

2.4 Core Cooling Systems

The information in this section of the reference ABWR DCD, including all subsections, tables, and figures, is incorporated by reference with the following departures.

STD DEP T1 2.4-1 (Figure 2.4.1a, Table 2.4.1)

STD DEP T1 2.4-2

STD DEP T1 2.4-3

STD DEP T1 2.14-1 (Figure 2.4.1b, Figure 2.4.1c, Figure 2.4.3)

2.4.1 Residual Heat Removal System

STD DEP T1 2.4-1

Design Description

The RHR System operates in the following modes:

- (6) *Augmented fuel pool cooling, and fuel pool makeup (Divisions A, B, and C)*

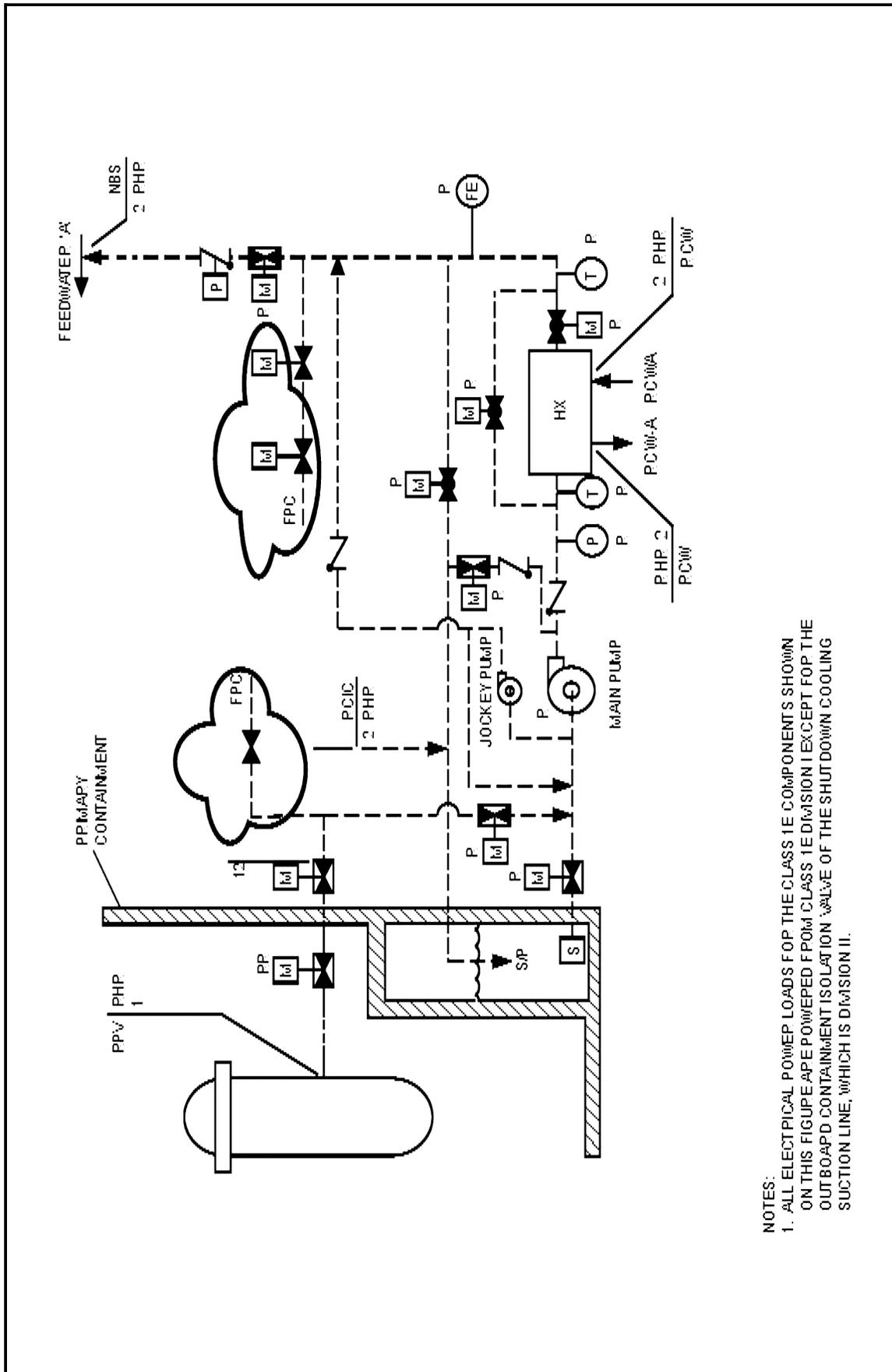
Augmented Fuel Pool Cooling and Fuel Pool Makeup

The augmented fuel pool cooling mode of the RHR System (Divisions A, B and C) can supplement the Fuel Pool Cooling (FPC) System as follows: (1) directly cooling the fuel pool by circulation fuel pool water through the RHR heat exchanger and returning it to the fuel pool; and (2) while providing shutdown cooling during refueling operations, return the cooled RHR shutdown cooling flow to the fuel pool. Also, this mode provides for fuel pool emergency makeup capability by permitting the RHR pumps (Divisions A, B and C) to transfer suppression pool water to the fuel pool. This mode is accomplished manually by control of individual system components. In the augmented fuel pool cooling mode, the RHR tube side heat exchanger flow rate for Divisions A, B or C is no less than 350 m³/h.

Other Provisions

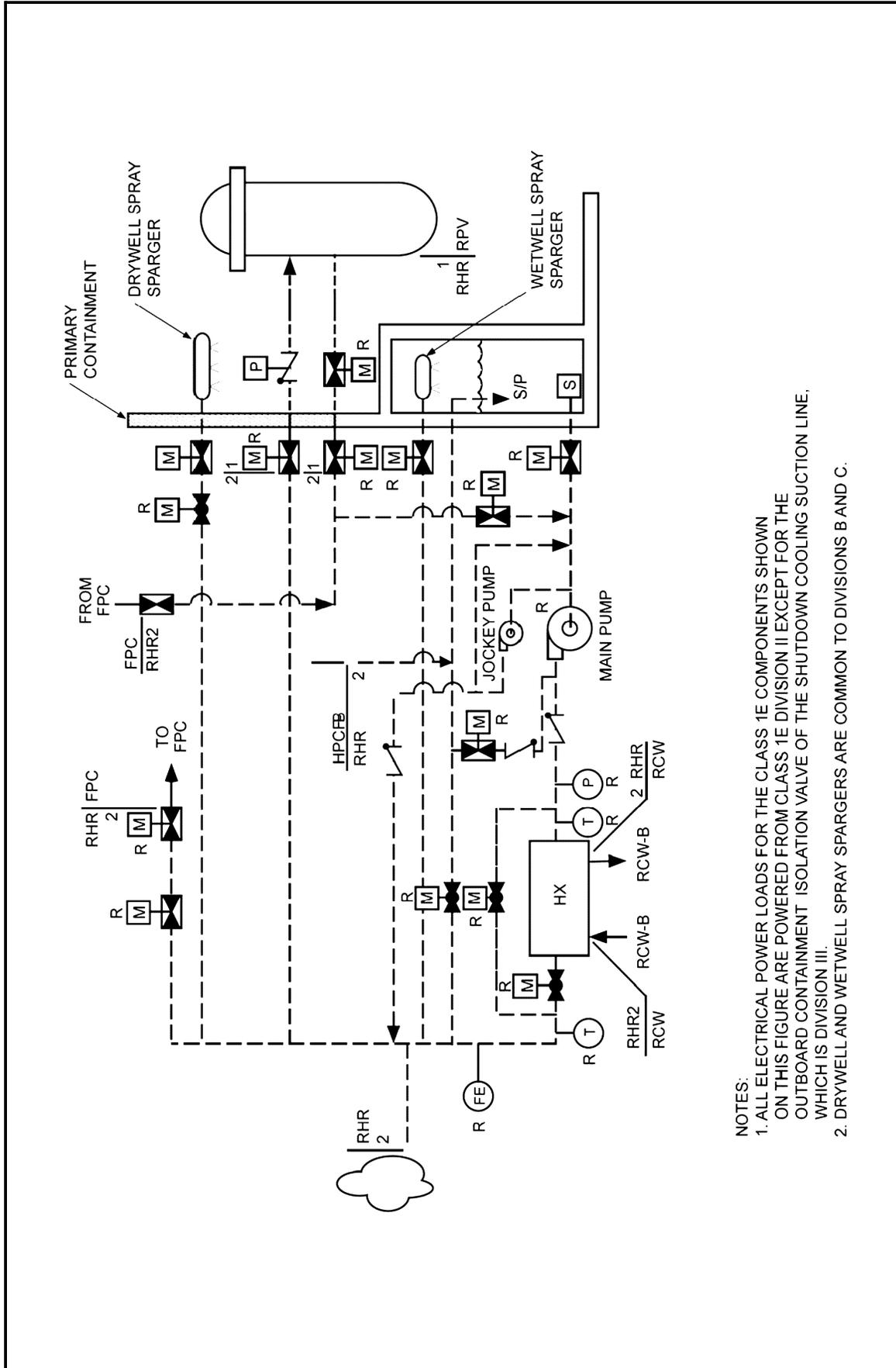
The piping and components outside the shutdown cooling suction line containment isolation valves and outside the suppression pool containment isolation valves, and upstream of the suction side of the pump with all its branches have a design pressure of 2.82 MPaG for intersystem LOCA (ISLOCA) conditions. Refer to Figures 2.4.1a, 2.4.1b, and 2.4.1c. ~~For RHR-A, the upgraded branch lines from the main pump suction include the path to and including the suppression pool suction valve, the path to the shutdown cooling outboard containment isolation valve, and the path to the jockey pump's discharge check valve including the jockey pump's bypass return line. For RHR-B and C, the upgraded branch lines include all the paths listed for RHR-A plus the path to (and including the valve) the Fuel Pool Cooling System that branches off the shutdown cooling suction line, titled "From FPC."~~ For RHR A and B, the upgraded branch lines from the main pump suction include the path to and including the suppression pool suction valve, the path to the shutdown cooling outboard containment isolation valve, the path to the jockey pump's discharge valve including the jockey pump's

bypass line and the path to the (and including the valve) the Fuel Pool Cooling System that branches off the shutdown cooling suction, titled, "From FPC". For RHR-C, the upgraded branch lines include all the paths listed for RHR-A and B plus the pipeline and valves that are part of the AC independent water addition mode that extends from the noncode boundary indicated by "NNS" to the "external connection" outside the "reactor building" and to the Fire Protection System interface indicated by "FP".



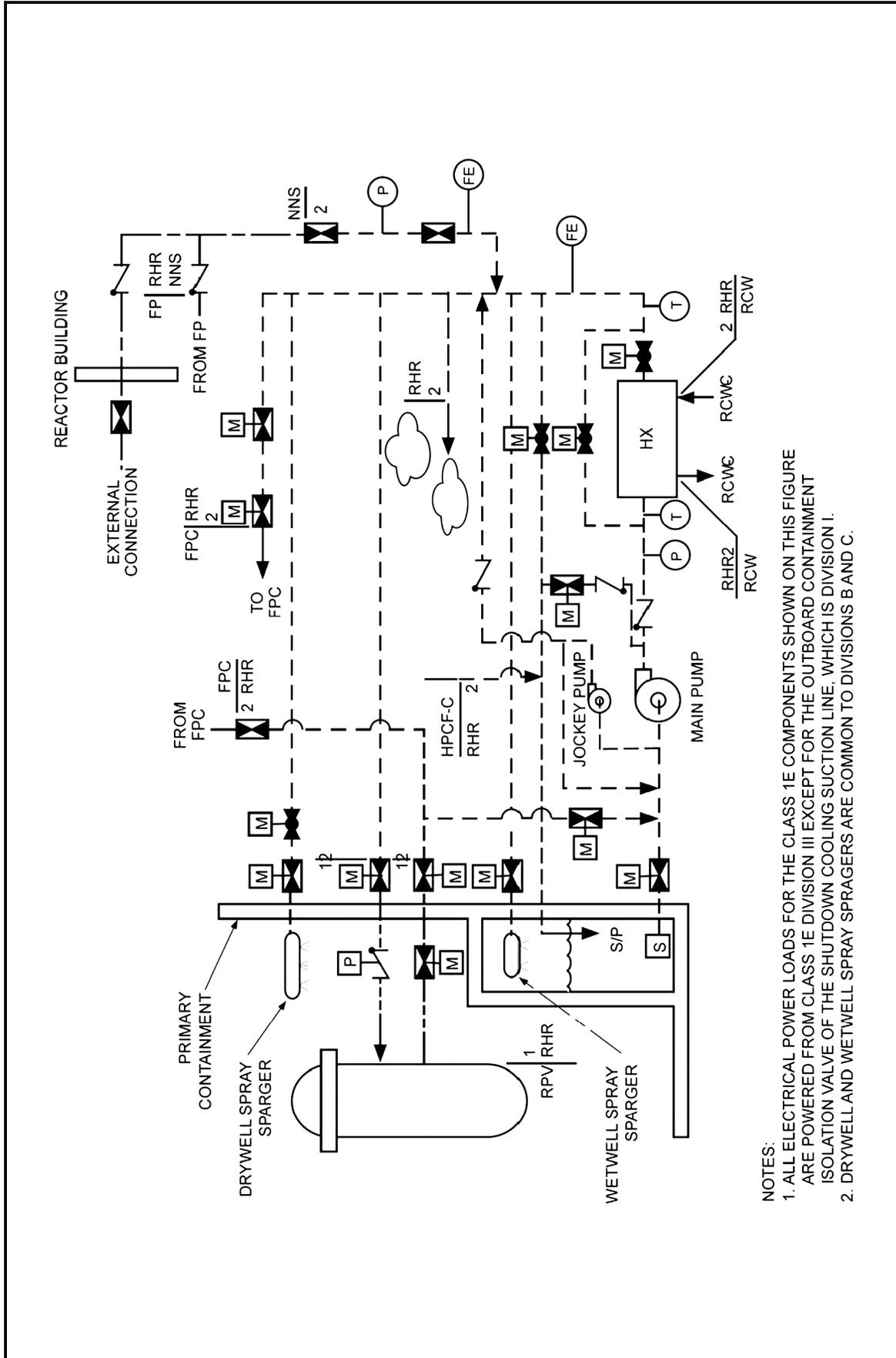
NOTES:
1. ALL ELECTRICAL POWER LOADS FOR THE CLASS 1E COMPONENTS SHOWN ON THIS FIGURE ARE POWERED FROM CLASS 1E DIVISION I EXCEPT FOR THE OUTBOARD CONTAINMENT ISOLATION VALVE OF THE SHUTDOWN COOLING SUCTION LINE, WHICH IS DIVISION II.

Figure 2.4.1a Residual Heat Removal System (RHR-A)



- NOTES:
1. ALL ELECTRICAL POWER LOADS FOR THE CLASS 1E COMPONENTS SHOWN ON THIS FIGURE ARE POWERED FROM CLASS 1E DIVISION II EXCEPT FOR THE OUTBOARD CONTAINMENT ISOLATION VALVE OF THE SHUTDOWN COOLING SUCTION LINE, WHICH IS DIVISION III.
 2. DRYWELL AND WETWELL SPRAY SPARGERS ARE COMMON TO DIVISIONS B AND C.

Figure 2.4.1b Residual Heat Removal System (RHR-B)



NOTES:
 1. ALL ELECTRICAL POWER LOADS FOR THE CLASS 1E COMPONENTS SHOWN ON THIS FIGURE ARE POWERED FROM CLASS 1E DIVISION III EXCEPT FOR THE OUTBOARD CONTAINMENT ISOLATION VALVE OF THE SHUTDOWN COOLING SUCTION LINE, WHICH IS DIVISION I.
 2. DRYWELL AND WETWELL SPRAY SPRAGERS ARE COMMON TO DIVISIONS B AND C.

Figure 2.4.1c Residual Heat Removal System (RHR-C)

Table 2.4.1 Residual Heat Removal System

| <u>Inspections, Tests, Analyses and Acceptance Criteria</u> | |
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| Design Commitment | Inspections, Tests, Analyses and Acceptance Criteria |
| <p>7. In the augmented fuel pool cooling mode, the RHR tube side heat exchanger flow rate for Divisions B or C is no less than 350 m³/h (heat exchanger heat removal capacity in this mode is bounded by suppression pool cooling requirements).</p> | <p>7. Tests will be performed to determine system flow rate through each heat exchanger in the augmented fuel pool cooling mode. Inspections and analyses shall be performed to verify that the augmented fuel pool cooling mode is bounded by suppression pool cooling requirements.</p> <p>7. The RHR tube side heat exchanger flow rate is greater than or equal to 350 m³/h in the augmented fuel pool cooling mode. Heat exchanger heat removal capacity in this mode is bounded by suppression pool cooling requirements.</p> |

2.4.3 Leak Detection and Isolation System

STD DEP T1 2.4-2 (Leak Detection System)

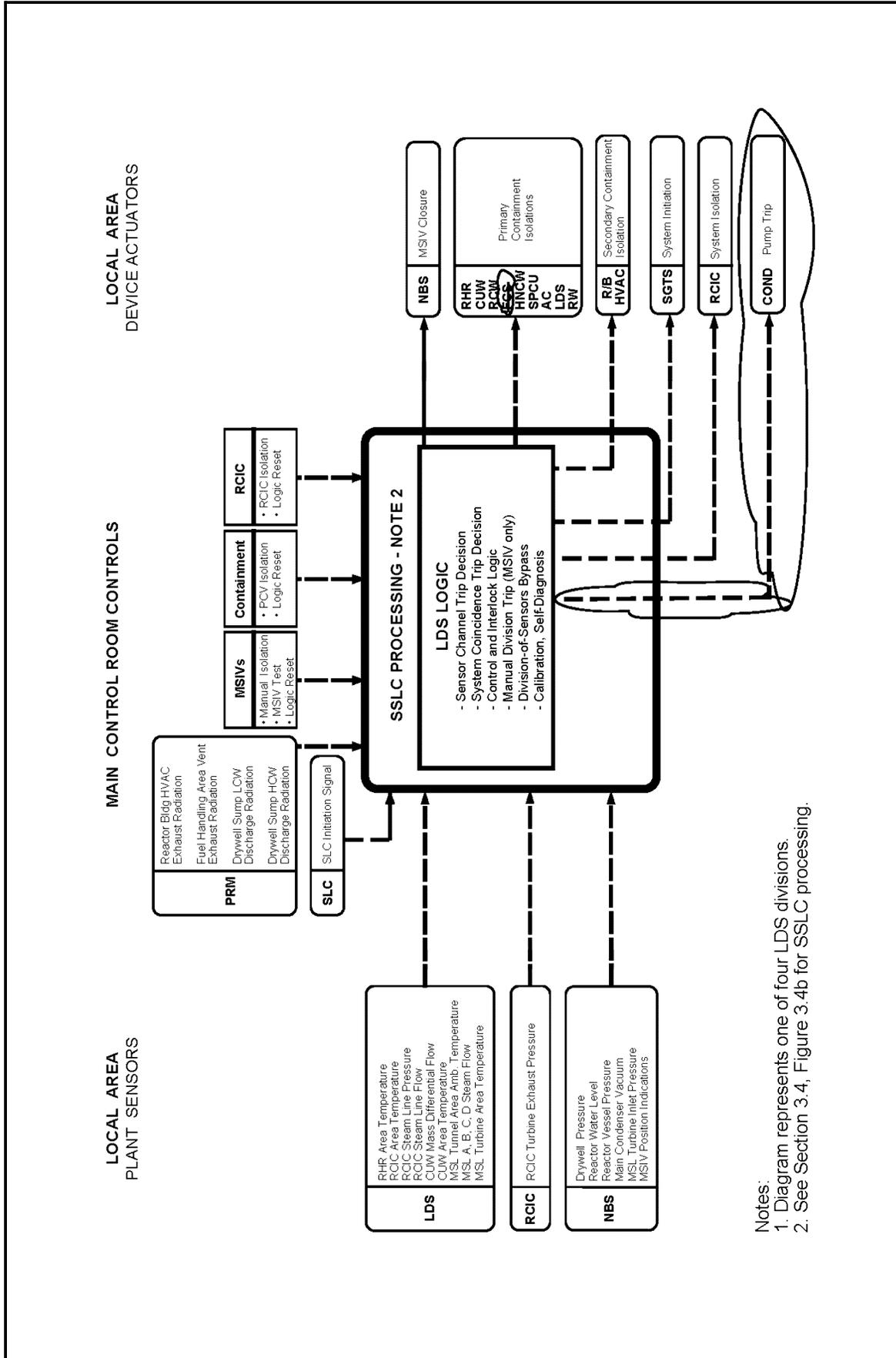
STD DEP T1 2.4-3 (Reactor Coolant Isolation Cooling System)

STD DEP T1 2.14-1 (FCS, Figure 2.4.3)

Design Description

The following primary and secondary containment isolation and automatic control functions are provided by the LDS using four instrument channels to monitor leakage:

- (8) *Isolation of the Reactor Core Isolation Cooling (RCIC) System steamline to the RCIC turbine on a signal indicating high steam flow in the RCIC line, low steam pressure in the RCIC line, high RCIC turbine exhaust pressure, or high ambient temperature in the RCIC equipment area.*
- (9) *Isolation of the Suppression Pool Cleanup (SPCU) System on a signal indicating high drywell pressure or low reactor water level.*
- ~~(10) *Isolation of the Flammability Control System (FCS) on a signal indicating high drywell pressure or low reactor water level.*~~
- (10) ~~(11)~~ *Isolation of the drywell sump low conductivity waste (LCW) and high conductivity waste (HCW) discharge lines on a signal indicating high drywell pressure or low reactor water level. Also, each discharge line is individually isolated on a signal indicating high radioactivity in the discharged liquid waste; only one channel is used for this function.*
- (11) ~~(12)~~ *Isolation of the LDS fission products monitor drywell sample and return lines on a signal indicating high drywell pressure or low reactor water level.*
- (12) ~~(13)~~ *The LDS provides to the neutron monitoring system a signal indicating a high drywell pressure or low reactor water level.*
- (13) The LDS provides a trip of the condensate pumps on signals that indicate high drywell pressure and high differential pressure between the feedwater lines.



Notes:
1. Diagram represents one of four LDS divisions.
2. See Section 3.4, Figure 3.4b for SSSLC processing.

Figure 2.4.3 Leak Detection and Isolation System Interface Diagram

2.4.4 Reactor Core Isolation Cooling System

STD DEP T1 2.4-3

Other Provisions

The Reactor Core Isolation Cooling System (RCIC) alternate design description was provided in ABWR Licensing Topical Report NEDE-32999P, “Advanced Boiling Water Reactor (ABWR) with Alternate RCIC Turbine-Pump Design,” dated December 20, 2006. This information on pages C-2 through C-6 of the Licensing Topical Report is incorporated by reference.

