizontal and vertical variability of the onsite hydrogeology and the potential effects of the construction and operation of the plant (COL 9.2(34)).

9.2.9.3 Safety Evaluation

The TGBOCWS has no safety-related function and therefore requires no safety evaluation.

The COL applicant is to provide operational procedures and programs for a site radiological environmental monitoring program to implement the minimization of contamination control in accordance with NRC RG 4.21 and RG 4.22, as applicable, and the documentation required by 10 CFR 20.1501 (COL 12.4(2)).

COL 9.2(31) The COL applicant is to provide the inspection and testing of the UHS to demonstrate that fouling and degradation mechanisms applicable to the site are effectively managed to maintain acceptable heat sink performance and integrity.

COL 9.2(32) The COL applicant is to provide the alarms, instrumentation, and controls required for the safety-related functions of the UHS.

COL 9.2(33) The COL applicant is to develop the following procedures for the water system: filling, venting, keeping it full, and operating it to minimize the potential for water hammer. The COL applicant is also to analyze the system for water hammer impacts, design the piping system to withstand potential water hammer forces, and analyze inadvertent water hammer events in the ECWS in accordance with NUREG-0927.

COL 9.2 (34) The COL applicant is either to prepare or to include operational procedures and maintenance programs.

COL 9.2 (35) The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations.

COL 9.2(36) The COL applicant is to include a site-wide radiological environmental monitoring program to monitor both the horizontal and vertical variability of the onsite hydrogeology and the potential effects of the construction and operation of the plant.

The COL applicant is to provide operational procedures and maintenance programs as related to leak detection and contamination control in accordance with RG 4.21.

9.2.11 References

1. 40 CFR Part 141, “National Primary Drinking Water Regulations,” Environmental Protection Agency.

2. 29 CFR 1910, “Occupational Safety and Health Standard,” Occupational Safety and Health Administration.

3. ASME B31.1-2010, “Power Piping,” The American Society of Mechanical Engineers, 2010.

Table 1.8-2 (14 of 29)

Item No.	Description
COL 9.2(23)	The COL applicant is to specify the following UHS chemistry requirements for bio-fouling and chemistry control: a. A chemical injection system to provide non-corrosive, non-scale-forming conditions to limit biological film formation b. The type of biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor, and silt dispersant, if necessary to maintain system performance based on site conditions.
COL 9.2(24)	The COL applicant is to verify the piping layout of the ESWS and UHS to prevent water hammer and develop operating procedures to provide reasonable assurance that the ESWS and UHS water pressure are above saturation conditions for all operating modes.
COL 9.2(25)	The COL applicant is to develop maintenance and testing procedures to monitor debris buildup and flush out and to remove the debris in the UHS.
COL 9.2(26)	The COL applicant is to evaluate the potential wind and recirculation effects of cooling towers based on meteorological condition.
COL 9.2(27)	The COL applicant is to provide the material specifications for piping, valves, and fittings of the UHS system based on site-specific conditions and meteorological conditions.
COL 9.2(28)	The COL applicant is to provide the evaluation of maximum evaporation and other losses based on the site-specific conditions and meteorological conditions in the UHS.
COL 9.2(29)	The COL applicant is to provide the detailed evaluation for UHS capability with consideration of site-specific conditions and meteorological data in the UHS.
COL 9.2(30)	The COL applicant is to provide chemical and blowdown to prevent biofouling and long-term corrosion, considering site water quality in the UHS.
COL 9.2(31)	The COL applicant is to provide the inspection and testing of the UHS to demonstrate that fouling and degradation mechanisms applicable to the site are effectively managed to maintain acceptable heat sink performance and integrity.
COL 9.2(32)	The COL applicant is to provide the alarms, instrumentation, and controls required for the safety-related functions of the UHS.
COL 9.2(33)	The COL applicant is to develop the following procedures for the water system: filling, venting, keeping it full, and operating it to minimize the potential for water hammer. The COL applicant is also to analyze the system for water hammer impacts, design the piping system to withstand potential water hammer forces, and analyze inadvertent water hammer events in the ECWS in accordance with NUREG-0927.
COL 9.2(34)	The COL applicant is either to prepare or to include operational procedures and maintenance programs.
COL 9.2(35)	The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations.
COL 9.2(36)	The COL applicant is to include a site-wide radiological environmental monitoring program to monitor both the horizontal and vertical variability of the onsite hydrogeology and the potential effects of the construction and operation of the plant.
COL 9.3(1)	The COL applicant is to provide operational procedures and maintenance programs as related to leak detection and contamination control.

The COL applicant is to provide operational procedures and maintenance programs as related to leak detection and contamination control in accordance with RG 4.21.

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COL 12.4(2) The COL applicant is to provide operational procedures and programs, ~~including the development of~~ a site radiological environmental monitoring ~~program, to implement the minimization of contamination approach~~ program to implement the minimization of contamination approach control for

COL 12.4(3) The COL applicant is to implement concrete tunnels for piping of the systems that may include underground piping carrying contaminated or potentially contaminated fluid to minimize buried piping.

12.4 in accordance with NRC RG 4.21 and RG 4.22, as applicable, and the documentation required by 10 CFR 20.1501

1. Regulatory Guide 8.8, "Information Relevant to Ensuring the Occupational Radiation Exposures at Nuclear Power Stations will be ALARA," Rev. 3, U.S. Nuclear Regulatory Commission, June 1978.

2. Regulatory Guide 8.19, "Occupational Radiation Dose Assessment in Light Water Reactor Power Plants Design Stage Man-Rem Estimates," Rev. 1, U.S. Nuclear Regulatory Commission, June 1979.

3. NUREG-0713, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities," U.S. Nuclear Regulatory Commission.

4. ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," The American Society of Mechanical Engineers, 2007.

5. NUREG-0737, "Clarification of TMI Action Plan Requirements," U.S. Nuclear Regulatory Commission, November 1980.

6. Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," U.S. Nuclear Regulatory Commission, July 2000.

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

8. Regulatory Guide 4.22, "Decommissioning Planning During Operations," U.S. Nuclear Regulatory Commission, December 2012.

Table 1.8-2 (21 of 29)

Item No.	Description
COL 12.4(1)	The COL applicant is to estimate construction worker doses based on site-specific number of operating units, distances, meteorological conditions, and construction schedule.
COL 12.4(2)	The COL applicant is to provide operational procedures and programs, including the development of a site radiological environmental monitoring program, to implement the minimization of contamination approach.
COL 12.4(3)	The COL applicant is to implement concrete tunnels for piping of the systems that may include underground piping carrying contaminated or potentially contaminated fluid to minimize buried piping.
COL 12.5(1)	The COL applicant is to provide the operational radiation protection program, including the items described in Section 12.5.
COL 13.1(1)	The COL applicant is to provide a description of the corporate or home office organization, its functions and responsibilities, and the number and the qualifications of personnel. The COL applicant is to be directed to activities such as the facility design, design review, design approval, construction management, testing, and operation of the plant.
COL 13.1(2)	The COL applicant is to develop a description of experience in the design, construction, and operation of nuclear power plants and experience in activities of similar scope and complexity.
COL 13.1(3)	The COL applicant is to describe its management, engineering, and technical support organizations. The description includes organizational charts for the current headquarters and engineering structure and any planned modifications and additions to those organizations to reflect the added functional responsibilities with the nuclear power plant.
COL 13.1(4)	The COL applicant is to develop a description of the organizational arrangement. The description is to include organizational charts reflecting the current headquarters and engineering structure and any planned modifications and additions to reflect the added functional responsibilities associated with the addition of the nuclear plant to the applicant's power generation capacity. The description shows how these responsibilities are delegated and assigned or expected to be assigned to each of the working or performance-level organizational units identified to implement these responsibilities. The description includes organizational charts reflecting the current corporate structure and the working- or performance-level organizational units that provide technical support for the operation.
COL 13.1(5)	The COL applicant is to develop the description of the general qualifications in terms of educational background and experience for positions or classes of positions described in the organizational arrangement.
COL 13.1(6)	The COL applicant is to develop a description of the structure, functions, and responsibilities of the onsite organization established to operate and maintain the plant.
COL 13.1(7)	The COL applicant is to provide an organizational chart showing the title of each position, minimum number of persons to be assigned to duplicate positions, number of operating shift crews, and positions that require reactor operator and senior reactor operator licenses.

The COL applicant is to provide operational procedures and programs for a site radiological environmental monitoring program to implement the minimization of contamination control in accordance with NRC RG 4.21 and RG 4.22, as applicable, and the documentation required by 10 CFR 20.1501.

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.:	**246-8307**
SRP Section:	**09.02.02 – Reactor Auxiliary Cooling Water Systems**
Application Section:	**9.2.8**
Date of RAI Issue:	**10/14/2015**

Question No. 09.02.02-2

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefore, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

SRP 9.2.2, Section III, Item 9, indicates that the reviewer should also consider the appropriateness of identified COL action items.

COL item 9.2(35) requires the COL applicant to maintain complete documentation of system design, construction, design modifications, field changes, and operations. The items addressed by this COL item, with the exception of the system design and design modifications, are post licensing actions that cannot be completed prior to the issuance of a COL license. Since the Turbine Building Closed Cooling Water (TBCCW) system is part of the design being certified, when referenced by a COL application, it will become part of the licensing basis for the COL. Design modification to the TBCCW in the COL application would likely be considered a departure and would be required to be identified as such in a COL application, and the NRC will review the change if required. Once a COL is issued, changes to the COL must be in accordance with 10CFR 52.98, “Finality of combined license; information requests,” which provides information on what is required for changes to or departures from information within the scope of the reference design.

Also, since the TBCCW is a non-safety-related system, and is presented in the DCD as part of the to-be-certified design, with no conceptual design information requirements, the staff is unclear what information the COL applicant needs to submit as part of its COL application regarding the TBCCW. The staff is also unclear as to what post licensing commitments are being sought.

The applicant is requested to provide the basis for the COL item and to discuss why post licensing aspects such field changes and operations are included.

Response

DCD Tier 2, OCL item 9.2(35) will be revised as indicated in the attachment to clarify what is required of the COL applicant.

KHNP also confirms that the TGBCCW is part of the design being certified, and that conceptual design information is presented in the DCD as follows:

- System design and operation description in DCD Subsection 9.2.8
- TGBCCW System component design parameters in Table 9.2.8-1, and
- TGBCCW flow diagrams in DCD Figure 9.2.8-1

The COL applicant is to confirm that there are no departures and shall meet the interface requirements (i.e., cooling duties and temperature requirements, piping and control interfaces) as defined in the conceptual design.

Impact on DCD

DCD Tier 2, Subsection 9.2.8.2.1, 9.2.8.2.2, 9.2.8.2.3, 9.2.9.1, 9.2.9.2.1, 9.2.9.2.2, 9.2.9.2.3, 9.2.10, 12.4.3, Table 1.8-2 (14 of 29 and 21 of 29), Table 9.2.8-1, Figure 9.2.8-1(1 of 4), and Figure 9.2.9-1 will be revised as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on Technical Specifications.

Impact on Technical/Topical/Environmental Reports

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

9.2.8 Turbine Generator Building Closed Cooling Water System

The turbine generator building closed cooling water (TGBCCW) system provides cooling water for the removal of heat from turbine generator building equipment and non-safety-related equipment. The heat is dissipated to the turbine generator building open cooling water system (TGBOCWS). See Subsection 9.2.9 for the description of the TGBOCWS.

9.2.8.1 Design Bases

The TGBCCW system meets the following design bases:

a. The TGBCCW system provides a continuous supply of cooling water to the turbine generator building during normal plant operation.

b. The TGBCCW system rejects heat from the equipment to the TGBOCWS through TGBCCW heat exchangers.

c. Demineralized water with corrosion inhibitors is used for cooling water.

d. The cooler cold side of the equipment is protected from overpressure by the thermal relief valve.

e. The TGBCCW system supplies cooling water to the independent closed loop cooling system that allows operation of one air compressor when the TGBCCW system is not available.

9.2.8.2 System Description

9.2.8.2.1 General Description

[[The TGBCCW system consists of three 50 percent heat exchangers]],

~~The TGBCCW system consists of three 50 percent heat exchangers~~, two 100 percent pumps, one surge tank, one chemical addition tank, associated piping, valves, instrumentation and controls that are located in the turbine generator building. The TGBCCW system is a closed loop system. A flow diagram of the TGBCCW system is shown in Figure 9.2.8-1, and major system components are described in Table 9.2.8-1.

[[two heat exchangers in service]].

The TGBCCW system provides the plant cooling capability for all plant operation modes with one pump and ~~two heat exchangers in service~~. The heated water is returned through the return header and is pumped through the TGBCCW heat exchangers, where the heat is dissipated to the TGBOCWS.

Cooling water from the heat exchanger is distributed to the various equipment coolers through the individual lines branched off from a single discharge header. The discharge isolation valves of the heat exchangers have jogging operation provisions to control the cooling water temperature in conjunction with the heat exchanger bypass line.

The TGBCCW flow to the main turbine lube oil coolers, generator hydrogen coolers, and feedwater pump turbine lube oil coolers is regulated by automatic control valves located in the associated cooler outlet lines. Air-operated control valves are modulated in response to temperature signals from the temperature indicating controllers for the fluid being cooled. The flow of cooling water to all other coolers is regulated manually by individual throttling valves located at each cooler outlet. Thermal relief valve is installed at the outlet of each cooler.

The surge tank provides a reservoir to compensate leakage from the system, the expansion and contraction of the cooling fluid with changes in system temperature and a constant suction head source of the TGBCCW pumps. The surge tank is connected to the suction of the pumps.

Makeup water to the surge tank is provided from the demineralized water makeup system and is automatically controlled by the surge tank water level. The surge tank is pressurized by the nitrogen system to prevent oxygen from entering the system.

A corrosion inhibitor is periodically added to the TGBCCW system via the chemical addition tank to control the pH of the system and for corrosion inhibition.

9.2.8.2.2 System Operation

During startup, the TGBCCW system is initially filled with demineralized water and the surge tank is pressurized by the nitrogen system. The TGBCCW system is placed in operation by manually starting one pump in the MCR or RSR. The standby pump is placed in the automatic mode. The required cooling water flow for the manually controlled coolers is sustained by throttling outlet valves for each cooler.

[[two heat exchangers]]

During normal operation, one TGBCCW pump and ~~two heat exchangers~~ are normally in operation with one pump and one heat exchanger on standby. The standby pump automatically starts whenever the pump discharge header pressure falls below a preselected value. The redundant TGBCCW heat exchanger is placed in service manually.

During winter or when the TGBOCW temperature is low, the cooling water temperature is controlled by the use of a TGBCCW heat exchanger bypass line. Then the bypassed water in high temperature is mixed with the cooled water from the heat exchanger at its outlet.

The TGBCCW system is shut down after the TGBOCWS is shut down to prevent contamination of the TGBCCW from TGBOCW leaking through the failed plate or gasket of the TGBCCW heat exchanger. The TGBCCW system is shut down by manually stopping the operating TGBCCW pump(s) in the MCR and RSR. During TGBCCW system shutdown mode, all coolers and components rejecting heat to the TGBCCW system are out of service.

The CLCS is normally isolated and started manually to provide cooling water during the TGBCCW system malfunction or outage for maintenance. Before the TGBCCW system is shut down, the CLCS is tied to the operating air compressor by opening manual isolation valves.

9.2.8.2.3 Design Features for Minimization of Contamination

The APR1400 is designed with specific features to meet the requirements of 10 CFR 20.1406 and NRC RG 4.21. The basic principles of NRC RG 4.21, and the methods of control suggested in the regulations, are specifically delineated in four design objectives and two operational objectives discussed in Subsection 12.4.2.

The TGBCCW system consists of heat exchangers, pumps, a surge tank, a chemical addition tank, piping, valves, and instrumentation to supply continuous cooling water for dissipating the heat from the turbine building equipment coolers and rejecting the heat to the TGBOCWS. The TGBOCWS then discharges the heat to the CW cooling towers.

The TGBCCW heat exchangers supply continuous cooling water to the turbine generator building equipment (generator hydrogen cooler, ISO phase bus duct cooler, generator stator water cooler, feedwater pump turbine lube oil coolers, etc.), which are not normally expected to contain radioactive fluid. The TGBCCW heat exchangers are plate type and

When the pressure at the TGBCCW pump discharge is low, an alarm is provided in the MCR. The water level in the surge tank is indicated locally and in the MCR. An alarm also is provided on the high or low water level in the surge tank in the MCR.

Makeup water flow to the surge tank is initiated automatically by surge tank water level low signal and is continued until the normal level is re-established.

The TGBCCW heat exchangers water outlet header temperature is indicated in the MCR and RSR.

9.2.9 Turbine Generator Building Open Cooling Water System

The turbine generator building open cooling water system (TGBOCWS) supplies cooling water to remove heat from the turbine generator building closed cooling water (TGBCCW) heat exchangers.

9.2.9.1 Design Bases

The TGBOCWS meets the following design bases:

a. The TGBOCWS supplies sufficient cooling water to the TGBCCW heat exchangers during all modes of plant operation.

b. Upon isolation or loss of one of ~~two operating TGBCCW heat exchangers~~ [[two operating TGBCCW heat exchangers]] or strainer, the remaining standby heat exchanger or strainer is capable of heat removal.

c. The cooling water is branched off from the discharge header of the circulating water (CW) pump and is returned back to the CW discharge conduit, after cooling the TGBCCW heat exchangers. The TGBOCWS then discharges the heat to the CW cooling towers.

9.2.9.2 System Description

9.2.9.2.1 General Description

The cooling water of TGBOCWS is branched off from the circulating water (CW) pumps header. The heated cooling water after passing the TGBCCW heat exchangers is discharged to the heat sink via the CW system.

The system consists of redundant strainers, valves, associated piping, and instrumentation and controls, which are located in the turbine generator building. A flow diagram is shown in Figure 9.2.9-1.

The system performs its cooling function with ~~two 50 percent TGBCCW heat exchangers~~ [[two 50 percent TGBCCW heat exchangers]] and one 100 percent strainer. Each heat exchanger is provided with flushing connections at both the inlet and outlet of the heat exchanger for the flushing of the heat exchangers.

In the prevention of TGBCCW system contamination by TGBOCWS, the design operating pressure of the TGBOCWS is lower than the design operating pressures of the TGBCCW system.

To minimize the potential for water hammer, the operating pressure at all location in the system remains higher than the saturated condition at the operating temperature.

9.2.9.2.2 System Operation

The TGBOCWS startup operation is followed by TGBCCW system startup.

The TGBOCWS supplies cooling water to the TGBCCW heat exchangers. Cooling water flows through the strainer to remove coarse particles prior to the TGBCCW heat exchangers. Cooling water passes through the cold side of two of the ~~three 50 percent TGBCCW heat exchangers~~ [[three 50 percent TGBCCW heat exchangers]]. The remaining heat exchanger in standby is isolated.

The TGBOCWS provides sufficient cooling capability for all plant operating modes with the CW system operating. Cooling water supply to the standby TGBCCW heat exchanger is accomplished from the MCR and RSR by using remote-controlled motor-operated butterfly valves.

The TGBOCWS is shut down by stopping all of the CW pumps or by closing the inlet and outlet valves of all of the TGBCCW heat exchangers' cold side.

When the cold side of a TGBCCW heat exchanger is isolated, the side is vented, drained, flushed with raw water, and drained again to prevent biological growth and fouling in the heat exchanger.

The shutdown of the TGBOCWS precedes the shutdown of the TGBCCW system to prevent contamination of the TGBCCW system from leakage through a failed plate or gasket in the TGBCCW heat exchanger.

9.2.9.2.3 Design Features for Minimization of Contamination

The APR1400 is designed with specific features to meet the requirements of 10 CFR 20.1406 and Regulatory Guide 4.21. The basic principles of NRC RG 4.21, and the methods of control suggested in the regulations, are specifically delineated in four design objectives and two operational objectives as discussed in Subsection 12.4.2.

The TGBOCWS consists of heat exchangers, piping, valves, and instrumentation to supply cooling water to the TGBCCW heat exchangers. The cooling water is supplied from the CW system header and is returned back to the CW discharge conduit, after cooling the ~~three TGBCCW heat exchangers.~~ [[three TGBCCW heat exchangers]]. The TGBOCWS is designed not to be in contact with radiological components. The only interface for the TGBOCW system is with TGBCCW heat exchangers in the TGBCCWS, which supplies continuous cooling water to the turbine generator building equipment (generator hydrogen cooler, ISO phase bus duct cooler, generator stator water cooler, feedwater pump turbine lube oil coolers, etc.), which are not expected to contain radioactive fluid. Also, the TGBCCW heat exchangers are plate type with titanium material, which minimizes pinhole leaks. The TGBOCW side is designed to operate at a higher pressure than the TGBOCW side. The heat exchanger seals are designed to leak toward the outside of the heat exchangers and the leaked drains are collected in the turbine generator building floor drain system for treatment and release. Based on this evaluation, the TGBOCWS is compliant with NRC RG 4.21.

Prevention/Minimization of Unintended Contamination

a. The TGBOCWS is designed to exchange heat with TGBCCW heat exchangers, and is not to be in close contact with radioactively contaminated components.

Table 9.2.8-1

TGBCCW System Component Design Parameters

Turbine Generator Building Closed Cooling Water Pump	
Quantity	2
Type	Centrifugal, Horizontal
Design Flow	~~53,000 L/min (14,000 gpm)~~
TDH	~~44.2 m (145 ft)~~
Turbine Generator Building Closed Cooling Water Heat Exchanger	
Quantity	~~3~~
Type	Plate
Heat Load	~~23 × 10^6 W (77 × 10^6 BTU/hr)~~
Number of Passes	1
Material of Construction	Titanium

[[53,000 L/min (14,000 gpm]]

[[44.2 m(145 ft]]

[[3]]

[[23 x 10^6W (77 x 10^6 BTU/hr)]]

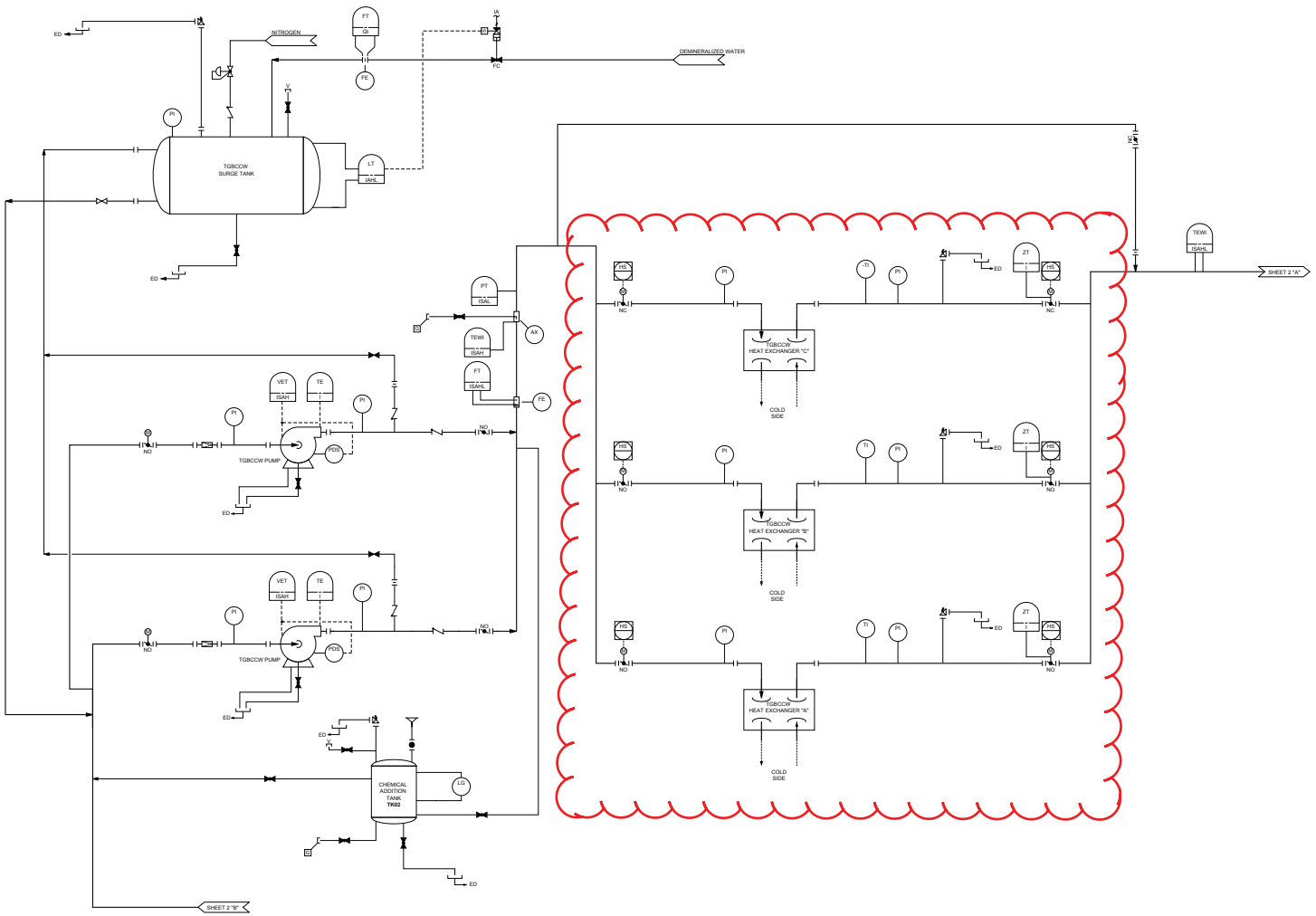

Figure 9.2.8-1 Turbine Generator Building Closed Cooling Water System Flow Diagram (1 of 4)

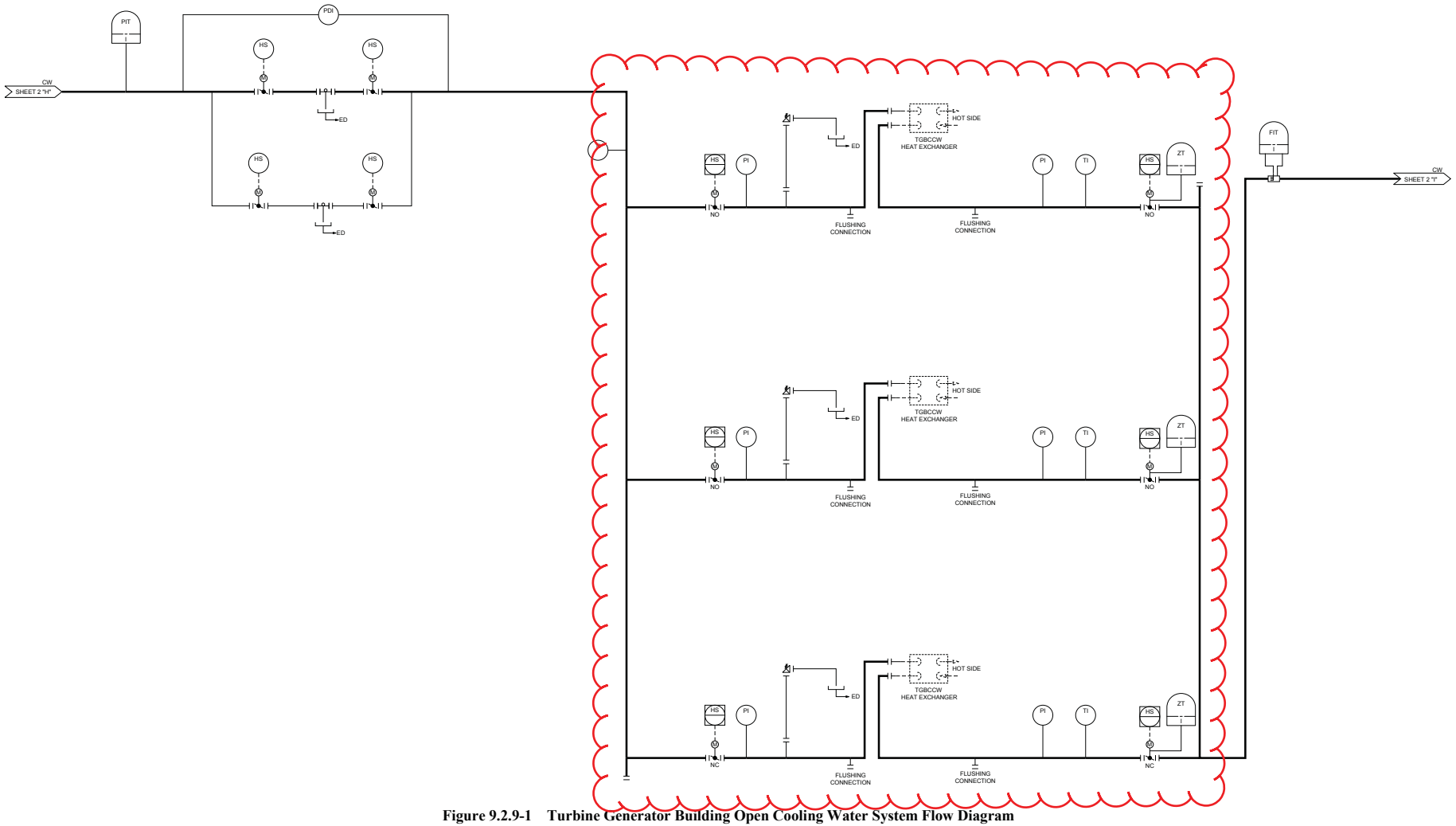

Figure 9.2.9-1 Turbine Generator Building Open Cooling Water System Flow Diagram

d. The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations (COL 9.2(35)). Documentation requirements are included as a COL information item.

Site Radiological Environmental Monitoring

The TGBCCW system is designed to prevent contamination through leakage in the heat exchangers. The integrity of the equipment heat exchanger and the TGBCCW heat exchangers is expected to be well maintained through surveillance, resulting in no contamination or a very low level of contamination of the system. Leakage from the system to the facility and the environment is captured by the design. The TGBCCW surge tank is located at a high elevation. Leakage from the tank is likely to be collected in the drain system inside the TGB. Hence, the TGBCCW system has low risk and low radiological consequence, and radiological environmental monitoring for the TGBCCW system is not considered effective. The COL applicant is to include a site-wide radiological environmental monitoring program to monitor both the horizontal and vertical variability of the onsite hydrogeology and the potential effects of the construction and operation of the plant (COL 9.2(36)).

9.2.8.3 Safety Evaluation

The TGBCCW performs no safety function. Therefore, no safety evaluation is required.

9.2.8.4 Inspection and Testing Requirements

Preoperational test is carried out as described in Section 14.2 to demonstrate the system performance, structural integrity, and leak-tightness of the system components.

9.2.8.5 Instrumentation Requirements

Local temperature and pressure indicators are provided at the equipment cooler outlet. Local temperature and pressure indicators are provided at the TGBCCW heat exchanger inlet and outlet.

The COL applicant is to provide operational procedures and programs for a site radiological environmental monitoring program to implement the minimization of contamination control in accordance with NRC RG 4.21 and RG 4.22, as applicable, and the documentation required by 10 CFR 20.1501 (COL 12.4(2).

COL 9.2(31) The COL applicant is to provide the inspection and testing of the UHS to demonstrate that fouling and degradation mechanisms applicable to the site are effectively managed to maintain acceptable heat sink performance and integrity.

COL 9.2(32) The COL applicant is to provide the alarms, instrumentation, and controls required for the safety-related functions of the UHS.

COL 9.2(33) The COL applicant is to develop the following procedures for the water system: filling, venting, keeping it full, and operating it to minimize the potential for water hammer. The COL applicant is also to analyze the system for water hammer impacts, design the piping system to withstand potential water hammer forces, and analyze inadvertent water hammer events in the ECWS in accordance with NUREG-0927.

COL 9.2 (34) The COL applicant is either to prepare or to include operational procedures and maintenance programs.

Deleted

COL 9.2 (35) The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations.

COL 9.2(36) The COL applicant is to include a site-wide radiological environmental monitoring program to monitor both the horizontal and vertical variability of the onsite hydrogeology and the potential effects of the construction and operation of the plant.

9.2.11 References

1. 40 CFR Part 141, “National Primary Drinking Water Regulations,” Environmental Protection Agency.

2. 29 CFR 1910, “Occupational Safety and Health Standard,” Occupational Safety and Health Administration.

3. ASME B31.1-2010, “Power Piping,” The American Society of Mechanical Engineers, 2010.

Table 1.8-2 (14 of 29)

Item No.	Description
COL 9.2(23)	The COL applicant is to specify the following UHS chemistry requirements for bio-fouling and chemistry control: a. A chemical injection system to provide non-corrosive, non-scale-forming conditions to limit biological film formation b. The type of biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor, and silt dispersant, if necessary to maintain system performance based on site conditions.
COL 9.2(24)	The COL applicant is to verify the piping layout of the ESWS and UHS to prevent water hammer and develop operating procedures to provide reasonable assurance that the ESWS and UHS water pressure are above saturation conditions for all operating modes.
COL 9.2(25)	The COL applicant is to develop maintenance and testing procedures to monitor debris buildup and flush out and to remove the debris in the UHS.
COL 9.2(26)	The COL applicant is to evaluate the potential wind and recirculation effects of cooling towers based on meteorological condition.
COL 9.2(27)	The COL applicant is to provide the material specifications for piping, valves, and fittings of the UHS system based on site-specific conditions and meteorological conditions.
COL 9.2(28)	The COL applicant is to provide the evaluation of maximum evaporation and other losses based on the site-specific conditions and meteorological conditions in the UHS.
COL 9.2(29)	The COL applicant is to provide the detailed evaluation for UHS capability with consideration of site-specific conditions and meteorological data in the UHS.
COL 9.2(30)	The COL applicant is to provide chemical and blowdown to prevent biofouling and long-term corrosion, considering site water quality in the UHS.
COL 9.2(31)	The COL applicant is to provide the inspection and testing of the UHS to demonstrate that fouling and degradation mechanisms applicable to the site are effectively managed to maintain acceptable heat sink performance and integrity.
COL 9.2(32)	The COL applicant is to provide the alarms, instrumentation, and controls required for the safety-related functions of the UHS.
COL 9.2(33)	The COL applicant is to develop the following procedures for the water system: filling, venting, keeping it full, and operating it to minimize the potential for water hammer. The COL applicant is also to analyze the system for water hammer impacts, design the piping system to withstand potential water hammer forces, and analyze inadvertent water hammer events in the ECWS in accordance with NUREG-0927.
COL 9.2(34)	The COL applicant is either to prepare or to include operational procedures and maintenance programs.
COL 9.2(35)	The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations.
COL 9.2(36)	The COL applicant is to include a site-wide radiological environmental monitoring program to monitor both the horizontal and vertical variability of the onsite hydrogeology and the potential effects of the construction and operation of the plant.
COL 9.3(1)	The COL applicant is to provide operational procedures and maintenance programs as related to leak detection and contamination control.

Deleted

COL 12.4(2) The COL applicant is to provide operational procedures and programs, ~~including the development of~~ a site radiological environmental monitoring ~~program, to implement the minimization of contamination approach~~ program to implement the minimization of contamination approach control for

COL 12.4(3) The COL applicant is to implement concrete tunnels for piping of the systems that may include underground piping carrying contaminated or potentially contaminated fluid to minimize buried piping.

12.4 in accordance with NRC RG 4.21 and RG 4.22, as applicable, and the documentation required by 10 CFR 20.1501

1. Regulatory Guide 8.8, "Information Relevant to Ensuring the Occupational Radiation Exposures at Nuclear Power Stations will be ALARA," Rev. 3, U.S. Nuclear Regulatory Commission, June 1978.

2. Regulatory Guide 8.19, "Occupational Radiation Dose Assessment in Light Water Reactor Power Plants Design Stage Man-Rem Estimates," Rev. 1, U.S. Nuclear Regulatory Commission, June 1979.

3. NUREG-0713, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities," U.S. Nuclear Regulatory Commission.

4. ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," The American Society of Mechanical Engineers, 2007.

5. NUREG-0737, "Clarification of TMI Action Plan Requirements," U.S. Nuclear Regulatory Commission, November 1980.

6. Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," U.S. Nuclear Regulatory Commission, July 2000.

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

8. Regulatory Guide 4.22, "Decommissioning Planning During Operations," U.S. Nuclear Regulatory Commission, December 2012.

Table 1.8-2 (21 of 29)

Item No.	Description
COL 12.4(1)	The COL applicant is to estimate construction worker doses based on site-specific number of operating units, distances, meteorological conditions, and construction schedule.
COL 12.4(2)	The COL applicant is to provide operational procedures and programs, including the development of a site radiological environmental monitoring program, to implement the minimization of contamination approach.
COL 12.4(3)	The COL applicant is to implement concrete tunnels for piping of the systems that may include underground piping carrying contaminated or potentially contaminated fluid to minimize buried piping.
COL 12.5(1)	The COL applicant is to provide the operational radiation protection program, including the items described in Section 12.5.
COL 13.1(1)	The COL applicant is to provide a description of the corporate or home office organization, its functions and responsibilities, and the number and the qualifications of personnel. The COL applicant is to be directed to activities such as the facility design, design review, design approval, construction management, testing, and operation of the plant.
COL 13.1(2)	The COL applicant is to develop a description of experience in the design, construction, and operation of nuclear power plants and experience in activities of similar scope and complexity.
COL 13.1(3)	The COL applicant is to describe its management, engineering, and technical support organizations. The description includes organizational charts for the current headquarters and engineering structure and any planned modifications and additions to those organizations to reflect the added functional responsibilities with the nuclear power plant.
COL 13.1(4)	The COL applicant is to develop a description of the organizational arrangement. The description is to include organizational charts reflecting the current headquarters and engineering structure and any planned modifications and additions to reflect the added functional responsibilities associated with the addition of the nuclear plant to the applicant's power generation capacity. The description shows how these responsibilities are delegated and assigned or expected to be assigned to each of the working or performance-level organizational units identified to implement these responsibilities. The description includes organizational charts reflecting the current corporate structure and the working- or performance-level organizational units that provide technical support for the operation.
COL 13.1(5)	The COL applicant is to develop the description of the general qualifications in terms of educational background and experience for positions or classes of positions described in the organizational arrangement.
COL 13.1(6)	The COL applicant is to develop a description of the structure, functions, and responsibilities of the onsite organization established to operate and maintain the plant.
COL 13.1(7)	The COL applicant is to provide an organizational chart showing the title of each position, minimum number of persons to be assigned to duplicate positions, number of operating shift crews, and positions that require reactor operator and senior reactor operator licenses.

The COL applicant is to provide operational procedures and programs for a site radiological environmental monitoring program to implement the minimization of contamination control in accordance with NRC RG 4.21 and RG 4.22, as applicable, and the documentation required by 10 CFR 20.1501.