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.:	**256-8321**
SRP Section:	**09.02.02 - Reactor Auxiliary Cooling Water Systems**
Application Section:	**9.2.2**
Date of RAI Issue:	**10/19/2015**

Question No. 09.02.02-5

General Design Criterion (GDC) 44 provides requirements for the transfer of heat from systems, As discussed in Standard Review Plan (SRP) 9.2.2 Section II, "Acceptance Criteria," General Design Criteria (GDC) 2 requires the capability of structures housing the Component Cooling Water System (CCWS) and the system itself to withstand the effects of natural phenomena like earthquakes, tornadoes, hurricanes, and floods.

All of the buildings housing CCWS equipment are shown in DCD Tier 2, Figure 1.2-1, “Typical APR1400 Site Arrangement Plan,” to be in scope of the standard plant and thus the DCD. The Auxiliary Building, Diesel Generator Building, and CCWHX building are all designed as seismic Category I and protect the CCWS components from external environmental hazard such as wind, tornado, hurricane, flood, and earthquakes.

Based on a review of the general arrangement drawings in Chapter 1 of the DCD, and the component cooling water flow diagram in Section 9.2 of the DCD, it appears that there are CCWS SSCs housed in tunnels connecting the CCW equipment in the Auxiliary Building to components in other buildings like the EDG and CCW heat exchanger buildings. The staff is unable to verify that the SSCs in piping tunnels will be adequately protected against external environmental hazard since DCD Figure 1.2-1 does not identify the pipe tunnels to be in scope of the DCD, and protection of the CCWS SSCs inside the pipe tunnel is not discussed in the DCD. Therefore, the applicant is requested to:

a. Identify pipe tunnels or any other features used to provide connection between CCWS SSCs in buildings that are physically separated from one another, and specify whether the tunnel/structure used is in scope of the DCD.

b. Discuss how the requirements of GDC 2 are met in regards to the capability of the tunnels/structure housing the CCWS SSCs to withstand the effects of natural phenomena like earthquakes, tornadoes, hurricanes, and floods.

c. If the pipe tunnels are not considered to be in scope of the DCD, provide requirements to ensure CCWS SSCs are protected from the environment hazards, and add a COL item specifying the COL applicant requirements regarding the CCWS tunnels.

d. Discuss how CCWS piping and SSCs located outside of plant buildings are protected from the effects of exposure to subfreezing environments

Response

a. As shown in DCD Tier 2, Figure 1.2-1, the CCW piping tunnels between the Auxiliary Building and CCW heat exchanger buildings are physically separated to the north side and the south side. However, because they are site-specific structures, their design is the responsibility of the COL applicant.

b. As described in DCD Tier 2, Section 3.1.2, the SSCs important to safety are designed to withstand, without loss of capability, the effects of the design basis natural phenomena along with appropriate combinations of normal and accident conditions. The CCW piping tunnels are classified as SSCs important to safety. Therefore, like other safety-related system housing structures, the CCW piping tunnels are designed to Safety Class 3 and Seismic Category I.

c. The CCW piping tunnels are in the COL scope and are designed to Safety Class 3 and Seismic Category I. Therefore the classification of the CCW piping tunnels will be added in Table 3.2-1 to provide requirements to ensure CCWS SSCs are protected from the environment hazards, and the COL item, COL 3.8(1), in Table 1.8-2 and Subsection 3.8.4 and 3.8.6 will be revised to specify the COL applicant requirements regarding the CCWS tunnels.

d. In addition, Tier 1 Table 2.7.2.2-1 and Tier 2 Table 3.2-1 will be revised to correct the location of the CCW piping and valves. Figure 9.2.2-1, CCWS flow diagram, will be revised to indicate correctly the piping location of the CCW pump suction (Sheet No. 1/4) and the connection between the Auxiliary Building and Compound Building (Sheet No. 4/4), which are located in the Auxiliary Building, not in the piping tunnel outside of the plant building.

e. The evaluation of the effects of exposure to subfreezing environments for the CCWS piping and SSCs located outside of plant buildings is the responsibility of the COL applicant. A COL item will be added in Table 1.8-2 and Subsection 9.2.2.2.2.4 and 9.2.10 for the COL applicant is to evaluate the effects, and, if required, to provide measures to protect from the subfreezing effects.

Impact on DCD

The DCD Tier 2, Table 1.8-2, Table 3.2-1, and Subsection 3.8.4 and 3.8.6 will be revised as shown in the attachment 1. Attachment 1 includes the correction of the non-conformance between paragraphs and typo in above subsections.

The DCD Tier 1, Table 2.7.2.2-1, and Tier 2, Table 3.2-1 and Figure 9.2.2-1 will be revised as shown in the Attachment 2.

The DCD Tier 2, Table 1.8-2 and Subsection 9.2.2.2.2.4 and 9.2.10 will be revised as shown in the Attachment 3.

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.

Table 1.8-2 (4 of 29)

Item No.	Description
COL 3.7(3)	The COL applicant is to provide the seismic design of the seismic Category I SSCs that are not part of the APR1400 standard plant design. The seismic Category I structures are as follows: a. Seismic Category I essential service water building b. Seismic Category I component cooling water heat exchanger building
COL 3.7(4)	The COL applicant is to confirm that the any site-specific non-seismic Category I SSCs are designed not to degrade the function of a seismic Category I SSC to an unacceptable safety level due to their structural failure or interaction.
COL 3.7(5)	The COL applicant is to perform any site-specific seismic design for dams that is required.
COL 3.7(6)	The COL applicant is to perform seismic analysis of buried seismic Category I piping, conduits, and tunnels.
COL 3.7(7)	The COL applicant is to perform seismic analysis for the seismic Category I above-ground tanks.
COL 3.7(8)	The COL applicant that references the APR1400 design certification will determine whether essentially the same seismic response from a given earthquake is expected at each unit in a multi-unit site or each unit is to be provided with a separate set of seismic instruments.
COL 3.7(9)	The COL applicant is to confirm details of the locations of the triaxial time-history accelerograph.
COL 3.7(10)	The COL applicant is to identify the implementation milestones for the seismic instrumentation implementation program based on the discussion in Subsections 3.7.4.1 through 3.7.4.5.
COL 3.7B(1)	The COL applicant is to evaluate the HRHF response spectra.
COL 3.7B(2)	The COL applicant is to evaluate the representative items listed in Table 3.7B-2.
COL 3.8(1)	The COL applicant is to provide the design of site-specific seismic Category I structures such as the essential service water ~~supply structure and the component cooling water heat exchanger building.~~
COL 3.8(2)	The COL applicant is to identify any applicable site-specific loads such as site proximity explosions and missiles, potential aircraft crashes, and the effects of seiches, surges, waves, and tsunamis.
COL 3.8(3)	The COL applicant is to determine the environmental condition associated with the durability of concrete structures and provide the concrete mix design that prevents concrete degradation including the reactions of sulfate and other chemicals, corrosion of reinforcing bars, and influence of reactive aggregates.
COL 3.8(4)	The COL applicant is to determine construction techniques to minimize the effects of thermal expansion and contraction due to hydration heat, which could result in cracking.
COL 3.8(5)	The COL applicant is to monitor the safety and serviceability of seismic Category I structures during the operation of the plant and provide the appropriate maintenance.
COL 3.8(6)	The COL applicant is to provide reasonable assurance that the design criteria listed in Table 2.0-1 are met or exceeded.

building and the component cooling water heat exchanger building, essential service water conduits, component cooling water piping tunnel, and class 1E electrical duct runs.

Table 3.2-1 (2 of 86)

Item No. / Principal SSCs	Location[2]	Safety Class	Quality Group	Codes and Standards	10 CFR 50, App. B[3]	Seismic Category	Remarks
9. Essential Service Water / Component Cooling Water Heat Exchanger Building		SC-3	N/A	ACI349-1997, ANSI/AISC N690-1994 incl. supp. 2(2004)	Yes	I	
II. Systems and Components							
1. AC – Auxiliary Process Cabinet							
a. APC A/B/C/D	AB	SC-3	N/A	IEEE-603-1991, IEEE 323-2003, IEEE 344-2004	Yes	I	
b. APC N1/N2	AB	NNS	N/A	N/A	A	III	
2. AF – Auxiliary Feedwater							
a. Auxiliary feedwater pumps							
1) Pumps	AB	SC-3	C	ASME Sec. III ND-2007 with 2008 addenda	Yes	I	
2) Motors	AB	SC-3	N/A	ANSI C50.41-NEMA C50.41-1982	Yes	I	
b. Auxiliary feedwater pump suction piping and valves from auxiliary feedwater suction manual valves (AFW-V1001 A/B, AFW-V1002 A/B)	AB	SC-3	C	ASME Sec. III ND-2007 with 2008 addenda	Yes	I	
c. Auxiliary feedwater pump discharge piping and valves up to and excluding auxiliary feedwater isolation valves (AFW-V043 ~ 046)	AB	SC-3	C	ASME Sec. III ND-2007 with 2008 addenda	Yes	I	
d. Auxiliary feedwater pump discharge piping from auxiliary feedwater isolation valves (AFW-V043 ~ 046) up to feedwater connection	RCB	SC-2	B	ASME Sec. III Div. 1 NC-2007 with 2008 addenda	Yes	I	
10. Component Cooling Water Piping Tunnel		SC-3	N/A	ACI-349-1997 ANSI/AISC N690-1994 incl. supp.2(2004)	Yes	I	

cooling water heat exchanger building, essential service water conduits, and class 1E electrical duct runs (COL 3.8(1)).

component cooling water piping tunnel,

3.8.4.1 Description of the Structures

3.8.4.1.1 Auxiliary Building

The auxiliary building houses the mechanical and electrical equipment used for normal plant operation and safe shutdown of the reactor. The auxiliary building is composed of the electrical and control area, main steam valve house, chemical and volume control system (CVCS) area, emergency diesel generator area, and fuel handling area.

The electrical and control area consists of the Class 1E electrical equipment rooms at elevation 78 ft 0 in and those areas located above them. The electrical and control area provides two physically separate divisions for electrical distribution, control, and instrumentation systems leading to the main control room (MCR). The upper floor of the electrical and control area contains the MCR, which is designed to provide security, fire, and environmental protection to the control equipment and the MCR operators.

The main steam valve house is a compartment located above the auxiliary feedwater (AFW) tank areas on the north and south sides of the auxiliary building. The compartment is from elevation 137 ft 6 in to 175 ft 0 in. The main steam valve house is designed to provide environmental protection, primarily missile protection, for the main steam and feedwater line safety-related valves and piping.

The CVCS area consists of a number of small rooms that are used to isolate components for water treatment required by operating systems. Individual rooms are used for radiation shielding.

The emergency diesel generator area provides protection to two diesel generators installed in separate compartments located on opposite sides of the auxiliary building.

The fuel handling area includes the spent fuel pool, refueling canal, cask loading pit, cask decontamination pit, truck/rail shipping bay, and new fuel storage area. The spent fuel pool is an open stainless steel lined reinforced concrete vessel used for submerged storage

The COL applicant is to provide testing and inservice inspection programs to examine inaccessible areas of concrete structures for degradation and monitoring of groundwater chemistry (COL 3.8(9)).

The long-term settlement is the site-specific characteristics. The COL applicant is to provide the soil parameters for APR1400 site (COL. 3.8(10).

3.8.6 Combined License Information

COL 3.8(1) The COL applicant is to provide the design of site-specific seismic Category I structures such as the essential service water building and the component cooling water heat exchanger building, essential service water ~~condits~~, and class 1E electrical duct runs.

conduits, component cooling water piping tunnel,

COL 3.8(2) The COL applicant is to identify any applicable site-specific loads such as site proximity explosions and missiles, potential aircraft crashes, and the effects of seiches, surges, waves, and tsunamis.

COL 3.8(3) The COL applicant is to determine the environmental condition associated with the durability of concrete structures and provide the concrete mix design that prevents concrete degradation including the reactions of sulfate and other chemicals, corrosion of reinforcing bars, and influence of reactive aggregates.

COL 3.8(4) The COL applicant is to determine construction techniques to minimize the effects of thermal expansion and contraction due to hydration heat, which could result in cracking.

COL 3.8(5) The COL applicant is to monitor the safety and serviceability of seismic Category I structures during the operation of the plant and provide the appropriate maintenance.

COL 3.8(6) The COL applicant is to provide reasonable assurance that the design criteria listed in Table 2.0-1 are met or exceeded.

Table 2.7.2.2-1 (1 of 2)

Component Cooling Water System Equipment and Piping Location/Characteristics

Equipment and Piping Name	Location	ASME Section III Class	Seismic Category
CCW heat exchangers	CCWHX Building	3	I
CCW pumps	Auxiliary Building	3	I
CCW surge tanks	Auxiliary Building	3	I
CCW makeup pumps	Auxiliary Building	3	I
Component cooling water supply and return piping and valves excluding the following a) through h) below:	Auxiliary Building, CCWHX Building	3	I
a) Containment penetration piping of RCP cooler supply line between and including the valves, CC-V231 and CC-V1099 in the division I	Containment Building	2	I
b) Containment penetration piping of RCP cooler return line between and including the valves, CC-V249, CC-V250, and, CC-V1100 in the division I	Containment Building	2	I
c) RCP cooler supply and return piping between the valves, CC-V1099, CC-V249, and CC-V1100 in the division I	Containment Building	-	II
d) Non-essential supply and return piping between the valve CC-V145 and CC-V147 in the division I excluding the following e) through g) below:	Auxiliary Building	-	II
e) Containment penetration piping of letdown heat exchanger supply line between and including the valves CC-V296, CC-V297, and CC-V1685 in the division I	Containment Building	2	I

,EDG Building, Yard

Table 2.7.2.2-1 (2 of 2)

Equipment and Piping Name	Location	ASME Section III Class	Seismic Category
f) Containment penetration piping of letdown heat exchanger return line between and including the valve CC-V301, CC-V302, and CC-V1686 in the division I	Containment Building	2	I
g) Letdown heat exchanger supply and return piping between the valves, CC-V297, CC-V301, CC-V1685, and CC-V1686 in the division I	Containment Building	-	II
h) Non-essential supply and return piping between the valve CC-V146 and CC-V148 in the auxiliary building of the division II	Auxiliary Building	-	II
i) Non-essential supply and return piping in the compound building of the division II	~~Containment Building~~ Compound Building	-	III

Table 3.2-1 (7 of 86)

Item No. / Principal SSCs	Location[2]	Safety Class	Quality Group	Codes and Standards	10 CFR 50, App. B[3]	Seismic Category	Remarks
d. CCW surge tanks	AB	SC-3	C	ASME Sec. III ND-2007 with 2008 addenda	Yes	I	
e. Chemical addition tank	AB	NNS	D	ASME Sec. VIII-2007 with 2008 addenda	A	II	(3)(d)
f. Component cooling water supply and return piping and valves excluding the following 1) through 9) below:	~~AB~~ AB, CCWHXB, EDGB, Yard	SC-3	C	ASME Sec. III ND-2007 with 2008 addenda	Yes	I	
1) Containment penetration piping of RCP cooler supply line between and including the valves, CC-231 and CC-1099 in the division I	RCB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
2) Containment penetration piping of RCP cooler return line between and including the valves, CC-249, CC-250, and CC-1100 in the division I	RCB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
3) RCP cooler supply and return piping between the valves, CC-1099, CC-249, and CC-1100 in the division I	RCB	NNS	D	ASME B31.1-2010	A	II	(3)(d)

Table 3.2-1 (9 of 86)

CPB

Item No. / Principal SSCs	Location[2]	Safety Class	Quality Group	Codes and Standards	10 CFR 50, App. B[3]	Seismic Category	Remarks
9) Non-essential supply and return piping in the compound building of the division II	~~RCB~~	NNS	D	ASME B31.1-2010	N/A	III	
10. CD – Condensate							
a. Piping in auxiliary bldg.	AB	NNS	D	ASME B31.1-2010	A	II	(3)(d)
b. Condenser, condensate pumps, tanks, valves, strainers, and feed water heaters	TGB	NNS	D	ASME B31.1-2010	N/A	III	
c. Other piping	TGB	NNS	D	ASME B31.1-2010	N/A	III	
11. CE – Control Element Assembly Drive							
a. Control element drive mechanism	RCB	SC-1	A	ASME Sec. III NB -2007 with 2008 addenda	Yes	I	
1) Pressure housing assembly	RCB	SC-1	A	ASME Sec. III NB -2007 with 2008 addenda	Yes	I	
2) Motor assembly	RCB	SC-2	B	N/A	Yes	I	
3) Extension shaft assembly	RCB	SC-2	B	N/A	Yes	I	
b. Reactor trip switchgear	RCB	SC-3	N/A	IEEE-603-1991	Yes	I	
c. Rod drive motor generator set	RCB	NNS	N/A	N/A	N/A	III	

Replace with A in the next page

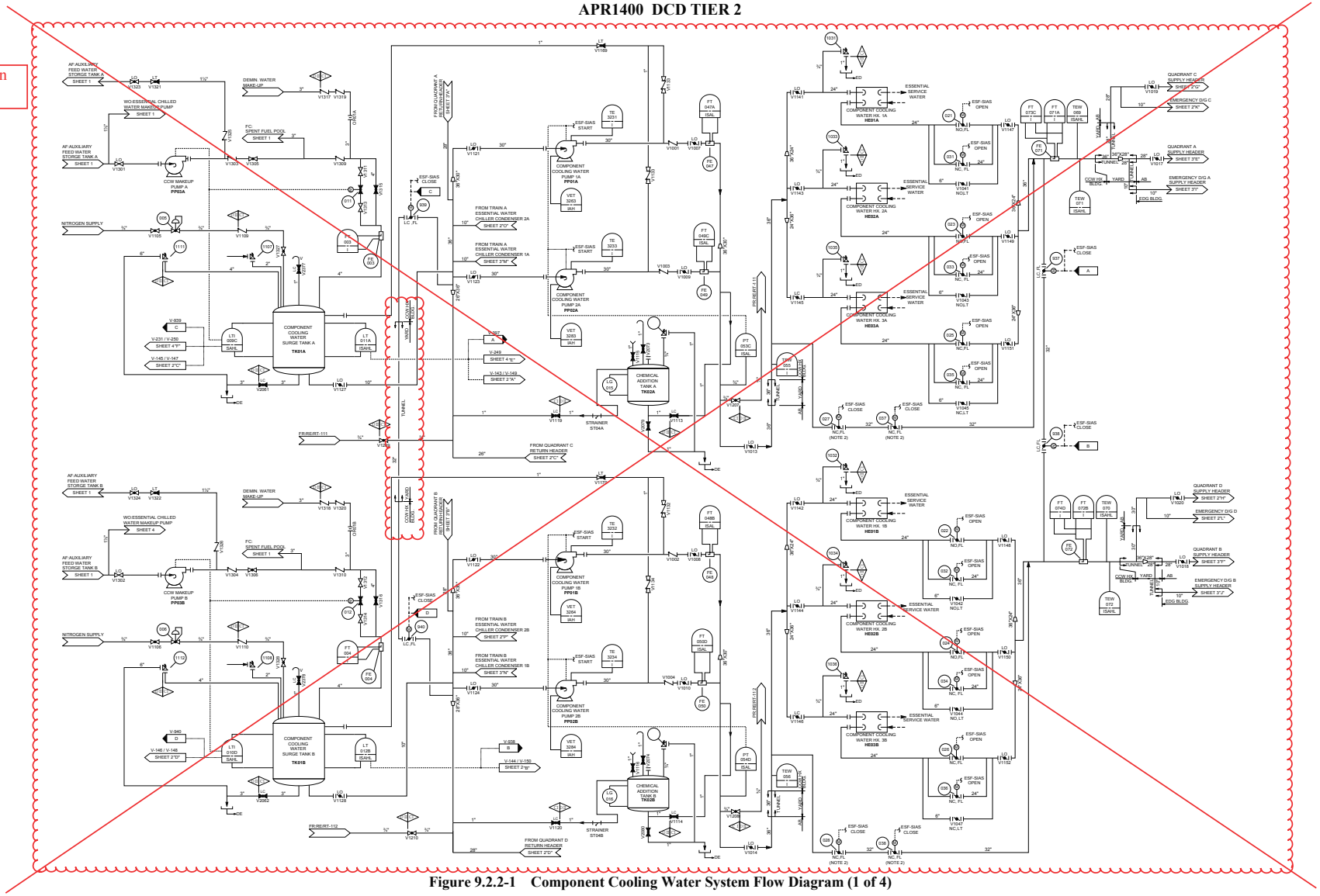

Figure 9.2.2-1 Component Cooling Water System Flow Diagram (1 of 4)

A

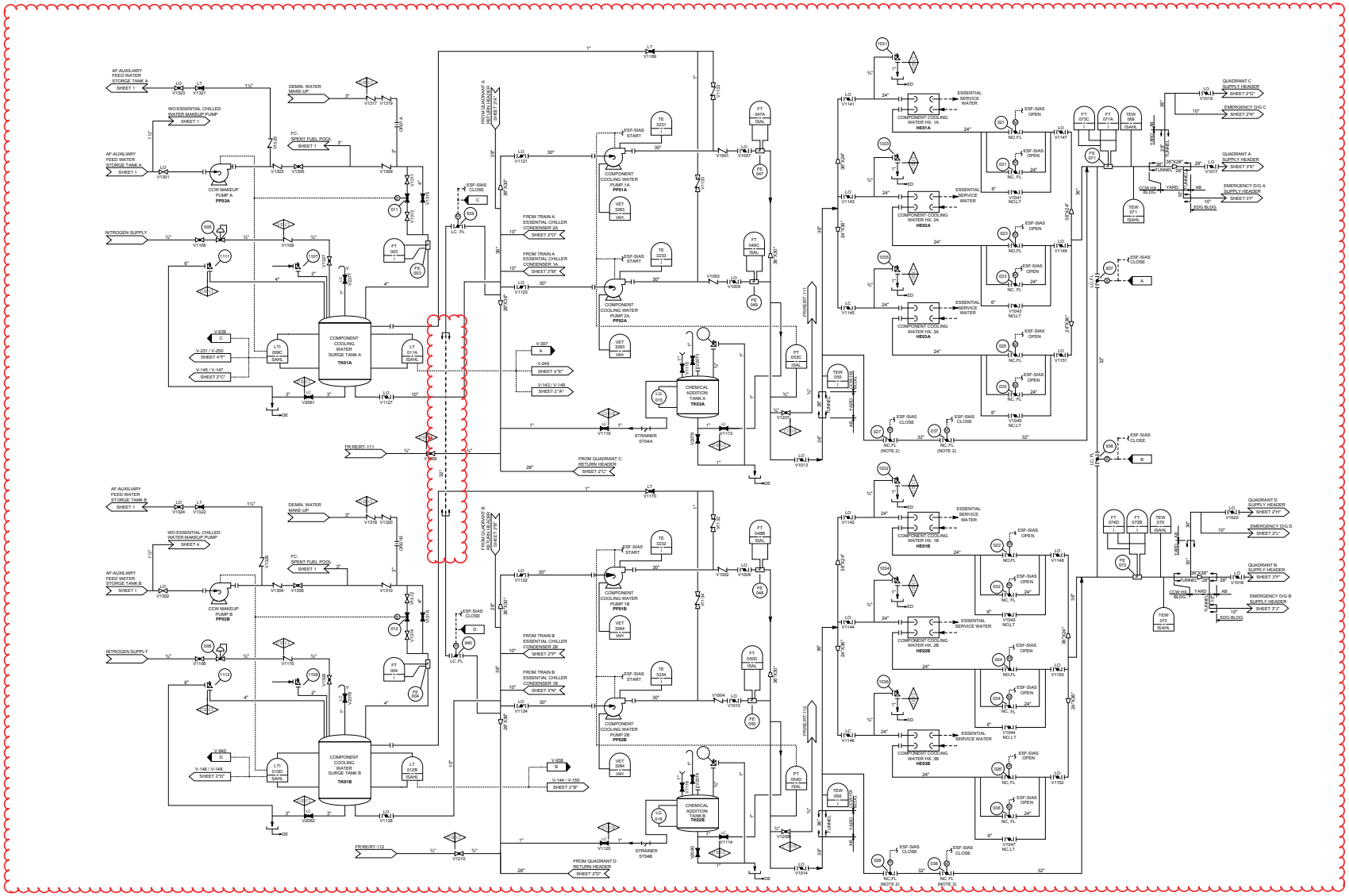

Figure 9.2.2-1 Component Cooling Water System Flow Diagram (Sheet 1 of 4)

Replace with B in the next page

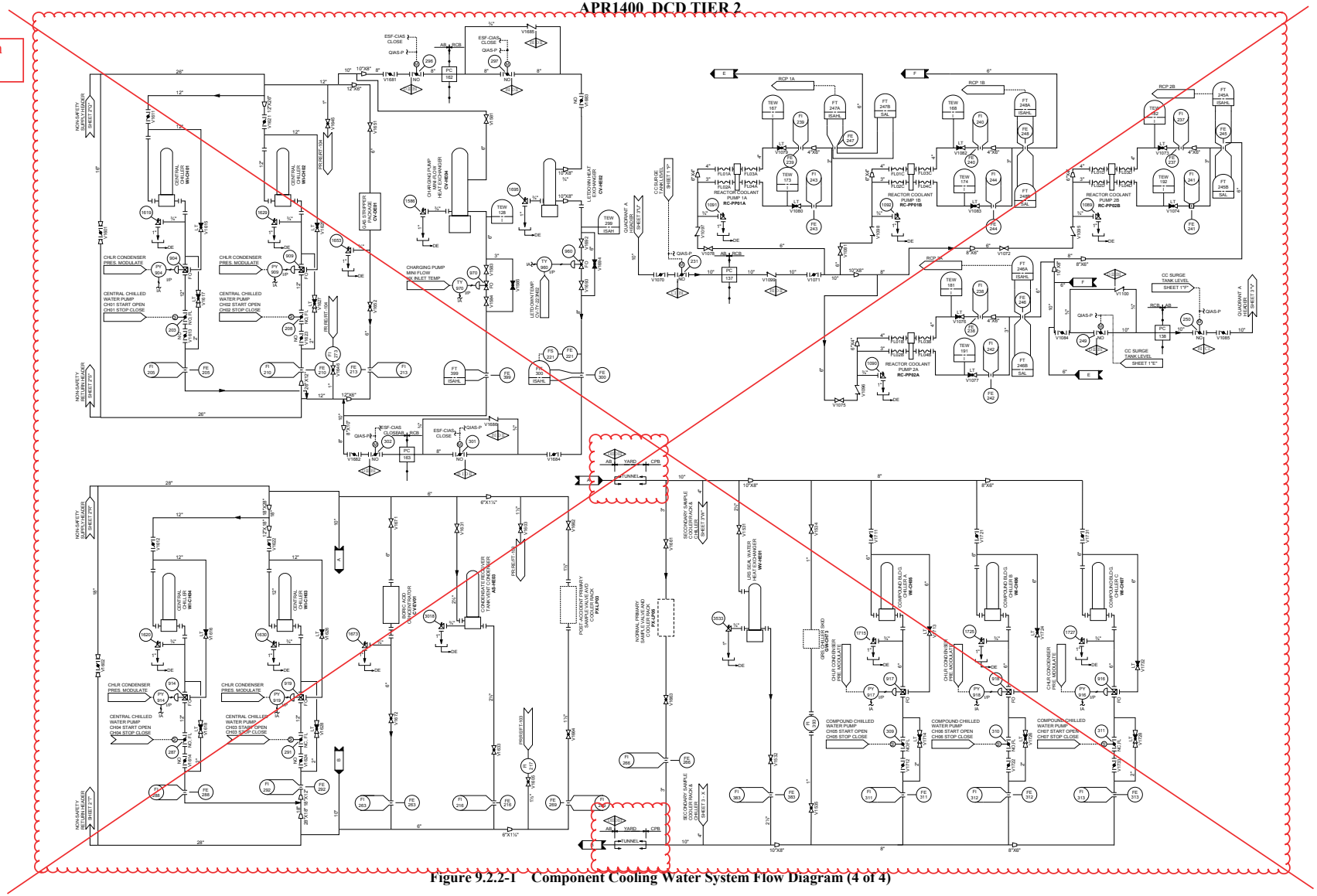

Figure 9.2.2-1 Component Cooling Water System Flow Diagram (4 of 4)

B

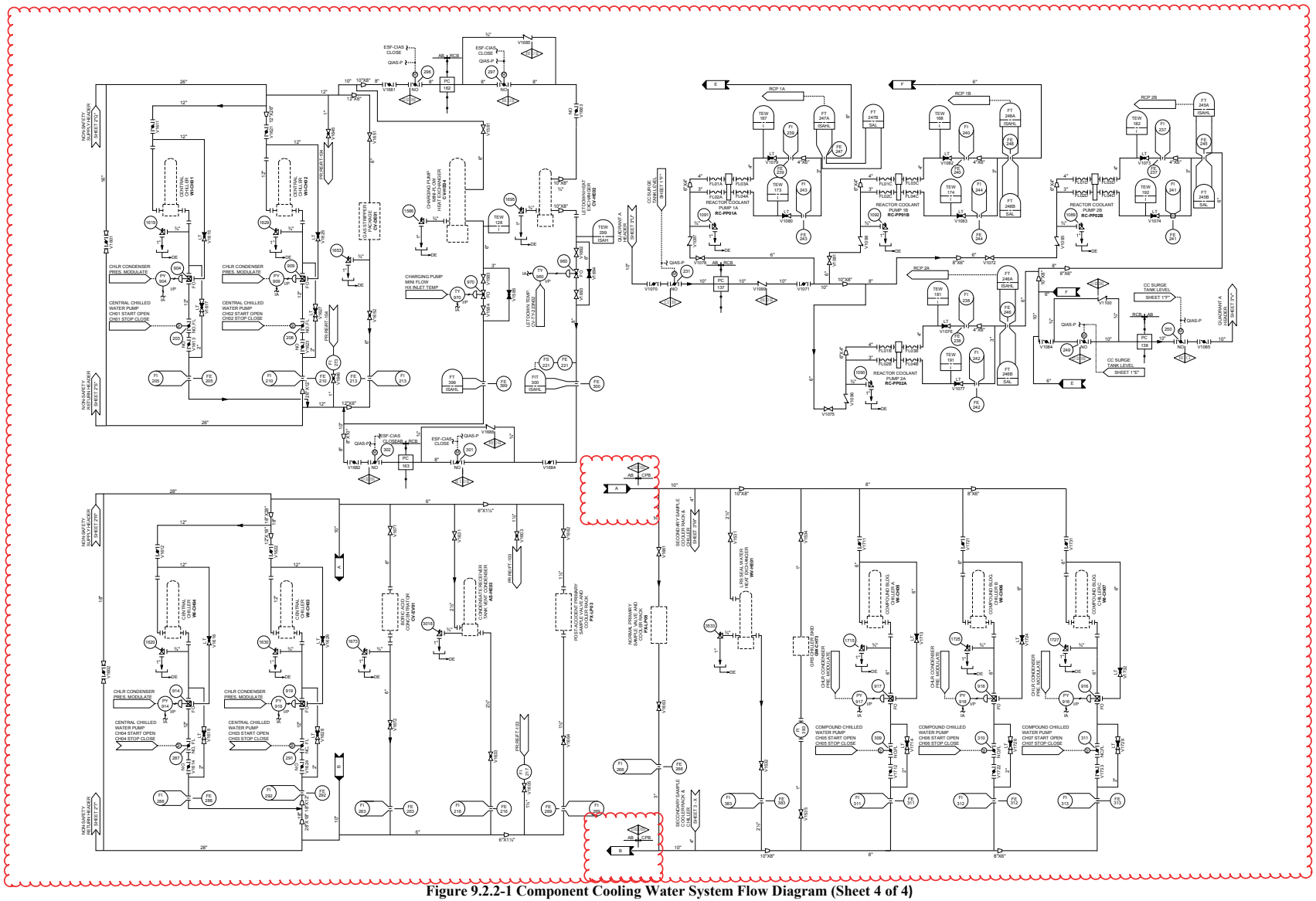

Figure 9.2.2-1 Component Cooling Water System Flow Diagram (Sheet 4 of 4)

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.

COL 9.2(37) The COL applicant is to evaluate the effects of exposure to subfreezing environments for the CCWS piping and SSCs located outside of plant buildings, and, if required, to provide measures to protect from the subfreezing effects.

The surge tank is pressurized by the nitrogen gas to minimize air ingress. The elevation of the surge tank and piping arrangement minimize the potential for nitrogen accumulation in places other than the surge tank.

9.2.2.2.2.4 Piping, Valves, and Fittings

CCWS piping is carbon steel and is protected against corrosion by the addition of corrosion inhibitors. The safety-related piping, valves, and fittings are designed and fabricated in accordance with ASME Section III, Class 3 requirements.

There are two cross connection lines between the divisions at the pump suction header and at the downstream of the CCW heat exchangers. Each line is normally isolated with two motor operated valves (MOVs) in series.

Relief valves are provided, as required, for equipment protection. Vents are installed in high points, and drains are installed in low points in the CCWS.

Vents are located to provide reasonable assurance that the piping is filled with water to reduce the water hammer occurrences after pump startups. Also, valve opening/closing times are selected to minimize water hammer effects and to provide reasonable assurance of isolation of a leak before the CCW surge tank empties.

The COL applicant is to develop procedures for water systems filling, venting, keeping the system full, and operation to minimize the potential for water hammer; to analyze the system for water hammer impacts; to design the piping system to withstand potential water hammer forces; and to analyze inadvertent water hammer events in accordance with NUREG-0927 (Reference 10) in the CCWS (COL 9.2(9)).

The following valves are required to perform a specific function in shutting down the reactor or to mitigate the consequences of an accident. The active valves are listed in Table 9.2.2-5.

a. Nonessential supply header isolation valves (CC-143, 144, 145, and 146)

These MOVs close to terminate CCW flow to the nonessential equipment in the event of an accident. These valves automatically close on the SIAS or CCW surge tank low-low-level signal. The valve closure times are selected to prevent

The COL applicant is to evaluate the effects of exposure to subfreezing environments for the CCWS piping and SSCs located outside of plant buildings, and, if required, to provide measures to protect from the subfreezing effects. (COL 9.2(37)).

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 9.2(37)
The COL applicant is to evaluate the effects of exposure to subfreezing environments for the CCWS piping and SSCs located outside of plant buildings, and, if required, to provide measures to protect from the subfreezing effects.

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.