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MFN 06-216
Supplement 2

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 34 –Auxiliary Systems– RAI Numbers 9.3-16 S01, 9.3-17 S01, 9.3-18 S01, and 9.3-19 S01**

Enclosure 1 contains GEH's response to the subject NRC RAI transmitted via Reference 1 which is a supplemental request to the RAIs transmitted via Reference 2. The original RAI response was submitted to the NRC via Reference 3.

If you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

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NRO

Reference:

1. E-mail dated March 11, 2007, from NRC to GE.
2. MFN 06-198, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 34 Related to the ESBWR Design Certification Application*, June 22, 2006.
3. MFN 06-216, Letter from GE to U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information Letter 34 Related to ESBWR Design Certification Application – Auxiliary Systems – RAI Numbers 9.3-3 through 9.3-10 and 9.3-12 through 23,* July 19, 2006.

Enclosure:

1. MFN 06-216, Supplement 2 – Response to Portion of NRC Request for Additional Information Letter No. 34 – RAI Numbers 9.3-16 S01 through 9.3-19 S01

cc:	AE Cubbage	USNRC (with enclosure)
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Enclosure 1

MFN 06-216
Supplement 2

Response to Portion of NRC Request for
Additional Information Letter No. 34
Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Number 9.3-16 S01, 9.3-17 S01,
9.3-18 S01, and 9.3-19 S01

For historical purposes, the original text of RAIs 9.3-16 through 9.3-19 and the GE responses are included.

NRC RAI 9.3-16

Why are the following items are not included in the ITAAC:

(a) The SLCS can be manually initiated from the main control room

(b) Both trains of the SLC system are automatically initiated during an ATWS

(c) Injection valve shutoff after injection

(d) Accumulator relief valve set point

(e) Add the following if applicable: " In the SLC system, independence is provided between Class 1E divisions, and also between Class 1 E divisions and non-Class 1E equipment.

(f) Add the following: motor operated valves (MOVs) and squib actuated valves designated as having an active safety-related function open, close, or both open and close under system pressure, fluid flow, and temperature conditions.

(g) Physical Separation between trains

(h) PRA insights

(i) Seismic qualification

GE Response

The content and level of detail for the Tier 1 Design Descriptions and ITAAC is being addressed on a generic basis for all systems in the response to RAI 14.3-1 that will be provided under separate cover. The SLCS Tier 1 material will be revised and updated as necessary in accordance with the final response to RAI 14.3-1.

NRC RAI 9.3-16 S01

The staff reviewed the revised ITAAC and determined that the following have not been added. Please address the following portions of the SLCS that are not in the ITAAC:

a) Provisions for manual initiation of the SLCS in the MCR
b) Injection valve shutoff after injection
c) Accumulator relief valve setpoint
d) Physical separation between trains

GEH Response:

a) ITAAC item "2e" was added to Revision 3 of DCD Tier 1, Table 2.2.4-2 to address the manual initiation of the Standby Liquid Control (SLC) system in Main Control Room.
b) The squib injection valves are not capable of closure after injection. The ESBWR SLC system has been designed with redundant injection shut-off valves, which isolate upon low accumulator solution level signals using 2-out-of-4 logic. ITAAC item "9" was added to Revision 3 of DCD Tier 1, Table 2.2.4-2 to address the accumulator isolation signal for the redundant shut-off valves.
c) The accumulator relief valve setpoint is to be developed during the detailed design phase of the project in accordance with ASME requirements. This setpoint is not within the scope of Tier 2, which is the source of Tier 1. Therefore, the setpoint is not provided in Tier 1.
d) The SLC accumulators and injection lines for trains A and B are housed in separate equipment rooms. However, the physical separation ITAAC is intended for systems, which require redundant 100% capacity trains. The SLC system has two independent 50% capacity trains (not redundant).

DCD Impact

No DCD changes will be made in response to this RAI.

NRC RAI 9.3-17

DCD Tier 1, ITAAC Table 2.2.4-2, item # 2c, RPV inventory and reactor water cleanup (RWCU)/shutdown cooling (SDC) system values assumed in the calculations should be included in the ITAAC as in ABWR.

GE Response

DCD Tier 2, Rev. 1, Subsection 9.3.5.3 describes how the 25% margin for potential mixing non-uniformities in the reactor and the 15% margin for dilution by the RWCU/SDC in the shutdown cooling mode is applied to the minimum required 760 ppm equivalent natural boron concentration to establish the 1100 ppm requirement. The actual RWCU/SDC piping volume will not be established until the pipe routing is completed in the detailed design. At the time the ITAAC is confirmed, the as-built RWCU/SDC piping volume and RPV inventory will be applied to the analysis to confirm that the required 1100 ppm is provided. It is not necessary to include the assumed inventories in the ITAAC since the required concentration will be confirmed based on the as-built volumes.

No DCD changes will be made in response to this RAI.

NRC RAI 9.3-17 S01:

The staff requested that provisions be made in the ITAAC for dilution from RWCU/SDC water volumes. The licensee accounted for this by including ITAAC 2.b and 2.c, which specify different cold and hot shutdown boron concentration requirements. These design commitments are verified by analysis. The staff requires that the proposed analysis include the language "as-built" to indicate that volume contributions from RWCU/SDC are based on what is constructed, rather than what is designed.

GEH Response:

The term "as-built" is to be added to ITAAC item "2c" in DCD Tier 1, Table 2.2.4-2 for Revision 4. This clarifies that the liquid inventory from the Reactor Water Cleanup/ Shutdown Cooling (RWCU/SDC) system piping is based on the constructed system and not the designed system.

DCD Impact

DCD Tier 1, Table 2.2.4-2 is to be revised for Revision 4 as noted in the attached markup.

<u>NRC RAI 9.3-18</u>

DCD Tier 1, ITAAC Description

Add a description of the Accumulator and the squib actuated valves.

<u>GE Response</u>

With regard to changes to Tier 1 content and level of detail, please see the response to RAI 9.3-16.

<u>NRC RAI 9.3-18 S01:</u>

Please provide a supplemental response to address this specific RAI rather than referring indirectly to the response to RAI 14.3-1.

<u>GEH Response:</u>

ITAAC item "11", regarding the SLC squib injection valves, is to be added to DCD Tier 1, Table 2.2.4-2 for Revision 4. ITAAC items "1" (basic configuration) and "2a" (injectable volume) cover the description for the SLC accumulators. No additional ITAAC items are needed for the SLC accumulators.

<u>DCD Impact</u>

DCD Tier 1, Table 2.2.4-2 is to be revised for Revision 4 as noted in the attached markup.

NRC RAI 9.3-19

DCD Tier 1, ITAAC Figure 2.2.4-1

Add accumulator relief valve FO30 in addition to the vent shown for the Accumulator. Also, add the set pressure of the relief valve to the ITAAC.

Add accumulator pressure indicator in addition to the level indicator, as pressure is a critical parameter. 2500 psia is indicated in the figure. Clarify whether the 2500 psia is the normal pressure in the accumulator, the design pressure of the accumulator, or the accumulator pressure assumed in the safety analyses. Also, clarify whether the 24.5 cubic meters indicated is the design capacity of the accumulator, or the accumulator capacity assumed in the safety analyses. If these parameters are to be verified by the ITAAC, these values should be included in the ITACC Table 2.2.4-2.

Note: The ITAAC values to be verified should be the values assumed in the safety analyses.

GE Response

With regard to changes to Tier 1 content and level of detail, please see the response to RAI 9.3-16.

The accumulator pressure of 2500 psig is the design pressure. The specified volume of 24.5 m^3 is the design value for the internal volume of the accumulator.

NRC RAI 9.3-19 S01:

Please provide a supplemental response to address this specific RAI rather than referring indirectly to the response to RAI 14.3-1.

GEH Response:

The accumulator relief valve is to be added to Figure 2.2.4-1 for DCD Tier 1 Revision 4. The accumulator relief valve setpoint is to be developed during the detailed design phase of the project in accordance with ASME requirements. This setpoint is not within the scope of Tier 2, which is the source of Tier 1. Therefore, the setpoint is not provided in Tier 1.

Accumulator pressure instrumentation was added to Figure 2.2.4-1 for DCD Tier 1 Revision 3, and was shown as dual redundant. However, GEH has reevaluated the level of detail used in DCD Tier 1. While the pressure instrumentation is designed as dual redundant, GEH has chosen to show the pressure instrumentation generically in Figure 2.2.4-1 for DCD Tier 1 Revision 4. See the revised response (Revision 1) to RAI 14.3-83 S01 for further details on level of detail in DCD Tier 1, Figure 2.2.4-1 for Revision 4.

The design pressure and volume were removed from Figure 2.2.4-1 for DCD Tier 1 Revision 3. This level of detail is not required for a Tier 1 figure.

DCD Impact:

DCD Tier 1, Figure 2.2.4-1 is to be revised for Revision 4 as noted in the attached markup.

Table 2.2.4-2

ITAAC For The Standby Liquid Control System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The basic configuration of the SLC system is shown in Figure 2.2.4-1.	1. Inspections of the as built system will be conducted.	1. Report(s) exist(s) and conclude(s) that the as built SLC system conforms to the basic configuration shown in Figure 2.2.4-1.
2. The performance of the SLC system is based on the following plant parameters.	2. Analyses and tests will be performed as follows:	2. Report(s) exist(s) and conclude(s) the following:
a. Accumulator tank injectable boron solution volume $\geq 7.8\ m^3$ (2061 gal) for each train.	a. The as-built dimensions will be used in a volumetric analysis to calculate the minimum injectable boron solution volume from each accumulator tank.	a. Accumulator tank injectable boron solution volume is $\geq 7.8\ m^3$ (2061 gal) for each train.
b. The equivalent natural boron concentration for the total solution injection volume is ≥ 1600 ppm, based on the reactor in a hot shutdown condition with the liquid inventory in the RPV at the main steam line nozzle elevation.	b. An analysis will be performed to determine the equivalent natural boron concentration for the total solution injection volume based on the reactor in the hot shutdown condition with the liquid inventory in the RPV at the main steam line nozzle elevation.	b. The equivalent natural boron concentration for the total solution injection volume is ≥ 1600 ppm, based on the reactor in a hot shutdown condition with the liquid inventory in the RPV at the main steam line nozzle elevation.
c. The equivalent natural boron concentration at cold shutdown conditions for the total solution injection volume is > 1100 ppm, based on the liquid inventory in the RPV at the main steam line nozzle elevation plus the liquid inventory in the reactor shutdown cooling piping and equipment of the as-built RWCU/SDC System.	c. An analysis will be performed to determine the equivalent natural boron concentration at cold shutdown conditions for the total solution injection volume based on the liquid inventory in the RPV at the main steam line nozzle elevation plus the liquid inventory in the reactor shutdown cooling piping and equipment of the as-	c. The equivalent natural boron concentration at cold shutdown conditions for the total solution injection volume is > 1100 ppm, based on the liquid inventory in the RPV at the main steam line nozzle elevation plus the liquid inventory in the reactor shutdown cooling piping and equipment of the as-built RWCU/SDC System.

Table 2.2.4-2

ITAAC For The Standby Liquid Control System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	built RWCU/SDC System.	
d. Accumulator tank(s) with at least 12.5 wt% solution of sodium pentaborate with boron content enriched to 94% of the B_{10} isotope.	d. The solution will be tested for concentration and B_{10} enrichment.	d. The solution is at least 12.5 wt% sodium pentaborate and the B_{10} enrichment is equal to or greater than 94%.
e. The SLC system can be manually initiated from the main control room.	e. Tests will be conducted on the as-built SLC system using the manual initiation switches.	e. The SLC system initiates when the dual manual initiation switches are actuated concurrently.
f. Both trains of the SLC system are automatically initiated during an ATWS event or during a LOCA.	f. Tests will be conducted on the as-built SLC system using simulated ATWS/SLC signals and ECCS initiation signal (from SSLC/ESF or the DPS).	f. Upon receipt of the following simulated signals: (1) ATWS/SLC initiation signal or (2) ECCS initiation signal (from SSLC/ESF or the DPS), both trains of the SLC system automatically initiate.
g. On ATWS mitigation SLC initiation signal, RWCU/SDC system is sent an isolation signal via the LD&IS.	g. Tests will be conducted on the as-built SLC system using simulated ATWS/SLC initiation signal to confirm RWCU/SDC isolation signal via the LD&IS.	g. Following a simulated ATWS mitigation SLC initiation signal, an RWCU/SDC isolation signal is processed via LD&IS.

Table 2.2.4-2

ITAAC For The Standby Liquid Control System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3. The system shall be capable of delivering ≥ 5.4 m^3 of the injectable boron solution volume per each train at the average velocities given in Table 2.2.4-1 during an ATWS event with accumulator at 14.82 MPa and reactor at 8.61 MPa.	3. Tests will be conducted with water using an open vessel to demonstrate acceptable system performance. An analysis will be performed to establish test parameters, such as differential pressure, temperature and fluid densities, in order to simulate the design conditions associated with the SLC operation and to establish the acceptance criteria for the test.	3. Tests and analysis reports conclude that SLC system injects ≥ 5.4 m^3 of the injectable water volume per each train within a time period* such that the average velocities given in Table 2.2.4-1, against simulated differential pressure conditions associated with ATWS conditions are achieved. * Based on analysis for the actual test conditions.
4. The SLC system shall be capable of delivering ≥ 7.8 m^3 of the injectable boron solution volume per train to provide makeup water to the RPV in response to a Loss-of-Coolant-Accident (LOCA).	4. Tests will be conducted with water to demonstrate acceptable system performance. The test will be conducted using the same methods as in ITAAC 3.	4. SLC system injects a total volume of ≥ 7.8 m^3 of the injectable water volume per train, in response to a LOCA.
5. Injection of boron into the reactor core begins within 5 seconds of reaching a system initiation parameter setpoint.	5. Tests of the system with unborated water will be conducted by simulating a system initiation parameter signal.	5. Test report(s) document that the SLC injection into the reactor core begins within 5 seconds of reaching a system initiation parameter setpoint.
6. All power for the safety functions of SLC system are derived from the safety-related 120VAC electrical systems. Divisional assignments are made to ensure independence of redundant components.	6. Tests will be conducted after installation to confirm that the electrical power supply configurations are in compliance with design commitments.	6. Test report(s) document that the safety functions of SLC system are dependent only on safety-related power supply 120VAC and redundant components are located on separate divisions.

Table 2.2.4-2

ITAAC For The Standby Liquid Control System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. The ASME portions of the SLC system retain their integrity under internal pressures that will be experienced during service.	7. A hydrostatic test will be conducted on those portions of the SLC system that are required to be hydrostatically tested by the ASME Code.	7. Test report(s) document that the ASME portions of the SLC system conform to the requirements in the ASME Code, Subsection III.
8. Control Room alarms, indications and controls provided for the SLC system are as defined in Subsection 2.2.4.	8. Inspections will be performed on the control room alarms, indications and controls for the SLC system.	8. Alarms, indications and controls exist or can be retrieved in the Control Room as defined in Subsection 2.2.4.
9. The SLC system logic uses four independent level instrumentation channels to monitor SLC accumulator level. An accumulator injection isolation signal is initiated when any 2-out-of-4 associated level channels have tripped.	9. The accumulator level instrument channels of the SLC system shall be tested using simulated signal inputs to confirm accumulator isolation.	9. Report(s) exist(s) and conclude(s) that the SLC accumulator injection isolation logic uses four independent and redundant instrument channels to monitor level and an injection isolation signal is initiated when any 2-out-of-4 channels have tripped.

Table 2.2.4-2

ITAAC For The Standby Liquid Control System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10. Independence is provided between safety-related divisions and between safety-related divisions and nonsafety-related equipment.	10. Analyses and tests will be performed as follows: a. Test(s) will be performed to verify the electrical independence of each safety-related division. b. An inspection will be performed to verify the physical independence of the as-installed safety-related divisions and the nonsafety-related equipment. c. Test(s) will be performed to verify communication independence on each redundant network.	10. a. Report(s) exist(s) and conclude(s) that electrical independence is provided between safety-related divisions and between safety-related divisions and nonsafety-related equipment. b. Report(s) exist(s) and conclude(s) that physical independence exists between each of safety-related divisions and also between safety-related divisions and nonsafety-related equipment. c. Report(s) exist(s) and conclude(s) that) that communication independence exists between each of safety-related divisions and also between safety-related divisions and nonsafety-related equipment.
11. The SLC squib valve used in the injection will open as designed.	11. A vendor type test will be performed on a squib valve to open as designed.	11. Report(s) exist(s) and conclude(s) that SLC squib valves used in the injection will open as designed.

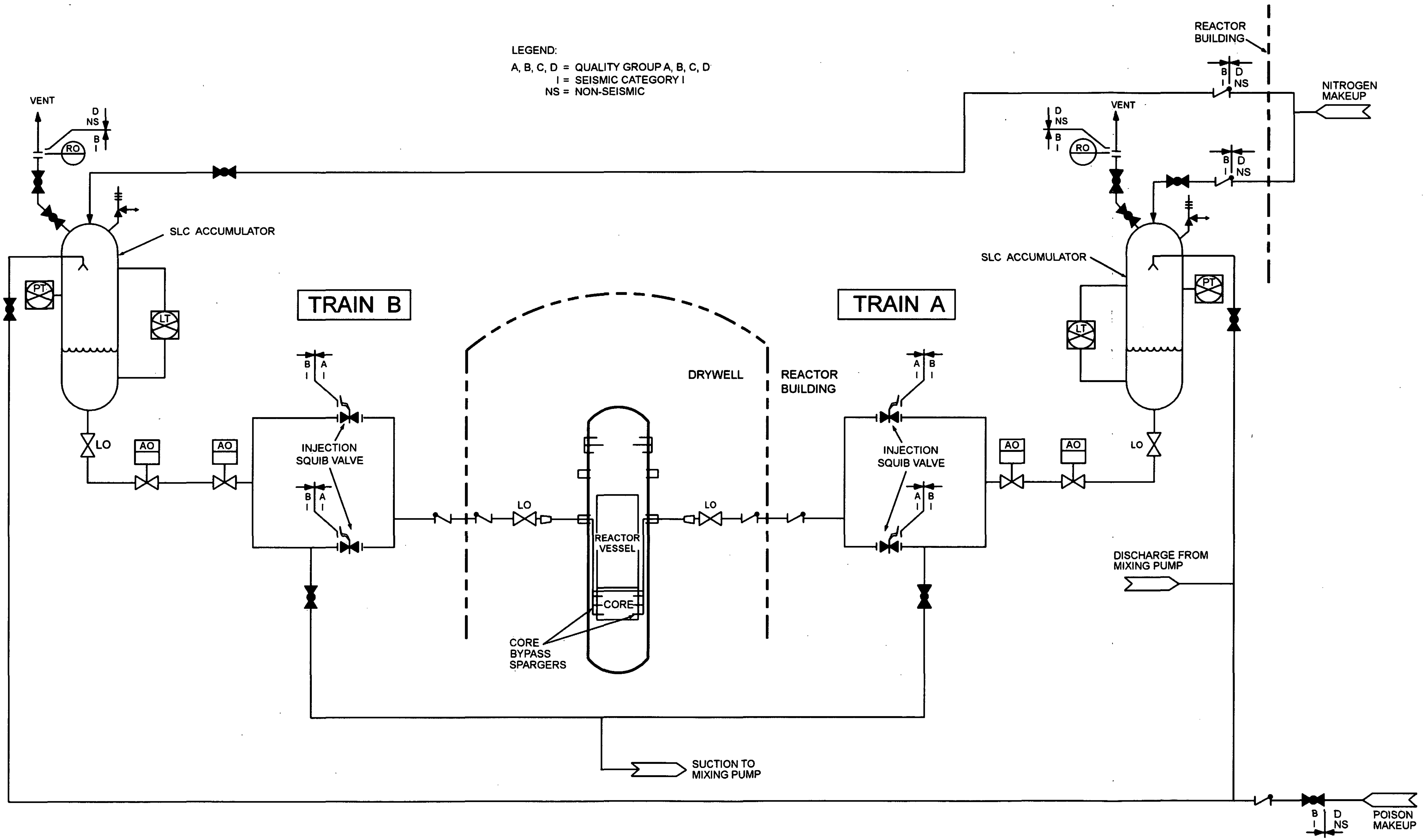
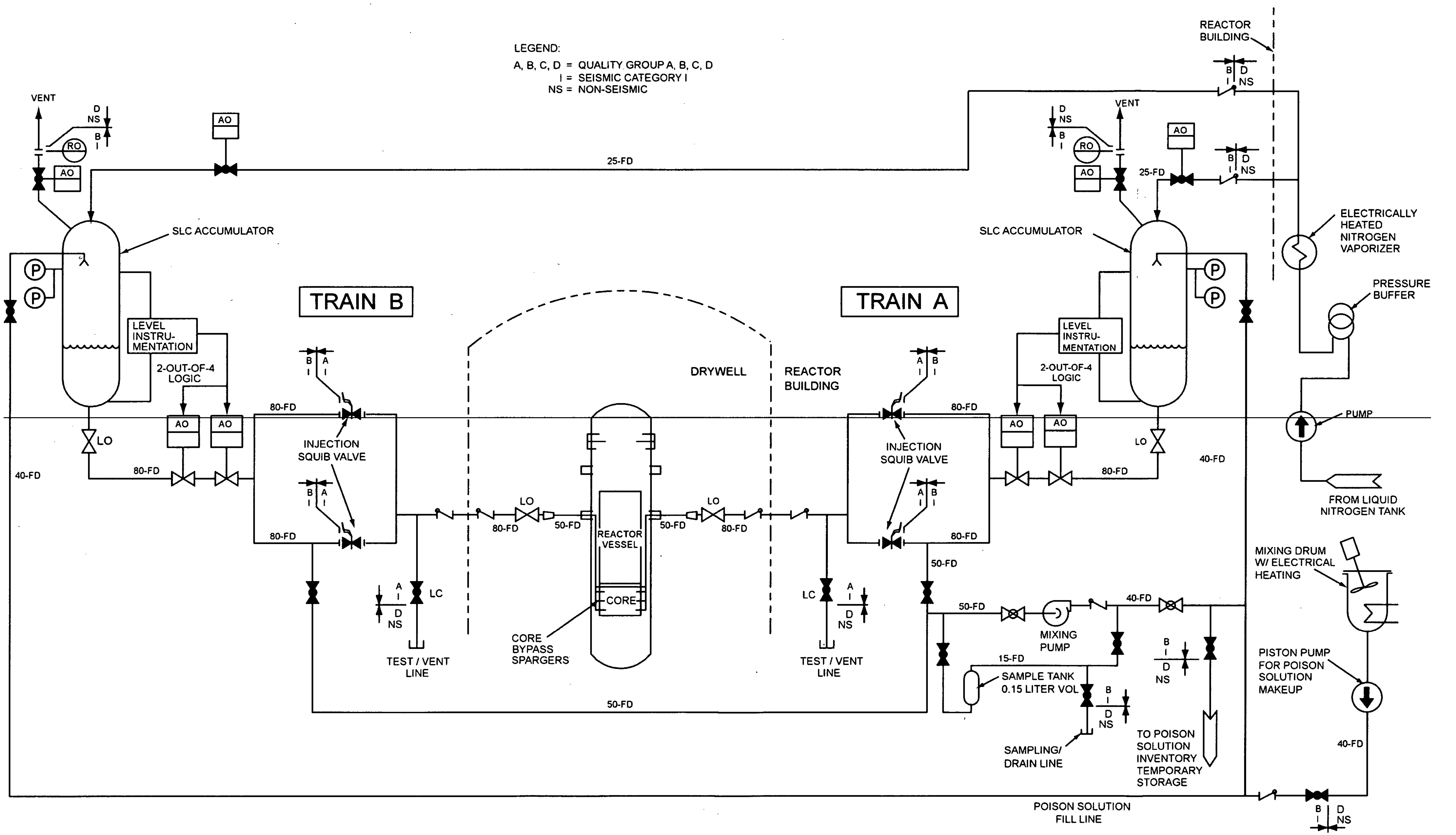


Figure 2.2.4-1. Standby Liquid Control System



~~Figure 2.2.4-1. Standby Liquid Control System~~