ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Monday, August 16, 2010 2:48 PM
To: Tesfaye, Getachew
Cc: Hearn, Peter; KOWALSKI David (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA)
Subject: FW: DRAFT RESPONSES FOR FSAR Chapter 9 Weekly NRC Telecon
Attachments: Blank Bkgrd.gif; DRAFT RESPONSE RAI 351 Q.09.02.05-30 (e).pdf; DRAFT RESPONSE RAI 361 Q.09.02.02-101.pdf

Importance: High

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Subject: DRAFT RESPONSES FOR FSAR Chapter 9 Weekly NRC Telecon
Importance: High

Marty:

Please transmit to Getachew Tesfaye the attached partial set of DRAFT responses to RAI 351 and 361 questions. If the NRC reviewers have sufficient time to review these responses, they can be discussed at tomorrow's (8/17/10) FSAR Chapter 9 Weekly Telecon/GoToMeeting with the NRC, or can be scheduled for a future telecon.

Attached are the following DRAFT response(s):

- Response to RAI 351 - Question 09.02.05-30 (Part e).
- Response to RAI 361 - Question 09.02.02-101.

Note that these DRAFT responses have not been through the final Licensing review/approval process; nor do they reflect technical editing.

Please call me if you have any questions. Thanks.

David J. Kowalski, P.E.

Principal Engineer
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Response to

Request for Additional Information No. 351(4112, 4163), Revision 1

01/15/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 09.02.05 - Ultimate Heat Sink
SRP Section: 09.05.01 - Fire Protection Program

Application Section: FSAR Chapter 9

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

Question 09.02.05-30:

Follow-up to RAI 175, Question 9.2.5-17:

Standard Review Plan (SRP) 9.2.5 Section III, paragraph 1 requires confirmation of the overall arrangement of the ultimate heat sink (UHS). The staff reviewed the descriptive information, arrangement, design features, environmental qualification, performance requirements, and interface information provided in Tier 1 Final Safety Analysis Report (FSAR) Section 2.7.11 to confirm completeness and consistency with the plant design basis as described in Tier 2 Section 9.2.5. The staff found that the Tier 1 information is incomplete, inconsistent, inaccurate, or that clarification is needed with respect to the following considerations:

a. Although the Introduction Section in Chapter 1 of the Tier 1 FSAR states that the information in the Tier 1 portion of the FSAR is extracted from the detailed information contained in Tier 2, the staff found that much of the information provided in FSAR Tier 1 is not described in Tier 2 FSAR Section 9.2.5 (e.g., equipment locations, valve functional requirements, indication and control information, priority actuation and control system description and functions, automatic actuation and interlock details, valve failure modes, and harsh environment considerations). This Tier 1 information needs to be added to Tier 2.

b. FSAR Tier 1 does not stipulate that the ultimate heat sink (UHS) is accessible for performing periodic inspections as required by General Design Criteria (GDC) 45.

c. FSAR Tier 1 does not stipulate that the UHS design provide for flow testing of makeup water for accident and emergency conditions.

d. FSAR Tier 1 does not stipulate that the essential service water system (ESWS) pumps are protected from debris from the cooling towers.

e. FSAR Tier 1 does not stipulate that the safety related UHS outdoor piping is adequately protected from the elements and postulated hazards.

f. Tier 1, Figure 2.7.11-1, “Essential Service Water System Functional Arrangement,” does not show nominal pipe sizes for the UHS, which are necessary for design certification. This table does not show design information for the UHS fans.

g. Tier 1, Table 2.7.11-2, “Essential Service Water System Equipment I&C and Electrical Design,” does not include information pertaining to the UHS fans and corresponding power supplies.

h. The point of Note 2 for Tier 1, Table 2.7.11-2 is not clear since it does not appear to pertain to anything on the table. However, this appears to be due to an oversight whereby dedicated ESWS components are not listed in the table.

i. The discussion under Item 6 Tier 1 of Table 2.7.11-2 related to environmental qualification is inconsistent with the information provided in Table 2.7.11-2 in that no equipment is listed in the table for harsh environment considerations.

Based on the staff’s review of the applicant's response to RAI 9.2.5-17 (ID1817/6814) AREVA #175, Supplement 3, the following were determined as unresolved and needed further clarification/resolution by the applicant.

The applicant's response to Item (b) focuses on inservice inspection requirements, while the question that was asked focuses on the requirement specified by 10 CFR 50, Appendix A, General Design Criterion (GDC) 45. GDC 45 requires that “the cooling water system shall be designed to permit appropriate periodic inspections of important components, such as heat exchangers and piping, to assure the integrity and capability of the system.” Therefore, the capability to perform periodic inspections of important components needs to be described in FSAR Tier 2 and ITAAC need to be established to confirm this aspect of the design.

With regard to the response to Item (d), the staff does not agree that screens and filters that are solely for equipment protection are not safety significant. Filters and screens are relied upon to ensure that debris, aquatic organisms, and other material that find their way into the cooling tower basins do not adversely impact the capability of the essential service water system and ultimate heat sink to perform their safety functions. Without the screens and filters, pumps and valves can be damaged and rendered inoperable, heat exchanger tubes and cooling tower spray nozzles can become clogged, and heat transfer surfaces can become fouled. Therefore, ITAAC are needed to confirm the installation and proper mesh size of the filters and screens that are relied upon. Additionally, FSAR Tier 2 Sections 9.2.1 and 9.2.5 need to be revised to describe important filter and screen design specifications such as maximum allowed differential pressure and mesh size, including the bases for these specifications.

The response to Item (e) indicates that the UHS does not have any safety-significant outdoor piping within the scope of design certification. Based on this, the staff agrees that ITAAC are not needed to confirm adequate protection of exposed equipment. However, ITAAC are needed to confirm that ESWS and UHS piping and components are not exposed to the elements and postulated hazards. Additionally, based upon further review, the staff found that additional information needs to be included in the FSAR to address freeze protection considerations, especially for divisions that are in standby and for those parts of the cooling tower that are exposed and vulnerable to cold weather conditions.

The response to Item (f) refers to a response that was provided to RAI 9.2.1-22 (AREVA RAI No. 119, Supplement 1). The response indicates that line sizing details will be identified later in the design process. Consequently, this item remains open pending submittal of the information that was requested and a schedule for providing this information needs to be established.

In response to second part of Item (f), the applicant stated that design information for the UHS fans will be added to FSAR Tier 1, Table 2.7.11-2, “Essential Service Water System Equipment I&C and Electrical Design,” as part of the response to Item (g) of this RAI. The staff noted that the FSAR markup of Table 2.7.11-2 does not specify alternate power supplies for the two fans in Essential Service Water (ESW) Building 4. In this regard, additional information is needed to explain why an alternate power source is not specified for the ESW Building 4 cooling tower fans since they are necessary to support operation of the dedicated ESW train. The dedicated ESW train is provided to mitigate accidents that are beyond the design basis when normal backup power may not be available. Therefore, the applicant should specify an alternate power source for these fans similar to that shown for several other dedicated ESW train components in FSAR Tier 1 Table 2.7.11-2.

Response to Question 09.02.05-30:

Item (e)

Pumps, piping, valves and other components essential to the operation of the UHS are located within the boundary of the ESWPB. As stated in Tier 2 Section 9.4.11, the ESWPB ventilation system maintains a minimum temperature. Moreover, the ESWS riser is located within the ESWPB and then branches off laterally to the spray nozzle headers above the cooling tower fill. The lateral branches are designed to be self draining when they are not in operation. Other piping and instrumentation subject to freezing conditions are provided with freeze protection design features, such as heat tracing. FSAR section 9.2.5.4 will be revised to include this freeze protection design feature.

ITAAC 2.1 and 2.2 in Tier 1 Table 2.7.11-3 confirm the as-built ESWS and UHS conform to the functional arrangement as shown on Tier 1 Figure 2.7.11-1 and are located as listed in Tier 1 Table 2.7.11-1. ITAAC 6.1 in Tier 1 Table 2.6.13-3 verifies the capability of the ESWPB ventilation system to maintain the ambient temperature in the ESWPB. Thus, ITAAC 2.1, 2.2 and 6.1 confirm the arrangement of the design and the capability of the ventilation system.

As stated in Tier 2 Section 9.2.5.4, "The cooling tower bypass piping provides a means for diverting ESW return flow directly to the tower basin under low load/low ambient temperature conditions to maintain ESW cold water temperature within the established limits and to protect against freezing." Moreover, Tier 2 Section 2.4.7 explains that the cooling tower basin water temperature is monitored for all four ESW trains, regardless of operational status. In the event that basin water temperature drops to 40°F, an alarm alerts the operator to bring the train into bypass operation to prevent the formation of ice in the basin.

ITAAC 2.1 Tier 1 Table 2.7.11-3 confirms the as-built ESWS and UHS conforms to the functional arrangement as shown on Tier 1 Figure 2.7.11-1. Thus, ITAAC 2.1 confirms the arrangement of the cooling tower bypass.

The cooling tower fans provide freeze protection for the cooling tower air inlets as explained in the previously accepted response to RAI 351 9.2.5-25 part 4.

As stated in Tier 2 Section 14.2 Test 049 and Section 16 SR 3.7.19.3, an initial test and a periodic surveillance confirm the fan is capable of operating in the reverse direction.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 9.2.5.4 will be revised as described in the response and indicated on the enclosed markup.

Insert 1

Pumps, piping, valves and other components essential to the operation of the UHS are located within the boundary of the ESW pump building. As stated in Tier 2 Section 9.4.11, the ESW pump building ventilation system maintains a minimum temperature. Moreover, the ESWS riser is located within the ESW pump building and then branches off laterally to the spray nozzle headers above the cooling tower fill. The lateral branches are designed to be self draining when they are not in operation. Other piping and instrumentation subject to freezing conditions are provided with freeze protection design features, such as heat tracing.

conditions, and with the highest essential service water (ESW) heat load for a 72-hour period, without incurring pump damage during operation.

UHS tower blowdown is automatically secured during the initial 72-hour post-accident period through system instrumentation and control design features, so the only significant system water inventory losses are due to evaporation, tower drift, and valve seat leakage and seepage.

Meteorological conditions resulting in the maximum evaporative and drift loss of water for the UHS over a 72-hour period are presented in Table 9.2.5-3—Design Values for Maximum Evaporation and Drift Loss of Water from the UHS[1].

Meteorological conditions for the U.S. EPR that result in minimum cooling tower cooling that are the worst combination of controlling parameters (wet bulb and dry bulb), including diurnal variations for the first 24 hours of a DBA LOCA, are presented in Table 9.2.5-4 and do not result in a maximum ESWS supply temperature from the UHS basin exceeding 95°F.

9.2.5.4 System Operation

The safety related ESWS pumps cooling water from the cooling tower basin to supply ESWS loads and back to the mechanical draft cooling tower. The four safety-related divisions of the UHS are powered by Class 1E electrical buses and are emergency powered by the emergency diesel generators (EDG).

The non-safety-related dedicated ESWS pumps cooling water from the division four cooling tower basin to the dedicated system heat load and back to the division four mechanical draft cooling tower during SA and beyond DBAs.

The cooling tower fans are driven with multi-speed drives that are capable of fan operation in the reverse direction. Consistent with vendor recommendations, the fan may be operated in the reverse direction for short periods to minimize ice buildup at the air inlets. Cooling tower fans operating in the reverse direction during normal operation are considered operable at the onset of a design basis accident (DBA). Upon receipt of a safety injection (SI) signal, any fans operating in the reverse direction are secured and brought to a complete stop before re-energizing to operate at full speed in the forward direction. Upon receipt of an SI signal, fans in the operating and standby trains are automatically set to full fan speed to dissipate the maximum heat load to the environment. The cooling tower bypass piping provides a means for diverting ESW return flow directly to the tower basin under low load/low ambient temperature conditions to maintain ESW cold water temperature within established limits and to protect against freezing.

Based on the increase in heat removal during a DBA, a temperature of less than or equal to 90°F is maintained in the UHS basin during normal operation, so that the cooling tower basin temperature does not exceed 95°F.

9.2.5.5 Safety Evaluation

The UHS pump buildings and cooling towers are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles and other natural phenomena. Section 3.3, Section 3.4, Section 3.5, Section 3.7 and Section 3.8 provide the basis for the adequacy of the structural design of these structures. The aboveground piping and components are protected by the structures.

The UHS is designed to remain functional after a safe shutdown earthquake (SSE). Section 3.7 and Section 3.9 provide the design loading conditions that are considered. Section 3.5, Section 3.6 and Section 9.5.1 provide the hazards analyses to verify that a safe shutdown, as outlined in Section 7.4, can be achieved and maintained.

The four division design of the UHS provides complete redundancy; therefore a single failure will not compromise the UHS system safety-related functions. Each division of UHS is independent of any other division and does not share components with other divisions or with other nuclear power plant units.

Considering preventative maintenance and a single failure, two UHS divisions may be lost, but the ability to achieve the safe shutdown state under DBA conditions can be reached by the remaining two UHS divisions. In case of LOOP the four UHS cooling towers have power supplied by their respective division EDGs. Isolation valves can isolate non-safety-related portions of the system if necessary without compromising the safety-related function of the system.

The cooling towers must operate for a nominal 30 days following a LOCA without requiring any makeup water to the source or it must be demonstrated that replenishment or use of an alternate or additional water supply can provide continuous capability of the heat sink to perform its safety-related functions. The tower basin contains a minimum 72-hour supply of water. After the initial 72 hours, the site specific makeup water system will provide sufficient flow rates of makeup water to compensate for system volume losses for the remaining 27 days. The normal and emergency blowdown isolation valves provide automatic isolation of the ESWS from downstream non-safety-related blowdown piping under DBA conditions to prevent loss of ESW inventory. The ESW emergency makeup water system also provides isolation of the normal makeup water system from the tower basins under DBA conditions to prevent loss of ESW inventory.

The heat load after 72 hours post-DBA is lower than the peak heat load due to a reduction in the decay heat from the reactor. Consequently, the makeup flow rate required after 72 hours is lower than the peak condition. Since the UHS basin contains

RAI 361

Question 09.02.02-101:

Follow-up to RAI 174, Question 09.02.02-53

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. Based on the staff's review of the applicant's response to RAI 174, Question 9.2.2-53, Supplement 5 and information provided in the associated markup of the Final Safety Analysis Report (FSAR), Section 9.2.8, "Safety Chilled Water System" the staff found a significant design change to the system. The safety chilled water system (SCWS) design now utilizes "cross-ties" between Trains 1 and 2 and between Trains 3 and 4, instead of the independent four-train system structure utilized in the original design. In order to satisfy the above requirements, address the following regarding instrumentation and controls (I&C):

a. Clarify the difference between a single pump tripping/failing and multiple pumps tripping/failing along with the logic for maintaining the proper flow to ensure adequate cooling for both trains.
   1. Table 2.7.2-3, "Safety Chilled Water ITAAC," Item 4.4 states that the standby chiller and its pump(s) start on a trip of the running chiller or its pump(s). Describe the SCWS response (i.e. how many pumps start) on a loss of a single pump in the operating train. Also describe the SCWS response to a loss of both pumps in the operating train.
   2. Final Safety Analysis Report (FSAR) Section 9.2.8.6 states that the affected chilled water system train is deactivated by "pump" failure. Clarify if this is deactivation occurs for the loss of a single pump or requires loss of both pumps.

b. FSAR Section 9.2.8.6 indicates the cross-tied loops isolate on low-low system pressure. The staff requests that the applicant address if there is a similar isolation based on low expansion tank level. If not, describe the SCWS would response to a slow leak of the inventory lost but no activation of the low-low pressure trip.

c. Technical Specification (TS) Bases B3.7.9 states that the chiller standby units start on trip of the running chiller. Address the SCWS response to increasing temperatures if the running chiller is overloaded or degraded but not tripped.

d. Address any I&C logic associated with the motor-operated cross-tie valves (auto-close or auto-open) if applicable.

Response to Question 09.02.02-101:

a. For full load, cross-tie operation of SCWS, two pumps in the operating train are required to operate. If one pump fails, the standby train is automatically started and the operating train is manually stopped from the MCR.

   As indicated in the response to RAI 356 Supplement 4, Question 09.02.02-86 markup of FSAR Tier 2, Section 9.2.8.6:

"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."

As indicated in the response markup to FSAR Tier 2, Section 9.2.8.6 for RAI 356 Supplement 4 Question 09.02.02-92, "In the event the operating train fails, the opposite stand-by train starts within one minute." This means that within one minute of the fault signal that initiates the automatic switchover sequence, the pumps and the chiller in the standby train will start.

As indicated in the response markup to FSAR Tier 2, Section 9.2.8.6 for RAI 356 Supplement 4 Question 09.02.02-93, "Running pumps will trip on a pump fault, chiller fault, low evaporator flow (MIN-2), or MIN-3 pressure in the expansion tank. In cross-tie operation, any of these faults causes a switchover to the standby train in the divisional pair. In cross-tie operation, the switchover occurs for failure of a single pump or for simultaneous failure of two pumps in the operating train

The SCWS is designed to withstand the effects of running opposing pumps during auto switchover sequence. During the switchover, at least one bypass control valve in the divisional pair will be operating, which will bypass some of the excess pump flow.

As indicated in response markup to U.S. EPR FSAR Tier 2, Section 9.2.8.2.2 for RAI 356 Supplement 4 Question 09.02.02-86, "The design pressure is based on the total of pump shut-off head, the operating static pressure, and the lowest elevation in the SCWS."

As indicated in the response for RAI 361 Supplement 1 Question 09.02.02-98, "The initial testing program will include testing to verify that auto train swap to standby train due to pump/chiller failure does not indicate evidence of water hammer."

As indicated in the response for RAI 361 Supplement 1 Question 09.02.02-100, "FSAR Chapter 14.2 will be revised to include parallel pump testing as part of the initial test program."

SCWS is a closed loop system. Flow direction is from the SCWS pumps discharge, through the chiller unit, to the user heat exchangers, and back to the suction side of the pumps. Reverse flow in the system is prevented by a check valve in each pump discharge line.

The following additional information will be added to U.S. EPR FSAR Tier 2, Section 9.2.8.6.

The following automatic functions represent the generic steps in train switchover and will be performed or validated as a result of the abnormal condition in the affected train.

- Standby train prerequisites are met for train startup
- Cross-tie MOVs are open-Validate MOV position
- Start Standby Train Pump 1
- Start Standby Train Pump 2
- Start Standby Train Chiller Unit
- Enable the control loop for the differential pressure across the evaporator which starts system flow regulation by the bypass control valve in the standby train.
- Enable the pressure monitoring loop for system pressure

Annunciation will occur on automatic switchover.

Once the standby train is in operation, the following actions will be initiated manually from the control room to stop the previously operating train.

- Standby train is in operation – Validate operation
- Stop Operating Chiller (if running)
- Stop Operating Train Pump 1 (if running)
- Stop Operating Train Pump 2 (if running)
- Disable the operating train pressure monitoring loop for system pressure
- Close the operating train bypass control valve
- Disable the operating train control loop for differential pressure across the evaporator

b. SCWS pressure is maintained by the nitrogen pressure in the tank. There is no permanently connected nitrogen source and nitrogen supply is not connected during normal operation, so the effect of a nitrogen leak would be the same as a slow water leak. There is no similar isolation based on low expansion tank level. A slow leak of the inventory would activate a low pressure alarm. The operator would check nitrogen charge, check for water leaks and provide makeup water.

Refer to response to RAI 356 Question 09.02.02-86b for additional information on SCWS instrumentation.

c. The chiller evaporator outlet temperature is monitored. An alarm occurs if temperature reaches high set point. An automatic switchover to the standby train occurs if temperature reaches high–high set point.

d. Refer to response to RAI 174 Supplement 5, Question 09.02.02-53 markup of US EPR FSAR Tier 2, Section 9.2.8.6.
"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."

As indicated in the response to RAI 356 Supplement 4, Question 09.02.02-86 markup of FSAR Tier 2, Table 9.2.8-3, in the table:
Function = "MIN-2 (pressure) Manual Isolation Div. 1 and 2 (for divisional pair 3 and 4 – "Manual Isolation Div. 3 and 4"). Purpose = "MIN-2 alarm alerts operators to close cross-tie valves for inventory protection of a division".

FSAR Impact:

a. The U.S. EPR FSAR Tier 2, Section 9.2.8.6 will be revised as described in the response and indicated in the attached markup.

b. The U.S. EPR FSAR will not be changed as a result of this question.

c. The U.S. EPR FSAR Tier 2, Section 9.2.8.6 will be revised as described in the response and indicated in the attached markup.

d. The U.S. EPR FSAR will not be changed as a result of this question.

possible leakage of radioactive fluid from the heat exchanger. Otherwise, migration of radioactive material from potentially radioactive systems is prevented with a minimum of two heat exchanger barriers. Radiation monitors are in the CCWS to detect radioactive contamination entering and exiting the system.

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.

Insert 1

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.

Insert 2

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 ~~below a set limit~~to MIN-1, an alarm is issued for operators to check nitrogen

Revised IAW RAI 361 Q 09.02.02-101

Insert 1 to U.S. EPR FSAR Tier 2, Section 9.2.8.6
RAI 361 Q 09.02.02-101c

The chiller evaporator outlet temperature is monitored. An alarm occurs if temperature reaches high set point. An automatic switchover to the standby train occurs if temperature reaches high–high set point.

Insert 2 to U.S. EPR FSAR Tier 2, Section 9.2.8.6
RAI 361 Q 09.02.02-101a

The following automatic functions represent the generic steps in train switchover and will be performed or validated as a result of the abnormal condition in the affected train.

- Standby train prerequisites are met for train startup
- Cross-tie MOVs are open-Validate MOV position
- Start Standby Train Pump 1
- Start Standby Train Pump 2
- Start Standby Train Chiller Unit
- Enable the control loop for the differential pressure across the evaporator which starts system flow regulation by the bypass control valve in the standby train.
- Enable the pressure monitoring loop for system pressure

Annunciation will occur on automatic switchover.

Once the standby train is in operation, the following actions will be initiated manually from the control room to stop the previously operating train.

- Standby train is in operation – Validate operation
- Stop Operating Chiller (if running)
- Stop Operating Train Pump 1 (if running)
- Stop Operating Train Pump 2 (if running)
- Disable the operating train pressure monitoring loop for system pressure
- Close the operating train bypass control valve
- Disable the operating train control loop for differential pressure across the evaporator