ArevaEPRDCPEm Resource

From: Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
Sent: Tuesday, March 03, 2009 3:40 PM
To: Getachew Tesfaye
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); PANNELL George L (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 58 (954), Supplement 1
Attachments: RAI 58 Supplement 1 Response US EPR DC.pdf

Getachew,

On October 10, 2008, AREVA NP provided a schedule for responding to the 2 questions of RAI No. 58. The attached file, ""RAI 58 Supplement 1 Response US EPR DC" provides technically correct and complete responses to the remaining 2 questions, as committed.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 58 Questions 07.06-1 and 07-06-2.

The following table indicates the respective pages in the response document, "RAI 58 Supplement 1 Response US EPR DC," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 58 — 07.06-1	2	4
RAI 58 — 07.06-2	5	5

This concludes the formal AREVA NP response to RAI 58, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Ronda Pederson
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From: Pederson Ronda M (AREVA NP INC)
Sent: Friday, October 10, 2008 6:55 PM
To: 'Getachew Tesfaye'
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DUNCAN Leslie E (AREVA NP INC); PANNELL George L (AREVA NP INC); DELANO Karen V (AREVA NP INC); WELLS Russell D (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 58 (954), FSAR Ch7

Getachew,

The attached file, “RAI 58 Response US EPR DC.pdf” provides an interim response to each of the 2 questions.

A complete answer is not provided for either of the 2 questions.

A complete response to each of the questions will be provided by December 1, 2008.

Sincerely,

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From: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, September 12, 2008 5:56 PM
To: ZZ-DL-A-USEPR-DL
Cc: Joseph Ashcraft; Terry Jackson; Michael Canova; Joseph Colaccino; John Rycyna
Subject: U.S. EPR Design Certification Application RAI No. 58 (954), FSAR Ch7

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on August 26, 2008, and on September 5, 2008, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
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Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 280

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Response to

Request for Additional Information No. 58 (954), Revision 0

9/12/2008

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 07.06 - Interlock Systems Important to Safety
Application Section: 07.06 - Interlock Systems Important to Safety
ICE1 Branch

Question 07.06-1:

Demonstrate why using the pressurizer safety relief valves (PSRVs) operating in their low temperature overpressure protection (LTOP) mode and the spring-loaded safety valves on the residual heat removal (RHR) suction lines is an acceptable method to address Item 2 of Standard Review Plan, Branch Technical Position (BTP) 7-1, to prevent over pressurization of the RHR system. Demonstrate how this approach addresses DC FSAR, Tier 2 Section 15.8.1.1, “US EPR Design Features,” which requires implementation of interlocks and preventive actions that cope with deviations from normal operation to prevent an event from resulting in the actuation of a safety system.

10 CFR Part 50, Appendix A, General Design Criterion 15, "Reactor Coolant System Design," requires, in part, that the reactor coolant system and associated auxiliary, control, and protection systems shall be designed with sufficient margin to ensure that the design conditions of the reactor coolant system pressure boundary are not exceeded during any condition of normal operation, including anticipated operational occurrences. BTP 7-1 provides acceptance criteria for partially meeting the above criterion. Specifically, Item 2 of BTP 7-1 states that valve operators should receive a signal to close automatically whenever the primary system pressure exceeds the subsystem design pressure.

DC FSAR, Tier 2 Section 7.1.2.5.1 states that the applicable I&C systems listed in Table 7.1-2 are designed to meet the guidance of BTP 7-1, with the exception that the applicable RHR valves are not automatically shut upon re-pressurization of the reactor coolant system. The RHR suction valve interlocks and a justification for this approach are described in Section 7.6.1.2.1. DC FSAR, Tier 2 Section 7.6.1.2.1 states that when RHR is connected, an inadvertent increase in reactor coolant system pressure does not result in an automatic signal to close the RHR reactor coolant pressure boundary isolation valves. However, the PSRVs operating in their LTOP mode and the spring loaded safety valves on the RHR suction lines prevent the increasing pressure from exceeding the RHR system design pressure.

During an intentional increase in pressure, when either RCS temperature or pressure exceed the P14 permissive setpoint, the operator is prompted to acknowledge the P14 permissive and allowed to close the RHR reactor coolant pressure boundary isolation valves. Pressure protection now requires P17 permissive for LTOP to be active. DC FSAR, Tier 2 Section 7.1.3.12 states “Cold leg temperature (WR) measurements are compared to a Setpoint (248 °F). When three out of four measurements are less than the setpoint, the operator is prompted to manually validate the permissive.”

Response to Question 07.06-1:

U.S. EPR FSAR Tier 2, Section 7.6.1.2.1 cites two design features: the PSRVs operating in LTOP mode and the spring loaded safety valves in the RHR suction lines. When the RHR is connected, the opening of the medium head safety injection (MHSI) large miniflow lines must also be considered when evaluating potential overpressure events at low temperature.

U.S. EPR FSAR Tier 2, Section 7.6.1.2.4 describes an interlock function that holds open the MHSI large miniflow lines when the P17 permissive is validated. The MHSI large miniflow lines limit the discharge head that can be developed by the MHSI pumps. The interlock is provided for low temperature over-pressure protection of the reactor pressure vessel in case of SI actuation at low temperatures. The MHSI large miniflow valves are also interlocked in the open

position when permissive P14 is validated and any train of RHR is connected to the reactor coolant system. This second interlock using the MHSI large miniflow lines is provided to prevent over-pressurization of the RHR system when RCS temperatures are below the P14 value and above the P17 value. U.S. EPR FSAR Tier 2, Sections 7.6.1.2.1 and 7.6.1.2.4 will be revised to include this functionality.

The RHR system can only be connected to the RCS below the P14 RCS temperature value. Below the P14 temperature, over-pressure protection of the RHR system is provided differently in two different RCS temperature regimes, as described below. In both temperature regimes, a start of four MHSI pumps with one MHSI large miniflow line valve failed in the closed position is the limiting pressure addition event.

<u>P14 temp. > RCS temp. > P17 temp.</u>

- When P14 is validated and one or more trains of RHR are connected to the RCS, the MHSI large miniflow lines are interlocked in the open position.
- The design pressure of the RHR piping that must be protected is 945 psia.
- The opening setpoint of the RHR spring loaded safety valves is 815 psia.
- The delivery head of a MHSI pump with its large miniflow line open is 580 psia.
- A single failure of one MHSI large miniflow line to open is assumed.

During a pressure increase due to the failed closed large miniflow valve of one of the MHSI pumps, by the time RCS pressure reaches the RHR safety valve opening setpoint, the three MHSI pumps with open large miniflow lines are no longer able to inject due to the higher RCS pressure caused by the single MHSI pump with its large miniflow valve closed. Therefore the other three MHSI pumps re-circulate through their miniflow lines to the in-containment refueling water storage tank (IRWST). This leaves the one MHSI pump with its (failed) closed large miniflow line injecting into the RCS. The RHR spring loaded safety valves are sized based on the pressure and flow rate of one MHSI pump, with large miniflow line closed, injecting into the RCS while RHR is connected.

The RHR safety valves along with the interlock holding the large miniflow lines of three of the four MHSI pumps open provide over-pressure protection of the RHR system in this temperature regime.

<u>P17 temp. > RCS temp.</u>

- When P17 is validated, LTOP for the reactor pressure vessel (RPV) via two pressurizer safety relief valves (PSRV) is activated. Additionally, the MHSI large miniflow valves are interlocked in the open position.
- The LTOP setpoints for opening PSRVs are staggered at 540 psia and 556 psia.

The PSRVs, while preventing RPV brittle fracture, also prevent overpressure of the connected RHR system. The PSRV setpoints and sizing are based on the pressure and flow rate of four MHSI pumps, with one miniflow line closed, injecting into the RCS. The PSRVs along with the interlock holding the large miniflow lines open provide over-pressure protection of the RHR system when RCS temperature is below the P17 value.

U.S. EPR FSAR Tier 2, Section 15.8 addresses U.S. EPR compliance with requirements related to anticipated transients without scram (ATWS). To be clear, the statement quoted from U.S. EPR FSAR Tier 2, Section 15.8.1.1 in this RAI question does not relate to automatic closing of RHR isolation valves, and provides no commitment or requirement for any specific functionality. The statement is provided as general background information to support EPR compliance with ATWS requirements as indicated by the heading of U.S. EPR FSAR Tier 2, Section 15.8.1, "General Background."

However, the approach described above for preventing over-pressurization of the RHR system is consistent with the quoted statement. An interlock is provided to hold open the MHSI large miniflow lines so that an automatic action (i.e., automatic closure of RHR suction valves on increasing pressure) is not needed to protect RHR from overpressure.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 7.6.1, Section 7.6.1.2.1, Section 7.6.1.2.4, and Figure 7.6-3 will be revised as described in the response and indicated on the enclosed markup.

Question 07.06-2:

Demonstrate how the U.S. EPR design addresses the acceptance criteria in Branch Technical Position (BTP) 7-2 of the Standard Review Plan. Specifically, what is the position of isolation valve between the P12 permissive and >1000 psi. What impact does a SI signal have on the system between the P12 permissive and >1000 psi.

Clause 6.6 of IEEE Std. 603-1991 states, in part, that whenever the applicable permissive conditions are not met, a safety system shall automatically prevent the activation of an operating bypass or initiate the appropriate safety functions. BTP 7-2, specifically Item 4, states that the following feature should be incorporated into the design of the motor-operated isolation valve systems for safety injection tanks: Utilization of a safety injection signal to remove automatically (override) any bypass feature that may be provided to allow an isolation valve to be closed for short periods of time when the reactor coolant system is at pressure (in accordance with provisions of the technical specifications).

DC FSAR, TIER 2, Section 16.0 - Tech Spec B3.05, Accumulators B 3.5-1, states for an accumulator to be considered OPERABLE, the isolation valve must be fully open, power removed above 2000 psig, ……. APPLICABILITY In MODES 1 and 2, and in MODE 3 with RCS pressure > 1000 psig, the accumulator OPERABILITY requirements are based on full power operation.

Although cooling requirements decrease as power decreases, the accumulators are still required to provide core cooling as long as elevated RCS pressures and temperatures exist. This LCO is only applicable at pressures > 1000 psig. DCD TIER 2, Section 7.6.1.2 states that during a normal decrease in pressure, power is restored to the valves at a point in time determined by the operating procedures. Then, after RCS pressure decreases below the P12 threshold, the operator is prompted to manually acknowledge P12 which allows the isolation valves to be closed.

Address how the isolation valve will behave upon receipt of a safety injection signal, to automatically override the bypass feature that allows the valve to closed for short periods of time, when the accumulators are required to be operable.

Response to Question 07.06-2:

Upon generation of a safety injection actuation signal, with RCS pressure above 1000 psig, the accumulator isolation valves receive an ‘open’ signal. This is done because the Plant Technical Specifications allow these valves to be closed during short periods of time. U.S. EPR FSAR Tier 2, Section 7.6.1.2.2 will be revised to provide clarification.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 7.6.1.2.2 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

7.6 Interlock Systems Important to Safety

7.6.1 Description

This section describes the interlock functions important to safety that reduce the probability of occurrence of specific events, or maintain safety systems in a state that provides reasonable assurance of their availability. These interlocks are provided by instrumentation and control (I&C) functions designed to:

- Prevent over-pressurization of the residual heat removal (RHR) system when reactor coolant system (RCS) pressure and temperature are higher than the allowable values for RHR connection.
- Maintain the availability of the safety injection (SI) accumulators above specific RCS pressure conditions.

07.06-2

- Maintain separation between redundant component cooling water system (CCWS) trains.
- Prevent over-pressurization of the RCS and connected RHR system in case of SI actuation during low temperature operations.~~Prevent over-pressurization of the RCS in case of SI actuation during low temperature operations.~~

7.6.1.1 System Description

The control logic for these interlock functions is processed by the protection system (PS), with the exception of the interlocks to maintain separation between redundant CCWS trains. The control logic for the CCWS interlocks is processed by the safety automation system (SAS). The relevant control logic for each function is described in Section 7.6.1.2.

When plant conditions dictate that an interlock be activated, the interlock signal is sent from the PS or SAS to the priority and actuator control system (PACS). While the interlock signal is present, the PACS prevents an override of the interlock by actuation or control orders having a lower priority than the interlock function. When plant conditions are such that an interlock can be removed, the PS or SAS removes the interlock signal and the PACS allows the actuator to be influenced by other control systems. Further discussion of the operation of the PACS is presented in Section 7.1.

The capability to perform manual actions related to these interlocks (i.e., acknowledgement of permissive signal status) is provided on both the process information and control system (PICS) and the safety information and control system (SICS). Manual actions taken from the SICS have priority over those from the PICS as described in Section 7.1.

07.06-2

When RHR is connected, an inadvertent increase in RCS pressure does not result in an automatic signal to close the RHR RCPB isolation valves. However, the following design features prevent an increasing pressure from exceeding the RHR system design pressure:

- Interlock holding the MHSI large miniflow lines open (see Section 7.6.1.2.4).
- Pressurizer safety relief valves operating in their LTOP mode (see Section 7.3.1.2.13).
- Spring loaded safety valves on the RHR suction lines.

~~However, the pressurizer safety relief valves (PSRV) operating in their low-temperature overpressure protection (LTOP) mode (Section 7.3.1.2.13), and spring-loaded safety valves on the RHR suction lines prevent the increasing pressure from exceeding the RHR system design pressure.~~ During an intentional increase in pressure, when either RCS temperature or pressure exceed the P14 setpoint, the operator is prompted to acknowledge P14, and is then allowed to close the RHR RCPB isolation valves.

The operational status of the PS on a divisional basis is provided to the operator. Indications and alarms are provided to the operator regarding the state of the permissive P14 signal. Additionally, the following indications are provided to the operator to verify correct operation of the interlock:

- Open or closed position of ~~1st~~ first RHR RCPB isolation valve (each train).
- Open or closed position of second ~~2nd~~ RHR RCPB isolation valve (each train).

7.6.1.2.2 Safety Injection Accumulator Interlocks

There are four accumulators, one associated with each of the four independent SIS trains. Borated water is injected into the RCS from the accumulators when RCS pressure falls below the internal pressure of the accumulators.

The operation of the SI accumulators is described in Section 6.3.

Each accumulator is connected to the cold leg injection line of its respective RCS loop through two check valves and a motor operated isolation valve in series. Each isolation valve is interlocked to remain open above a specified RCS pressure value. This pressure value is the permissive P12 threshold.

Generation of the P12 permissive signal is described in Section 7.2.1.3.

Normally, the operator opens the isolation valves when RCS pressure exceeds accumulator pressure. Regardless, when ~~When~~ RCS pressure increases above the P12

threshold, the PS provides automatic signals to open the accumulator isolation valves. Once the valves are verified to be in the open position, control power is removed from the valves to prevent inadvertent closure. During a normal decrease in pressure, power is restored to the valves at a point in time determined by the operating procedures. Then, after RCS pressure decreases below the P12 threshold, the operator is prompted to manually acknowledge P12, which allows the isolation valves to be closed before RCS pressure is reduced below the accumulator pressure.

07.06-1

A pressure region exists below the P12 pressure threshold where the accumulators are required to be available but Plant Technical Specifications allow an accumulator isolation valve to be closed for a short period of time. To accommodate operation in this pressure region, an automatic 'open' signal is sent to the accumulator isolation valves when an SIS actuation occurs. The SIS actuation function is described in Section 7.3.1.2.

Two redundant ALU within a division send the automatic opening signal to the isolation valve of the corresponding accumulator (i.e., PS division one opens the isolation valve related to the train 1 accumulator). This arrangement precludes a single actuator logic unit (ALU) failure from preventing the opening of a valve. Any other single failure which could prevent opening of a valve, such as failure of a priority actuation and control (PAC) module or of the valve itself, is detected immediately by failure of the valve to open. Corrective actions can then be taken before continued increase in pressure.

The operational status of the PS on a divisional basis is provided to the operator. Indications and alarms are provided to the operator regarding the state of the P12 permissive signal. Additionally, the following indications are provided to the operator to verify correct operation of the interlock:

- Pressure and level of each accumulator.
- Open or closed position of each accumulator isolation valve.

7.6.1.2.3 Interlocks Isolating Redundant CCWS Trains

The CCWS is comprised of four closed-loop, safety-related supply trains that function to cool and transfer heat load from safety users to the heat sink. The common loads cooled by the CCWS consist of two separate sets, referred to as Common-1 and Common-2. The Common-1 header is supplied by either CCW train one or train two while the Common-2 header is supplied by either CCW train three or train four. Each common header is further divided into two sub-headers designated as Common 1a and 1b or Common 2a and 2b.

The operation of the CCWS is described in Section 9.2.2.

inadvertent connection of redundant CCWS trains. Each valve is equipped with redundant open/closed position sensors so that a single sensor failure does not result in inadvertent connection of redundant CCWS trains. While each switchover valve is controlled by one I&C division, multiple PAC modules in that division, acting on multiple solenoid devices, are required in order to change the position of a switchover valve. Therefore, a single PAC module failure does not result in inadvertent connection of redundant CCWS trains. For the CIV interlock, redundancy is obtained through the use of inner and outer CIVs, each controlled by a different division of I&C.

The single failure tolerance of the CCWS with respect to availability of the required cooling function is encompassed within the redundancy of the mechanical system design, as described in Section 9.2.2.

The following indications are provided to the operator relative to this interlock:

- Indication of open or closed position of each interlocked valve.
- Alarm indicating position conflict between supply and return switchover valve of the same CCWS train relative to the same common header.
- Alarm indicating position conflict between CIVs of the same common header.
- Alarm indicating connection of two CCWS trains to the same common header.

7.6.1.2.4 Interlocks to Provide Low Temperature Over-Pressure Protection

07.06-2

Low temperature RCPB overpressure events include mass input events and heat input events. Section 5.2.2 describes LTOP for the U.S. EPR design. An interlock is provided to support brittle fracture protection in case of a safety injection actuation during low temperature operation, which is the limiting case.

The medium head safety injection (MHSI) pumps are used to inject borated water from the in-containment refueling water storage tank (IRWST) into the cold legs when a safety injection signal is present. A large miniflow line branches off from the discharge side of each MHSI pump and provides a path, through a motor operated isolation valve, to the IRWST. These isolation valves are interlocked in the open position during low temperature operations to reduce the MHSI injection pressure.

Two distinct interlock functions are provided to prevent over-pressurization in case of SIS actuation during low temperature operation. One interlock is provided for protection against brittle fracture of the reactor pressure vessel (RPV). The second interlock protects the RHR system from over-pressurization when it is connected to the RCS.

07.06-2

Below the P17 temperature threshold, the large miniflow line isolation valves are interlocked in the open position to protect against brittle fracture of the RPV.

The large miniflow line isolation valves are also interlocked in the open position when RHR is connected to the RCS. The connection of RHR is detected by validation of the P14 permissive signal in conjunction with correct positioning of certain valves used by the RHR system.

Generation of the P14 and P17 permissive signals is described in Section 7.2.1.3.

Detection of the RHR connected condition is shown in Figure 7.6-3—Detection of RHR Connected.~~Below the P17 temperature threshold, the large miniflow line isolation valves are interlocked in the open position to limit the discharge pressure of the MHSI pumps. This provides protection against a fast increase in RCS pressure during cold conditions. When the P17 signal is present the PS maintains an open order, with highest priority, to all four large miniflow lines to prevent their inadvertent closure.~~

~~Generation of the P17 permissive signal is described in Section 7.2.1.3.~~

Two redundant ALU within a PS division each send the interlock signal to the large miniflow line isolation valve of one MHSI train. This arrangement precludes a single ALU failure from preventing the opening of a valve. The failure of a single PACS module~~,~~ or of a single valve is accommodated by PSRVs operating in their LTOP mode. The PSRVs provide adequate brittle fracture protection following the start of four MHSI pumps with any one large miniflow line in the closed position.

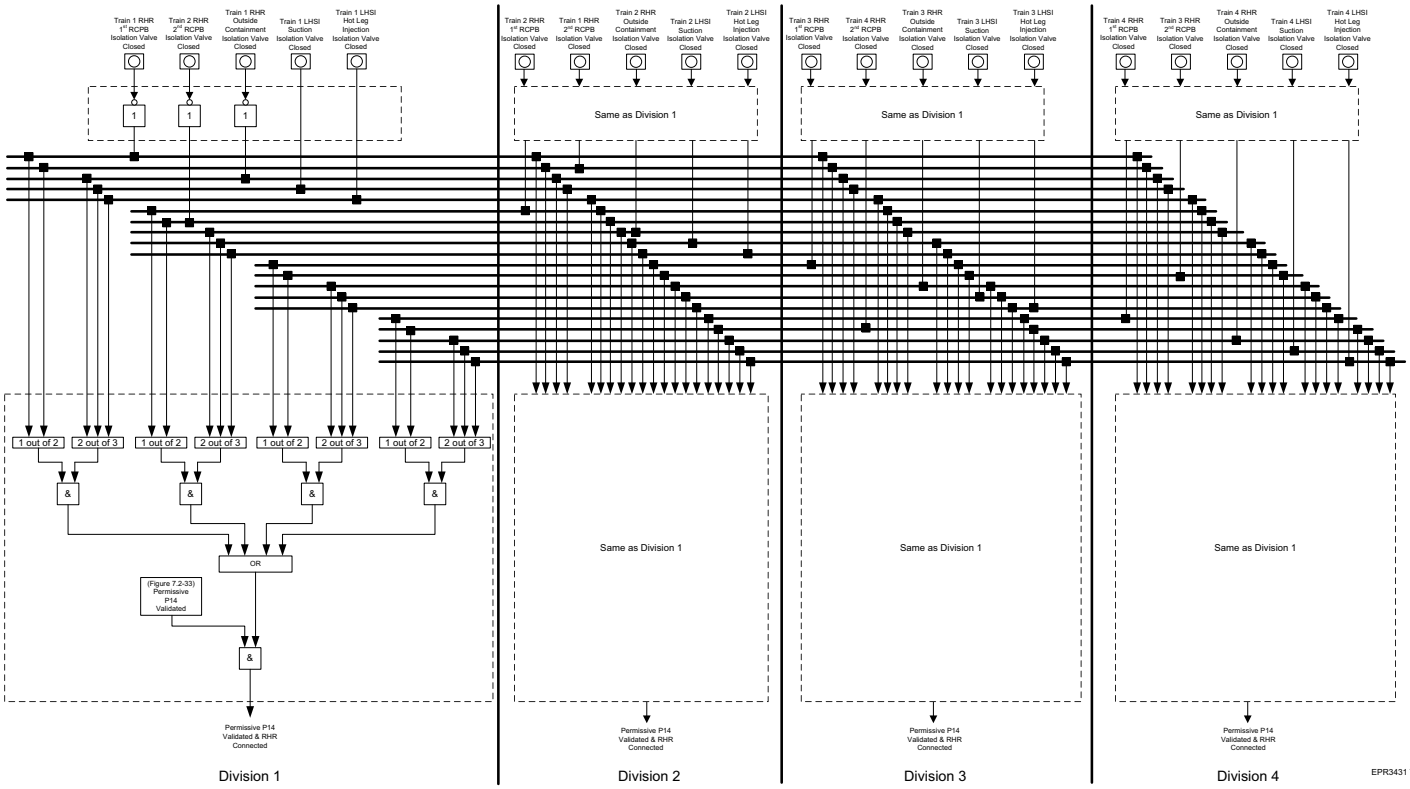
Actuation of the pressurizer safety relief valves by the PS in a LTOP capacity is described in Section 7.3.

Additionally, no single failure can prevent the isolation valve from being closed on at least one MHSI injection path during power operation when maximum MHSI discharge pressure is required.

The operational status of the PS on a divisional basis is provided to the operator. Indications and alarms are provided to the operator regarding the state of P17. Additionally, the following indications are provided to the operator to verify correct operation of the interlock:

- Open or closed position of each MHSI large miniflow line isolation valve (each train).
- Status of MHSI pump (on or off, each train).
- Open or closed position of each valve as shown in Figure 7.6-3.

Figure 7.6-3—Detection of RHR Connected



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