ArevaEPRDCPEm Resource

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Sent: Friday, September 24, 2010 4:55 PM
To: Tesfaye, Getachew
Cc: GARDNER Darrell (AREVA); Hearn, Peter
Subject: FW: RAI 356 question 91
Attachments: RAI 356 9.2.2-91 DRAFT.PDF

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please forward to NRC for Tuesday call.

From: HUDDLESTON Stephen (EP/PE)
Sent: Friday, September 24, 2010 9:08 AM
To: GARDNER Darrell (RS/NB)
Cc: BALLARD Bob (EP/PE)
Subject: RAI 356 question 91

Darrell,

Updated RAI 356 Q91 draft for the NRC that is revised to meet their last round of questions. Probably to late for today but they can at least see it. This is the last open question on this RAI.

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Response to

Request for Additional Information No. 356 (4232), Revision 0

02/01/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 09.02.02 - Reactor Auxiliary Cooling Water Systems
Application Section: 09.02.08

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)

Question 09.02.02-91:

Follow-up to RAI 174, Question 9.2.2-45:

The safety chilled water system (SCWS) must be capable of removing heat from structures, systems and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with general design criteria (GDC) 44 requirements. Under seismic or post-accident conditions where demineralized water may be unavailable for safety chilled water system (SCWS) makeup, the expansion tanks should contain sufficient water volume to assure reliable system operation without makeup for at least seven days. The Final Safety Analysis Report (FSAR) does not discuss expansion tank capabilities in the event of a makeup source interruption.

a. Describe the bounding system leak rate that is assumed during normal operating and accident conditions, the bases for these assumptions, and the number of days of operation that the expansion tank is sized for should the makeup source be unavailable.

b. Describe the treatment of these line with regard to expansion tank capabilities, and the routing of the nitrogen relief valves to safe areas for discharge. Verify hose connections are safety related and seismic at the interface of the pump suction.

Based on the staff's review of the applicant's response to RAI 9.2.2-45 (ID1810/6782) AREVA #174 Supplement 4 and audit conducted on October 27, 2009, the following items were determined as unresolved and therefore need to be further addressed and resolved by the applicant.

With regards to part (a), the applicant responded that a seismically qualified makeup source will be used to feed the SCWS and satisfy NRC Standard Review Plan Section 9.2.2, Section 3C requirements for makeup water in closed loop cooling systems but did not modify Tier 1 drawings to show this connection stating that the connection does not perform a significant safety function. The staff requests the applicant provide amplifying information to support this conclusion.

In addition, the applicant stated that SCWS expansion tank sizing details will be developed later in the design process noting that expansion tank sizing and internal volume determination are dependent on several factors. Provide a commitment that the Initial Plant Test Programs in FSAR Chapter 14 contains requirements to confirm that the expansion tank sizing and internal volume determination are acceptable.

The information described above is required by the staff in order to complete their review.

Consequently, this item will remain open pending submittal of the requested information and a schedule for providing this information needs to be established.

Response to Question 09.02.02-91:

In response to part (a), the primary means to satisfy NRC Standard Review Plan Section 9.2.2, Section 3C requirements for 7 day makeup water in closed loop cooling systems in the SCWS, will be the retention of a 7 day reserve volume in the SCWS expansion tank. The 7 day reserve volume will exceed the total of the nominal valve leakage rate identified by ASME QME-1 and

allow margin for valve stem packing, pump seal, tank diaphragm, and any remaining undefined leakage.

ASME QME-1 identifies a nominal valve leak rate of 0.6 $in.^3$/hr/NPS of nominal valve size. The following table summarizes the equivalent volume from a total train leakage to accommodate 24 hour 7 day leakage at a rate equivalent to 0.6 in^3/hr/NPS nominal valve size.

	Leakage Rate (ASME QME-1-2007 Nominal Rate for Valves)
(2) 6" Valves (gal/hr)	0.031
Pump Seals (gal/hr)*	0.050
Valve packing and miscellaneous (gal/hr)*	0.050
Train Total (gal/hr)	0.131
Train Total (gal/day)	3.144
7 Day Required Volume (gallons)	22

* based on engineering judgment

The SCWS Cross-Tie valves are considered for post-seismic leakage and are included in the IST program. These valves will be tested in accordance with the ASME OM Code, ISTC-3630 (e) which states, "leakage rate measurements shall be compared with permissible leakage rates specified by the plant Owner for a specific valve or valve combination." Per the ASME OM Code, these valves will be stroke tested quarterly and leak tested every 24 months. The IST program includes pre-service testing to establish baseline criteria for these valves, therefore additional testing will not be included in Chapter 14. Leak rate verification will be included in Tier 1 ITAAC (FSAR Section 2.7.2). The leak test differential pressure across the shut cross-tie valves will be established between a normal operating train with pumps in operation and a shutdown train with pumps secured.

To account for the potential for these valves to leak more than expected, each SCWS expansion tank is designed to include a minimum water volume of 100 gallons to accommodate potential system leakage for 7 days continuous for 24 hours with no makeup source in post-seismic conditions. This reserve volume of 100 gallons per train allows the system to accommodate a per train leakage of 0.595 gallons per hour (14.28 gallons per day) continuous for 24 hours per day for 7 days in the event that normal Demineralized Water makeup is not available. A review of operating experience has confirmed low leakage valves have been installed with seat leakage values maintained below the allowed leakage values for this SCWS expansion tank volume.

The SCWS system is designed with redundant pressure indication for each expansion tank. The pressure indication is transmitted to the MCR which provides the operators with the ability to retrieve trending data on expansion tank pressure and volume equivalent in real time and the ability to realize when 7 day train leakage is trending near a threshold value. This provides the operators the ability to take corrective action prior to exceeding the maximum allowed 7 day train leakage. The use of existing pressure indication at top (N_2 side) and bottom of the tank (water side) can provide a differential in equivalent inches of water.

The total SCWS expansion tank volume is 310 gallons (41.4 ft^3) of which the level at approximately half the tank volume or 155 gallons (20.7 ft^3) is considered the normal maximum fluid volume. The remaining half of the tank is pressurized nitrogen. The volume between the maximum and minimum normal operating volume is 25 gallons. A margin of 20 gallons is provided between the Min-1 alarm and the beginning of the 7 day reserve. The SCWS expansion tank fluid volumes and the relative set points are shown below.

Setpoint	Discussion		Volume of Fluid (ft^3)	Volume of Fluid (gal)
Relief Valve Setpoint	Relief valve for expansion tank opens to relieve high pressure.	Normal Max +10 gal margin	22.0	165
Alarm Max-1	Audio and Visual alarm in Main Control Room actuates to alert operators of high pressure.	Normal Max +5 gal margin	21.4	160
Normal Max	Maximum water volume the tank should reach when the system is properly filled and the maximum thermal expansion is present.	Tank half full	20.7	155
Normal Min	Minimum water volume the tank should reach when the system is properly filled and the minimum thermal expansion is present.	25 gal thermal range	17.4	130.0
Alarm Min -1	Audio and Visual alarm in Main Control Room actuates to alert operators of low water volume. Operators initiate makeup from normal Demineralized water source.	Normal Min -5 gal margin	16.7	125.0
Alarm Min-2	Audio and Visual alarm in Main Control Room actuates to alert operators of lowest water volume. Operators start the second train and close Cross-tie valves and each division operates independently.	Normal Min -10 gal margin	16.0	120.0
Start 7 Day Supply	Tank holds enough water for 7 day leakage supply and a small margin.	Normal Min -25 gal margin	14.0	105.0
End 7 Day Supply	7 day leakage supply has been used. A 5 gallon margin of water is left in the tank.	5 gal left in tank	0.7	5.0
Alarm Min-3	Audio and Visual alarm in Main Control Room actuates to alert operators. Causes the pumps and chillers in the system/train to auto trip due to low system pressure. If possible operators start the opposite train.	Tank empty	0.0	0.0

Response to RAI 356 Question 09.02.02-86 added Tier 2, FSAR Table 9.2.8-3 instrument indication display locations, input to a process computer and/or alarm and automatic actuation functions, for instruments on Tier 2, FSAR Figure 9.2.8-1.

A TS Surveillance will be added to verify that SCWS train leakage is less than .5 gallons per hour with a frequency of once per 24 months.

For defense in depth each SCWS expansion tank will maintain a post-seismic emergency makeup spool piece connection for water supply from the Seismic II Fire Water Distribution System inside the Nuclear Island. The Fire Water Distribution System is designed to remain functional after a SSE (Refer to FSAR Tier 2 Section 9.5.1.2.1).

FSAR Impact:

FSAR Tier 2 Section 9.2.8.2.2 will be revised to add requirements for makeup storage in the expansion tank as indicated in the attached mark-ups.

FSAR Tier 2 Section 9.2.8.3.2 will be revised to add requirements for a defense in depth post-seismic emergency makeup spool piece connection for water supply from the Seismic II Fire Water Distribution System inside the Nuclear Island.

FSAR Tier 2 Section 9.2.8.6 will be revised to clarify wording that on a Min-2 expansion tank pressure that operators close the Cross-tie valves and start the second train allowing each division to operate independently.

FSAR Tier 2 Section 9.2.8.5 will be revised to add leak testing and trending.

FSAR Tier 2 Section 9.5.1.1 will be revised to add a defense in depth post-seismic emergency 7 day makeup from the Fire Water Distribution System.

FSAR Tier 2 Section 14.2.12.6.2 Safety Chilled Water System (Test #052) will be revised to include requirements to confirm that the expansion tank sizing and internal volume determination are acceptable.

FSAR Tier 2 SR 3.7.9.3 will be added for TS bases

FSAR Tier 1 Section 2.7.2 and Table 2.7.2-3

Insert 1

The SCWS diaphragm expansion tank will contain a reserve volume for 7 days of normal SCWS leakage. The leakage rate for each Cross-tie Supply and Return valve is 3.6 in^3/hr. Valve leakage is based on ASME QME-1 that identifies a nominal valve leak rate of 0.6 $in.^3/hr/NPS$ of nominal valve size. The 7 day leakage volume also includes leakage of 0.1 gal /hr for valve stem packing, pump seal, tank diaphragm, and any remaining undefined leakage.

Each SCWS expansion tank will include a minimum water volume of 100 gallons to accommodate potential system leakage for 7 days continuous for 24 hours with no makeup source in post-seismic conditions of 0.5 gal/hr.

Insert 2

SR 3.7.9.3

Verifying SCW train leakage is within limits assures an adequate volume of water is maintained for each SCW train for 7 days in post-seismic operation with no make water source available. The 24 month Frequency is based on the need to perform this Surveillance under the conditions that apply during a unit outage. Operating experience has shown that these components usually pass the Surveillance when performed at the 24 month Frequency. Therefore, the Frequency is acceptable from a reliability standpoint.

The leakage value of 0.5 gallons per hour considers the worst case pressure difference between one operating SCW train with the SCW Cross-tie Supply and Return valves closed and the opposite SCW train shutdown. The leak test differential pressure across the closed cross-tie valves will be established between a normal operating train with pumps in operation and a shutdown train with pumps secured. This alignment would result in the greatest potential seat leakage across the isolated valves. If the train leakage surveillance is not within allowable limits for a SCW train, that train and the opposite train will be declared inoperable. The duration of SR 3.7.9.3 test should be long enough for the installed instrumentation to accurately measure the system losses with considerations to environmental changes in temperatures effecting the thermal contraction and expansion of water in the SCWS.

Insert 3

7.6	The SCWS expansion tank maintains a reserve volume to accommodate system leakage for 7 days	Tests and analysis will be performed to verify that the SCWS expansion tank maintains a reserve volume to accommodate system leakage for 7 days.	SCWS expansion tank maintains a reserve volume of 100 gallons to accommodate system leakage for 7 days

Insert 4

7.6 The SCWS expansion tank maintains a reserve volume to accommodate system leakage for 7 days

Insert 5

3.10 Verify Expansion tank operating parameters and performance
3.10.1 Operating pressure retained in the normal band with temperature changes from high to low.
3.10.2 Alarm set points
3.10.3 SCWS pressure leak rate
3.10.4 Operating Train Auto trips on expansion tank Min-3 pressure

Insert 6

Each SCWS expansion tank will maintain a defense in depth post-seismic emergency manual makeup spool piece connection to a seismic makeup water source for 7 day water supply from the Seismic II Fire Water Distribution System inside the Nuclear Island. The seismic makeup connection is shown on Figure 9.2.8-1. The Fire Water Distribution System is designed to remain functional after a SSE as described in Section 9.5.1.2.1.

Insert 7

Provide backup water supply to the SCWS expansion tanks after seismic event (post 7 days)

Insert 8

The SCWS expansion tank pressure indication is transmitted to the MCR for the provision of real time trending data on expansion tank pressure and volume equivalent to identify leakage. This provides the operators the ability to take corrective action prior to exceeding the maximum allowed 7 day train leakage. The pressure differential in equivalent inches of water is obtained from the pressure indication at the top and bottom of the tank.

Surveillance Requirement 3.7.9.3 is written to verify SCWS train leakage on a 24 month frequency. Plant procedures and controls associated with SR 3.7.9.3 and leakage trending will be implemented by the COL applicant.

- Fluctuations in the supplied electrical frequency.
- Increased pipe roughness due to aging and fouling.
- Fouled debris filters.
- Maximum pressure drop through the system heat exchangers.
- Minimum water level in the expansion tank considers net positive suction head to prevent cavitation of the SCWS pump and prevent vortex effects.

RAI 356, Q 9.2.2-91

Determination of the discharge head of the pumps is based on dynamic pressure losses and head losses of the mechanical equipment of the associated SCWS at full load operation.

Air-Cooled Chiller Refrigeration Unit

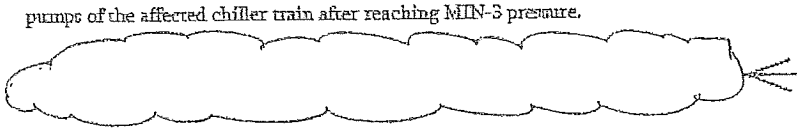
SCWS, Trains 1 and 4, each contain one air-cooled chiller refrigeration unit that functions to refrigerate chilled water to its design basis temperature of 41°F for supply to the system users. These chillers are located in dedicated rooms of the SBs. Each chiller contains a condenser, compressors, evaporator, and associated piping and controls. Environmentally safe refrigerants are used in these chillers.

Water-Cooled Chiller Refrigeration Unit

SCWS, Trains 2 and 3, each contain one water-cooled chiller refrigeration unit that functions to refrigerate chilled water to its design bases temperature of 41°F for supply to the HVAC users. These chillers are located in dedicated rooms of the SBs. Each chiller contains a condenser, compressors, evaporator, and associated piping and controls. Environmentally safe refrigerants are used in these chillers.

Diaphragm Expansion Tank

Each SCWS train contains a diaphragm expansion tank with a nitrogen fill connection in each of the SBs. The expansion tank provides for changes in volume pump NPSH, and establishes a point of reference pressure for the closed-loop system. These tanks are provided with relief valve overpressure protection. The expansion tank nitrogen maintains the operating static pressure to keep the highest point in the SCWS filled. The expansion tank pressure also keeps the SCWS pump suction pressure well above the fluid vapor pressure to enhance available NPSH. The normal water volume in the expansion tank allows for volume displacement due to temperature changes and operating transitions. A complete loss of nitrogen or water volume in an expansion tank will close the cross-tie valves on MIN-2 pressure and trip the SCWS operating pumps of the affected chiller train after reaching MIN-3 pressure.



INSERT 1

SURVEILLANCE REQUIREMENTS

SR 3.7.9.1

This SR is modified by a Note indicating that the isolation of the SCW components or systems may render those components inoperable, but does not affect the OPERABILITY of the SCW System.

Verifying the correct alignment for manual, power operated, and automatic valves in the SCW flow path provides assurance that the proper flow paths exist for SCW System operation. This SR does not apply to valves that are locked, sealed, or otherwise secured in position, since they are verified to be in the correct position prior to being locked, sealed, or secured. This SR does not require any testing or valve manipulation; rather, it involves verification that those valves capable of being mispositioned are in the correct position. This SR does not apply to valves that cannot be inadvertently misaligned, such as check valves.

Verifying the correct alignment for manual, power operated, and automatic valves in the SCW flow path provides assurance that the proper flow paths exist for SCW System operation. This SR does not apply to valves that are locked, sealed, or otherwise secured in position, since they are verified to be in the correct position prior to being locked, sealed, or secured. This SR does not require any testing or valve manipulation; rather, it involves verification that those valves capable of being mispositioned are in the correct position. This SR does not apply to valves that cannot be inadvertently misaligned, such as check valves.

The 31 day Frequency is based on engineering judgment, is consistent with the procedural controls governing valve operation, and ensures correct valve positions.

SR 3.7.9.2

This SR verifies proper automatic operation of the SCW train on an actual or simulated actuation signal. The SCW System is a normally operating system that cannot be fully actuated as part of routine testing during normal operation. The 24 month Frequency is based on the need to perform this Surveillance under the conditions that apply during a unit outage. Operating experience has shown that these components usually pass the Surveillance when performed at the 24 month Frequency. Therefore, the Frequency is acceptable from a reliability standpoint.

Insert 2

REFERENCES

1. FSAR Section 9.2.8.

Table 2.7.2-3—Safety Chilled Water System ITAAC
(6 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
7.1	The SCWS chiller refrigerating units shown on Figure 2.7.2-1, have the capacity to provide chilled water at the temperature to support the heat removal requirements of each user.	Tests and analyses will be performed to demonstrate the capability of the SCWS chiller refrigerating units to provide chilled water at a temperature to support the heat removal requirements of all users.	The SCWS chiller refrigerating units have the capacity to provide chilled water at the required temperature of 41°F.
7.2	The pumps listed in Table 2.7.2-1 have NPSHA that is greater than NPSHR at system run-out flow.	Testing will be performed to verify NPSHA for pumps listed in Table 2.7.2-1.	The pumps listed in Table 2.7.2-1 have NPSHA that is NPSHR at the minimum expansion tank level.
7.3	The SCWS delivers water to the equipment listed in Table 2.7.2-1.	Tests and analyses will be performed to determine the SCWS delivery rate under operating conditions.	The SCWS delivers at least the following flowrate to the equipment listed in Table 2.7.2-1. - 30 QKA 10/20/30/40 AP107: 565 gpm - 30 QKA 10/20/30/40 AP108: 565 gpm
7.4	Class 1E valves listed in Table 2.7.2-2 perform the function listed in Table 2.7.2-1 under system operating conditions.	Tests and analyses or a combination of tests and analyses will be performed to demonstrate the ability of the valves listed in Table 2.7.2-2 to change position as listed in Table 2.7.2-1 under system operating conditions.	The valve changes position as listed in Table 2.7.2-1 under system operating conditions.
7.5	The SCWS has provisions to allow full flow testing during plant operation.	Testing of flow of the SCWS through the recirculation loop back to the pump suction will be performed.	The flow test line allows full system flow through the recirculation loop back to the pump suction.

Insert 3

Next File

6.0 Environmental Qualifications

6.1 Components in Table 2.7.2-2, that are designated as harsh environment, will perform the function listed in Table 2.7.2-1 in the environments that exist during and following design basis events.

7.0 Equipment and System Performance

7.1 The SCWS chiller refrigerating units shown on Figure 2.7.2-1 have the capacity to provide chilled water at the temperature to support the heat removal requirements of each user.

7.2 The pumps listed in Table 2.7.2-1 have net positive suction head available (NPSHA) that is greater than net positive suction head required (NPSHR) at system run-out flow.

7.3 The SCWS delivers water to the equipment listed in Table 2.7.2-1.

7.4 Class 1E valves listed in Table 2.7.2-2 can perform the function listed in Table 2.7.2-1 under system operating conditions.

7.5 The SCWS provides for flow testing of the chilled water circulation pumps during plant operation.

Insert 4

8.0 System Inspections, Tests, Analysis, and Acceptance Criteria

Table 2.7.2-3 lists the SCWS ITAAC.

2.5 SCWS has been tested and preserved.

3.0 TEST METHOD

3.1 Verify pump performance characteristics (e.g., head versus flow, motor current) for the SCWS pumps.

3.1.1 $NPSH_a \geq NPSH_R$.

3.1.2 Discharge head.

3.1.3 Flow corresponding to head at each point.

3.1.4 Starting time (motor start time and time to reach flow).

3.2 Demonstrate that each SCWS division can be operated from its local and remote manual control station.

3.3 Demonstrate that each SCWS division starts automatically in response to each appropriate signal.

3.4 Verify that the chillers supply chilled water at the rated flow and design conditions.

3.5 Verify chilled water flow to each supplied component.

3.6 Verify alarms, interlocks, indicating instruments, and status lights are functional.

3.7 Verify system baseline performance during HFT.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.9 Verify that pump starts/stops, valve realignments, closing of the cross-connects occur without introducing water hammer.

Insert 5

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.7.9.1	----------NOTE---------- Isolation of SCW flow to individual components does not render the SCW System inoperable. --- Verify each SCW manual, power operated, and automatic valve in the flow path servicing safety related equipment, that is not locked, sealed, or otherwise secured in position, is in the correct position.	31 days
SR 3.7.9.2	Verify, on an actual or simulated loss of offsite power signal, each SCW train restarts following re-energization of the associated AC electrical power division.	24 months
SR 3.7.9.3	Verify train leakage for each SCW train less than .5 gallons per hour	24 months

A manually operated make up demineralized water supply is used when water loss resulting from operational measures (e.g., venting and draining) is indicated by an expansion tank pressure instrument.

The SCWS is treated with hydrazine in low concentration for corrosion control. Monitoring of the water chemistry is provided by means of local sampling.

9.2.8.3.2 Abnormal Operation

In the event of a DBA with concurrent loss of offsite power (LOOP) the operating train of a divisional pair receives a "Start" signal to return the operating train to operation after load shed. If an active single failure occurs (assume either the EDG fails to start or the SCW train pump or chiller does not re-start), then the standby train receives a "Start" signal. This sequence confirms that one train of a divisional pair is operating. At or before the end of 24 hours post DBA, the cross-tie isolation valves are manually isolated to protect against a passive failure.

The SCWS is powered from the emergency diesel generators (EDG) and continues to function during a DBA. Trains 1 and 4 of the SCWS provide a heat sink to ~~system users and~~Division 1 and 4 LHSI pumps and HVAC systems in the event of a severe accident or station blackout (SBO). Trains 1 and 4 are powered from motor control centers that are re-powered by the station blackout diesels during an SBO event.

INSERT 6

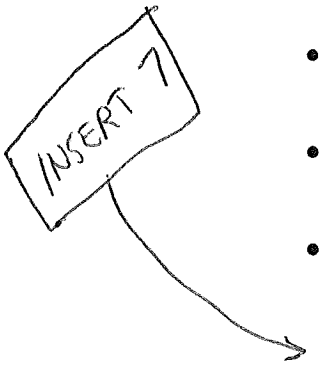
~~Under seismic or post-accident conditions, when demineralized water may be unavailable for SCWS makeup, a manual connection to the fire water distribution system is available to provide a seismic makeup source within a time frame consistent with the SCWS expansion tank capacity to accommodate expected out-leakage from the system for seven days.~~

A mechanical or electrical failure of the running SCWS pump results in a transfer to the standby pump.

Each refrigeration chiller in the four trains of the SCWS has three 50 percent capacity compressors to provide sufficient operating redundancy and flexibility in the event of a compressor failure. The two remaining chiller compressors provide 100 percent capacity as described in Section 9.2.8.2.1.

To allow divisional maintenance (e.g., maintenance on emergency diesel generators), the required SCWS safety-related components are alternately fed from the adjacent division to provide adequate cooling of certain safety-related components during a design basis event.

- Isolate combustible materials and limit the spread of fire by subdividing plant buildings into fire areas separated by fire barriers.
- Provide the capability to rapidly detect, control, and promptly extinguish fires that do occur.
- Provide protection for structures, systems, and components (SSC) important to safety so that a fire, not promptly extinguished, will not prevent the safe shutdown of the plant or result in the release of radioactive materials to the environment.
- Maintain one success path of SSC necessary to achieve safe shutdown conditions (i.e., cold shutdown) free of fire damage assuming all equipment in any one fire area will be rendered inoperable by fire, and post-fire re-entry for repairs or operator actions is not possible. Because of its physical configuration, the main control room (MCR) is excluded from this approach, but an independent alternative shutdown capability that is physically and electrically independent of the MCR is included in the design.
- Provide fire protection features for redundant shutdown systems in the Reactor Building (RB) that will make sure to the extent practicable that one success path of SSC necessary to achieve safe shutdown conditions (i.e., cold shutdown) is free of fire damage.
- Separate redundant trains of safety-related equipment used to mitigate the consequences of a design basis accident (but not required for safe shutdown following a fire) so that a fire within one train will not damage a redundant train.
- Prevent smoke, hot gases, or fire suppressant agents from migrating from one fire area to another to the extent they could adversely affect safe shutdown capabilities, including operator actions.
- Prevent failure or inadvertent operation of the FPS from impairing the safety capability of SSC important to safety.
- Preclude the loss of structural support, due to warping or distortion of building structural members caused by the heat from a fire, to the extent that such a failure could adversely affect safe shutdown capabilities.
- Provide floor drains sized to remove expected firefighting water flow without flooding safety-related equipment.



- Provide firefighting personnel access and life safety escape routes for each fire area.
- Provide emergency lighting and communications to facilitate safe shutdown following a fire.
- Limit the radiological release to any unrestricted area due to the direct effects of fire suppression activities (but not involving fuel damage) to as low as reasonably achievable and to not exceed applicable regulatory limits.

MIN-3 pressure is below the seven day normal makeup margin, but high enough to provide sufficient NPSH and prevent pump cavitation and still retain sufficient inventory margin in the expansion tank.

If the system experiences excessive leakage in excess of system makeup capability, the cross-tie isolation MOVs ~~close~~ on Low-2 system pressure. The non-operating ~~standby~~ train ~~automatically starts on Low-2 pressure~~. The train without excessive leakage returns to pressure and the train with excessive leakage is manually stopped from the DCS.

If the pressure falls to MIN-3, the following measures are initiated automatically for the affected train:

- Chilled water system "Protection OFF" alarms. The MIN-3 system pressure setpoint trip occurs before the pressure corresponding to the minimum required available NPSH is reached.
- Refrigeration unit shuts down.
- Chilled water circulating pump shuts down.

A humidity sensor is installed in the nitrogen region of the diaphragm expansion tank. This sensor issues a MAX-1 alarm indicating a leaky diaphragm if humidity exceeds a set limit.

To provide a constant water flow through the evaporator for the refrigeration unit, a controlled bypass is implemented between chilled water feed and chilled water return by means of a control valve. The controlled variable is differential pressure across the chiller evaporator.

The affected chilled water system pump and chiller is deactivated by a "Protection OFF" command in the case of the following faults:

- Pump failure.
- MIN-3.
- Minimum pressure limit for the system.
- Emergency power condition–under-voltage shutdown.

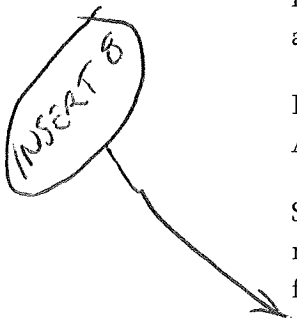
In the event of a DBA with LOOP the operating chiller and pumps will restart automatically after power is restored. In the event the operating train fails, the opposite stand-by train starts within one minute. In the event that the cross-tie valves close with one pump running in the operating SCWS division, the second standby pump starts within one minute if the running pump fails.

9.2.8.5 Inspection and Testing Requirements

Prior to initial plant startup, a comprehensive performance test will be performed to verify that the design performance of the system and individual components is attained. Refer to Section 14.2, Test #052, for initial plant testing of the SCWS.

After the plant is brought into operation, periodic tests and inspections of the SCWS components and subsystems are performed to verify proper operation. Scheduled tests and inspections are necessary to verify system operability.

The installation and design of the SCWS provides accessibility for the performance of periodic inservice inspection and testing. Periodic inspection and testing of safety-related equipment verifies its structural and leak tight integrity and its availability and ability to fulfill its functions.



Inservice inspection and testing requirements are in accordance with Section XI of the ASME Code (Reference 1) and the ASME OM Code (Reference 2).

Section 3.9.6 and Section 6.6 describe the inservice testing and inspection requirements, respectively. Refer to Section 16.0, Surveillance Requirement (SR) 3.7.9 for surveillance requirements that verify continued operability of the SCWS.

9.2.8.6 Instrumentation Requirements

The SCWS system is controlled by the safety automation system (SAS). The normal indication, manual control, and alarm functions are provided by the process information and control system (PICS). Instrument display location, and input to alarm and automatic or manual functions for instruments shown in Figure 9.2.8-1 are provided in Table 9.2.8-3.

An automatic switchover to operate the opposite chiller train occurs if the chilled water flow through the evaporator reaches a MIN-2 set point for the running train. Then, if the cross-tie valves are open and the opposite chiller is in stand-by, the opposite (non-running) chiller pumps are started. When differential pressure across the opposite chiller evaporator is greater than MIN-1, then the opposite chiller is automatically started and the initial running chiller train is stopped manually from the MCR.

System pressure is monitored with the aid of two pressure measurements for each train. The two measurements are combined in one measuring point. If the pressure falls to MIN-1, an alarm is issued for operators to check nitrogen charge or provide makeup with demineralized water. The SCWS expansion tank MIN-1 pressure alarm is below the lowest normal system operating pressure with sufficient margin to avoid a spurious alarm. SCWS expansion tank MIN-2 pressure is below MIN-1, but above the inventory margin required for seven days of normal operation. SCWS expansion tank