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U.S. Nuclear Regulatory Commission
Document Control Desk
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Perry Nuclear Power Plant
Docket No. 50-440
Response to the NRC Request for Comments on Precursor Analysis, Perry Nuclear Power Plant LERs 93-010 and 93-011

Gentlemen:

The attached response was requested by the Nuclear Regulatory Commission (NRC) Staff on the preliminary precursor analysis of the Emergency Core Cooling System strainer and Service Water pipe break incidents documented in Perry Nuclear Power Plant Licensee Event Reports (LERs) 93-010 and 93-011.

Attachment 1 contains the results of the review of the preliminary report. As discussed in the attachment, there are several areas where adjustments should be made to the analysis performed which would change the results. Attachment 2 discusses the information requested by Enclosure 2 of the NRC staff letter. Attachment 3 provides simplified one-line drawings of the various systems and system line-ups discussed in this response.

If you have questions or require additional information, please contact Mr. James D. Kloosterman, Manager - Regulatory Affairs at (216) 280-5833.

Very truly yours,

for Robert A. Stratman

JDK:GGR:ns

Attachments

cc: NRC Project Manager
NRC Resident Inspector Office
NRC Region III

A001

ATTACHMENT 1

Accident Sequence Precursor Analysis

Case 1 - Unavailability of Residual Heat Removal (RHR) - Suppression Pool Cooling

1) More credit should be given to containment venting for decay heat removal. The failure to vent the containment was modeled in the Perry Probablistic Risk Assessment (PRA). Three containment vent paths are available for venting: 1) from the containment upper pools, through the fuel pool cooling and cleanup line to the spent fuel pool in the intermediate building; 2) from the subsystem A containment spray headers, through the RHR system piping to the spent fuel pool in the intermediate building and 3) using the same alignment as for 2 except with subsystem B.

   Containment venting and the instructions on aligning containment venting is included in the Plant Emergency Instructions. For transients, loss of offsite power and large Loss of Coolant Accidents (LOCAs), the time to the containment design pressure (assuming no heat removal from containment) is approximately 9 hours based on success criteria runs made for the Perry PRA. An additional 8 hours is available before the containment is expected to fail (based on success criteria runs). Since containment pressure control is detailed in the Plant Emergency Instructions, approach to the containment design pressure is monitored. Given the times for containment pressurization, the operators have ample opportunity to align any or all of the containment venting modes.

   Sufficient water would still be available in the suppression pool for injection or steam condensation even after accounting for boil off and venting over a 24 hour period based on the computer runs generated for the success criteria.

   For the Perry PRA the probability for human error was assumed to be the same regardless of sequence or initiating event. Failure to align containment venting was more dependent on equipment than on human error. For transients and small LOCAs the estimated failure probability for containment venting was 1.1×10^{-4}. For loss of offsite power the failure probability was 1.4×10^{-3}.

   This change should reduce the core damage frequencies for the seven top sequences for Case 1 (sequences 11, 40, 12, 71, 21, 49 and 22).

2) For transients and small LOCAs, several alternate injection systems are available to the operators in the event that Emergency Core Cooling Systems (ECCSs) fail as noted below.

   a. Feedwater - A motor driven feedwater pump starts on loss of the turbine driven feedwater pumps. As this pump does not use steam, loss of the power conversion system will not cause failure of the motor feedpump. The motor feedpump will also start on a low reactor pressure vessel (RPV) level of level 2 [the same level at which the High Pressure Core Spray (HPCS) and Reactor Core Isolation Coolant (RCIC) systems initiate]. The source of water is the condenser and condensate system. Support systems modeled in the Perry PRA to the motor feedpump include offsite power, instrument air, service water, and nuclear closed cooling (a closed cooling system to remove waste heat from other systems). The probability of failure for RPV injection with the motor feedpump was estimated to be 9.5×10^{-3} (including human error).

      This should reduce the core damage frequency for sequences 12, 13, 22, 71 and 72 by giving more credit to the success of the motor feedpump.

3) For a loss of offsite power, the following alternate injection systems can be used.

   a. Emergency Service Water (ESW)/RHR B Flood - The ESW B pump is powered from the Division 2 standby diesel generator and can be aligned to provide water to the RPV through the RHR B lines. As it takes a significant amount of time to align, it was not modeled as being immediately available in the Perry PRA. However, it would be available given that short term ECCS is successful prior to failure due to strainer fouling. An additional function heading of RPV depressurization should be featured in the sequences for which HPCS or RCIC is successful to support ESW/RHR B Flood. The source of water for ESW/RHR B is Lake Erie. The only support systems are the standby diesel generators and their support systems and the ESW pumphouse ventilation. This change should reduce the core damage frequencies for sequences 40, 41, 49 and 65.

   b. Fire Protection - In the event that ESW B pump or the Division 2 standby diesel generator fails, the Plant Emergency Instructions provide for RPV injection using the diesel driven fire pump. The same alignment used for the ESW/RHR B is used for fire protection except that the fire protection system is cross-tied to ESW B when ESW B is not available. The source of water again is Lake Erie. There are no support systems needed for operation. This can provide water to the RPV in the event of a station blackout. Because of the alignment time needed, credit was not taken for short term injection. Given that HPCS functions during the station blackout over the short term, fire protection would be available for RPV injection over the long term. Once again an additional function heading of RPV depressurization should be featured in the sequences for which HPCS or RCIC is successful to support Fire Protection/RHR B Flood. The probability of failure for RPV injection using fire protection was estimated to be $2.7x10^{-1}$ (including human error) in a station blackout situation. This change should reduce the core damage frequencies for sequences 40, 41, 49 and 65.

Case 2 - Service Water Break with Loss of Motor Feedpump and Control Rod Drive (CRD) Problems

1) Case 2 should include venting of the containment in the same manner as described above for Case 1. The times of containment pressurization would be the same. Due to the times available to the operators, the failure probability (including operator error) would also be the same at $1.1x10^{-4}$. Inclusion of containment venting at this failure probability would significantly decrease the core damage frequencies of the dominant sequences. The top sequences (12 and 22) in addition to sequences 23 and 15 would be revised.

Flooding Sensitivity Study for Case 2

1) As in Cases 1 and 2, additional credit for containment venting would decrease the core damage frequencies in sequences 12 and 22 (the top two sequences for flooding sensitivity study for Case 2).

2) The Perry Individual Plant Examination considered flooding of the corridor on the 568 elevation of the auxiliary building. Although instrument racks for RHR A, B and C and LPCS are located in this corridor, flooding of the racks was deemed not to affect the systems ability to inject water into the RPV. The impact of rack flooding would be the loss of minimum flow bypass capability back to the suppression pool. As the systems would already be injecting if needed, this was considered a non-essential mode of operation. Additionally, the permissive from these ECCS systems to the Automatic Depressurization System (ADS) logic could be lost which would disable the automatic initiation feature of ADS, but this is not considered significant since the PEIs require disabling this initiation logic, and there are manual methods of opening the necessary safety relief valves. Therefore more credit should have been given to short term ECCS injection capability. This would have an effect on all four of the most significant sequences. Sequences 12 and 22 would be revised since Shutdown cooling would be available, and sequences 19 and 27 would be revised since short term ECCS injection would be available.

   In addition, alternate injection using suppression pool cleanup in the short term followed by either ESW/RHR B or fire protection along with containment venting for the long term would decrease the core damage frequency for sequences 19 and 27.

HPCS Sensitivity Study for Case 2

1) The core damage frequency for sequence 13 (the dominant sequence for the HPCS sensitivity study for Case 2) would be decreased if credit were taken for alternate injection using either ESW/RHR B or fire protection for long term injection following the failure of RCIC due to suppression pool heat up or strainer fouling. Containment venting should also be modeled along with the alternate injection sources to remove decay heat.

Flooding and HPCS Sensitivity Study for Case 2

Items 1 and 2 for the flooding sensitivity and Item 1 for the HPCS sensitivity apply also to the sensitivity study performed for flooding effects and HPCS combined.

Implementation Instructions

The directions to commence containment venting and RPV alternate injection are in the Plant Emergency Instruction (PEI) flow charts. The detailed alignment instructions are provided by PEI-SPI, Special Plant Instructions. Table 1 provides the specific alignment instructions for the actions noted above. Table 2 provides the Plant Emergency Instruction flow charts which contain the directions for implementing the actions.

Conclusions

The greatest benefit to the core damage frequencies generated for the preliminary precursor analysis come from the addition of containment venting to the model, using a failure probability in the range of 10^{-3} to 10^{-4}. Based on the number of hours available to the operators to align containment venting, failure rates of this order of magnitude are appropriate.

Other reductions in core damage frequency can be obtained by modeling the alternate injection systems available to the operators such as the motor feedpump, ESW/RHR B and fire protection.

Table 1
Detailed Alignment Instructions

Action	Alignment Instruction
Containment Venting	PEI-SPI, Sec 7
ESW or Fire Protection/ RHR B Flood	PEI-SPI, Sec 4.2
Suppression Pool Cleanup Alternate Injection	PEI-SPI, Sec 4.4

Table 2
Initiation Instructions

PEI Flow Chart	Action
PEI-B13, RPV Level Control Flow Chart	Alternate Injection
PEI-B13, RPV Level/Power Control Flow Chart	Alternate Injection
PEI-B13, RPV Flooding Flow Chart	Alternate Injection
PEI-T23, Containment Flooding Flow Chart	Alternate Injection
PEI-T23, Drywell & Containment Pressure Control Flow Chart	Containment Venting

ATTACHMENT 2

Enclosure 2 to the July 1, 1994 NRC letter requesting comments on the precursor analysis preliminary report indicated that certain information should be provided with any comments submitted. Enclosure 2 stated the information should include the following:

1. Normal or emergency operating procedures

   Attachment 1, Table 1 lists the section of the Plant Emergency Instruction (PEI) - Special Plant Instruction (SPI) that is referenced in the Attachment 1 review, and Attachment 1, Table 2 lists the applicable PEI Flow chart which would drive the operator to the associated SPI for various plant conditions. Copies of the SPI instruction sections and PEI flowcharts in effect in March 1993 have been given to the Resident Inspector office.

2. Piping and instrumentation drawings (P&IDs)

   Attachment 2, Table 1 lists the applicable systems referenced in Attachment 1 along with the Updated Safety Analysis Report (USAR) Figure number for that system's P&ID. In addition, Attachment 3 contains various one line system drawings for these systems which include the flow paths discussed for alternate injection or venting as applicable.

3. Electrical one-line drawings

   USAR Figures 8.2-2, 8.3-1 and 8.3-2 show the electrical one-line drawings for the Perry Nuclear Power Plant offsite and onsite A. C. distribution system.

4. Results of thermal-hydraulic analysis

   Any analysis results have been included in the discussion in Attachment 1.

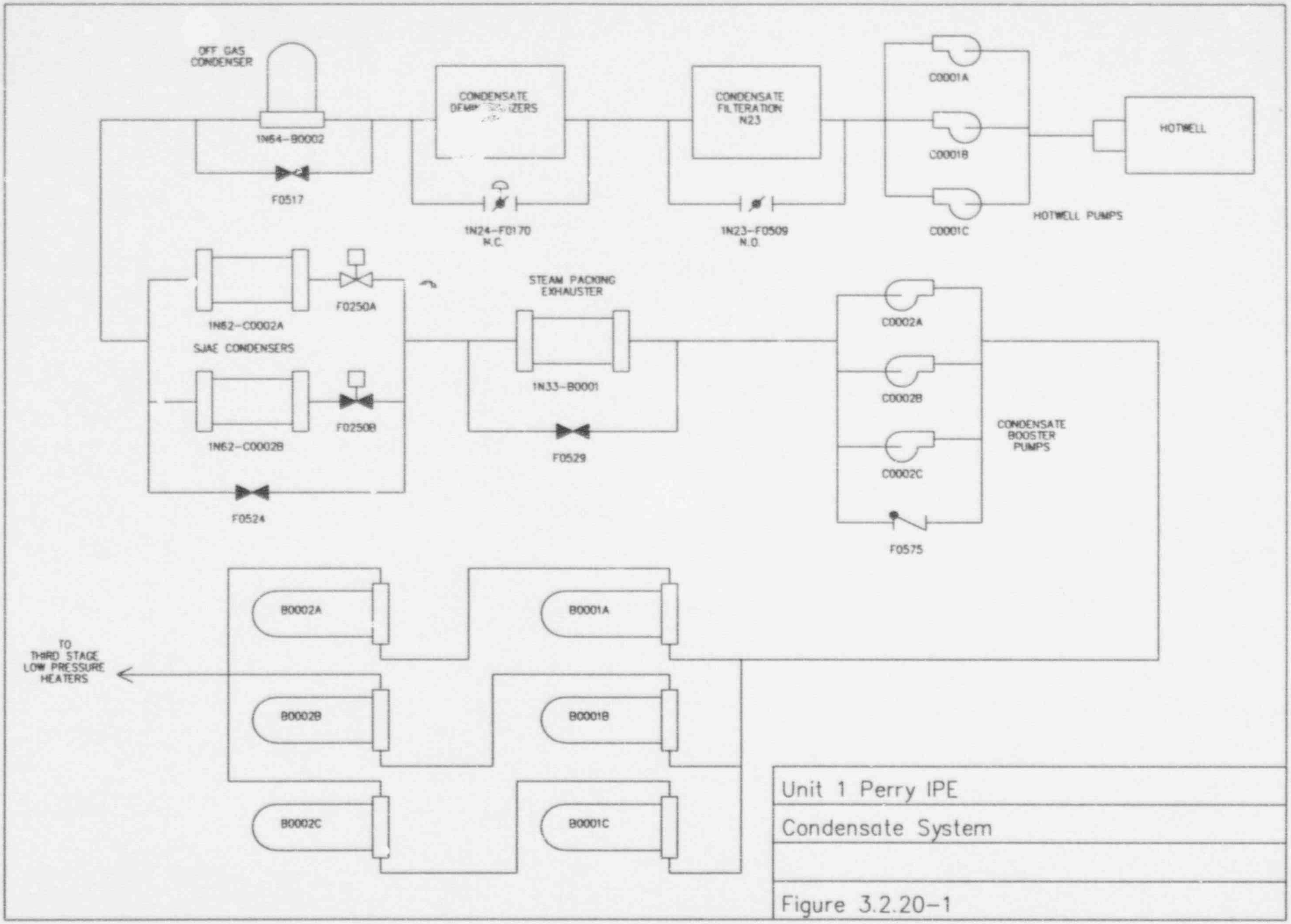
5. Operator training

   Operators and Shift Technical Advisors (STAs) are trained on the PEI flow charts and SPIs during initial qualification as well as during operator requalification. Copies of the applicable training modules for the PEI flowcharts listed on Attachment 1, Table 2 have been given to the Resident Inspector office.

Table 1

SYSTEM	USAR FIGURE NUMBER
Condensate	Figure 10.1-4
Emergency Service Water	Figure 9.2-1
Feedwater	Figures 10.1-3 and 10.1-8
Fire Protection	Figures 9.5-1 to 9.5-4
Fuel Pool Cooling and Cleanup	Figure 9.1-9
Reactor Core Isolation Cooling	Figure 5.4-9
Residual Heat Removal	Figure 5.4-13

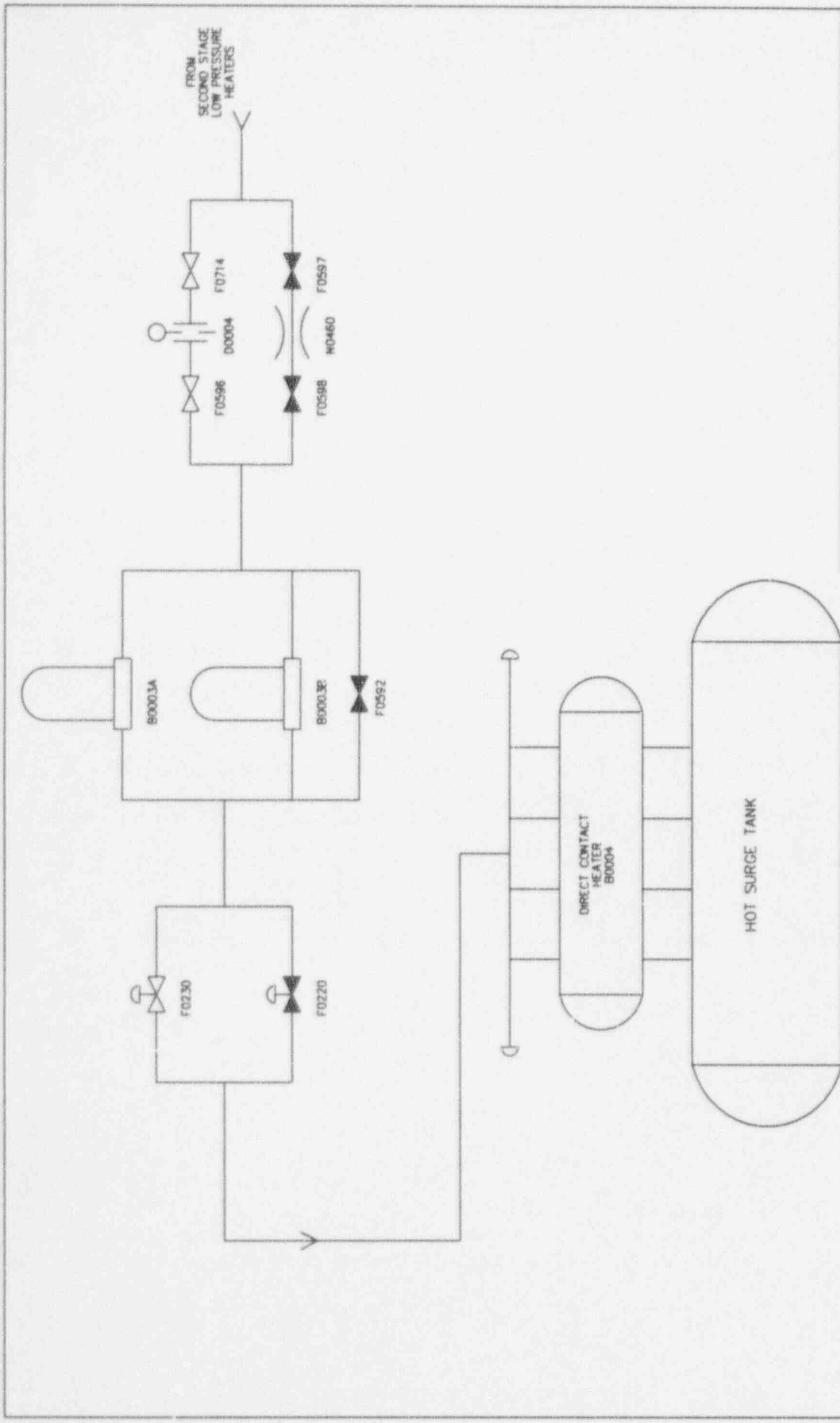
ATTACHMENT 3



Unit 1 Perry IPE

Condensate System

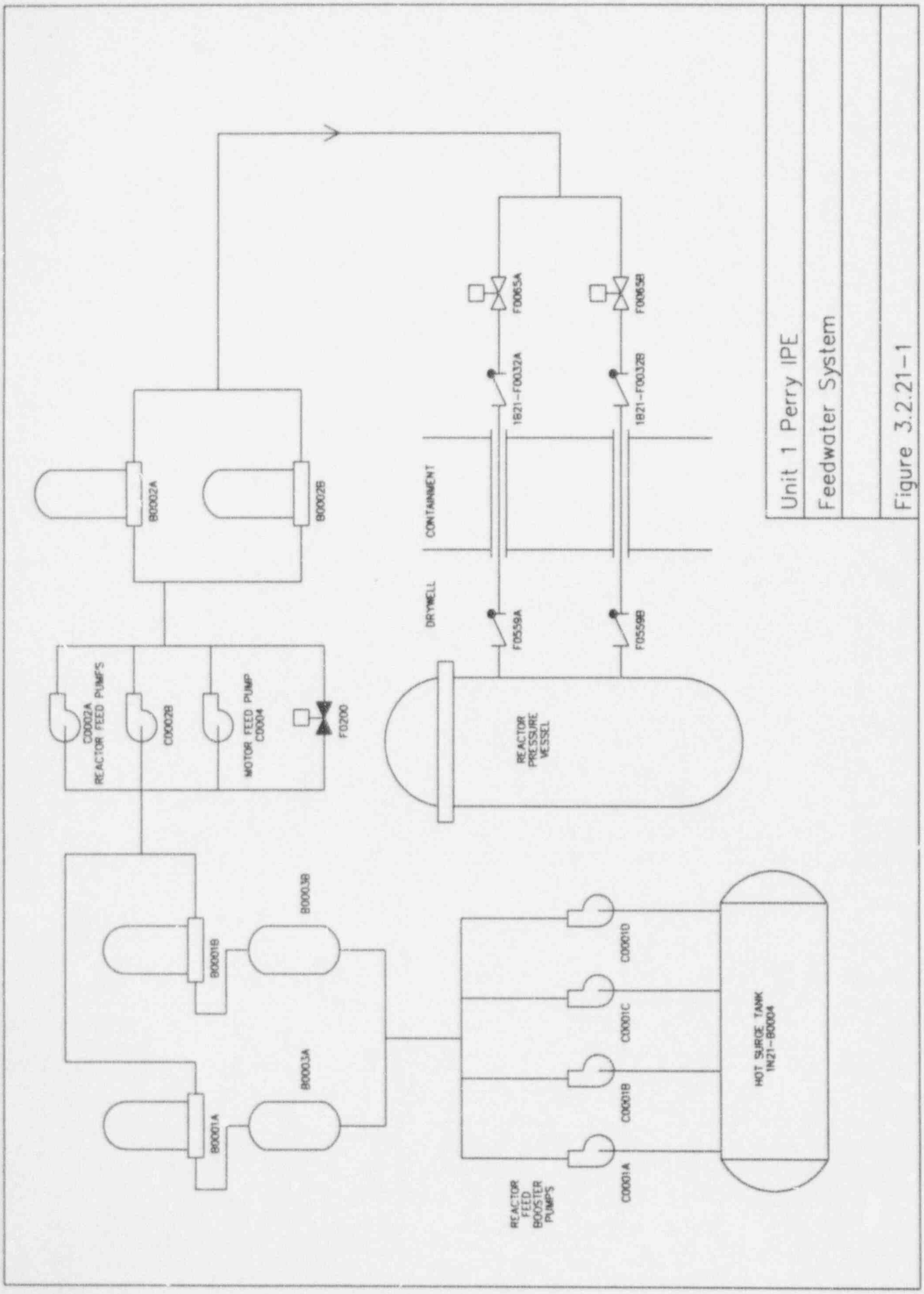
Figure 3.2.20-1



Unit 1 Perry IPE

Condensate System

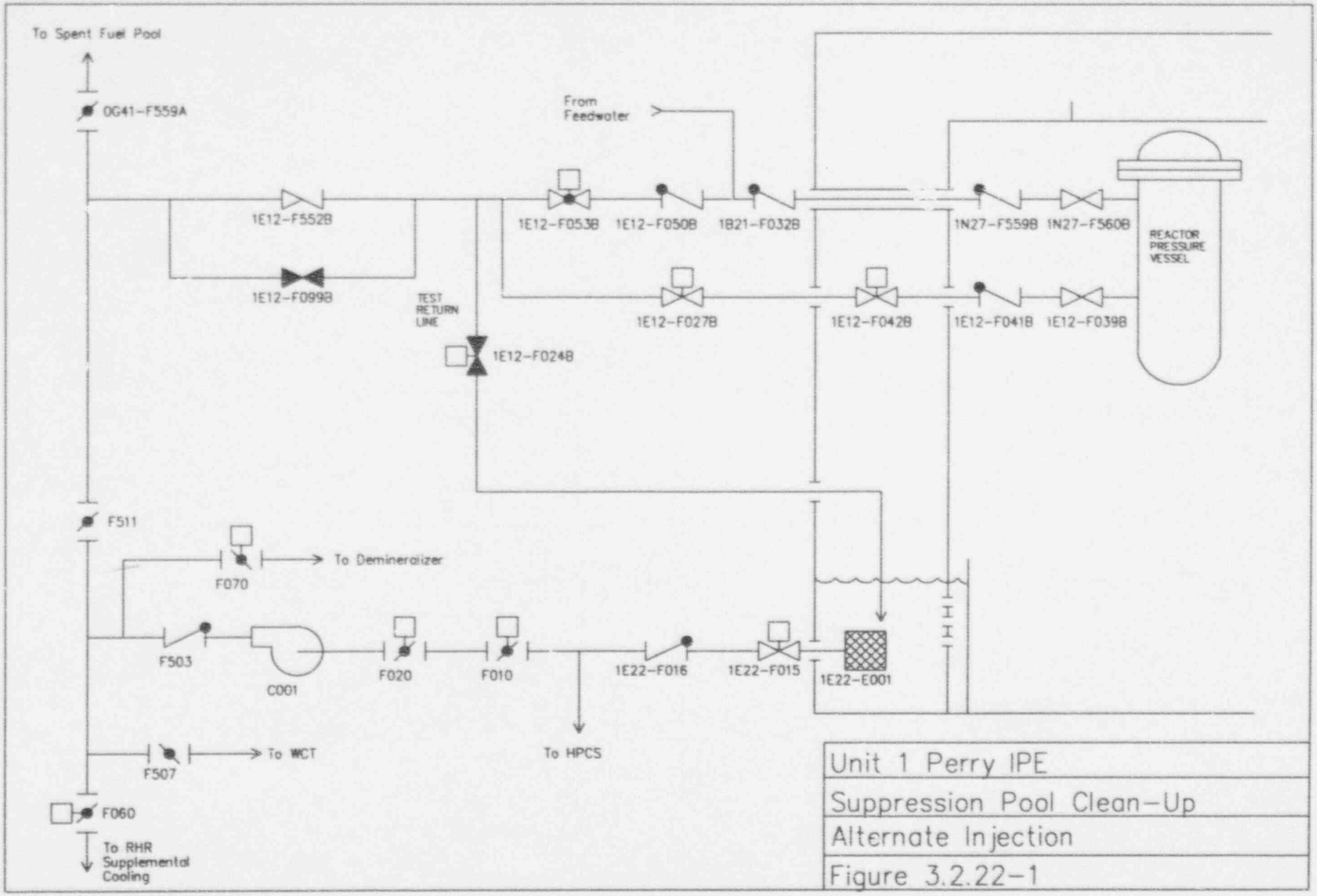
Figure 3.2.20-2



Unit 1 Perry IPE

Feedwater System

Figure 3.2.21-1

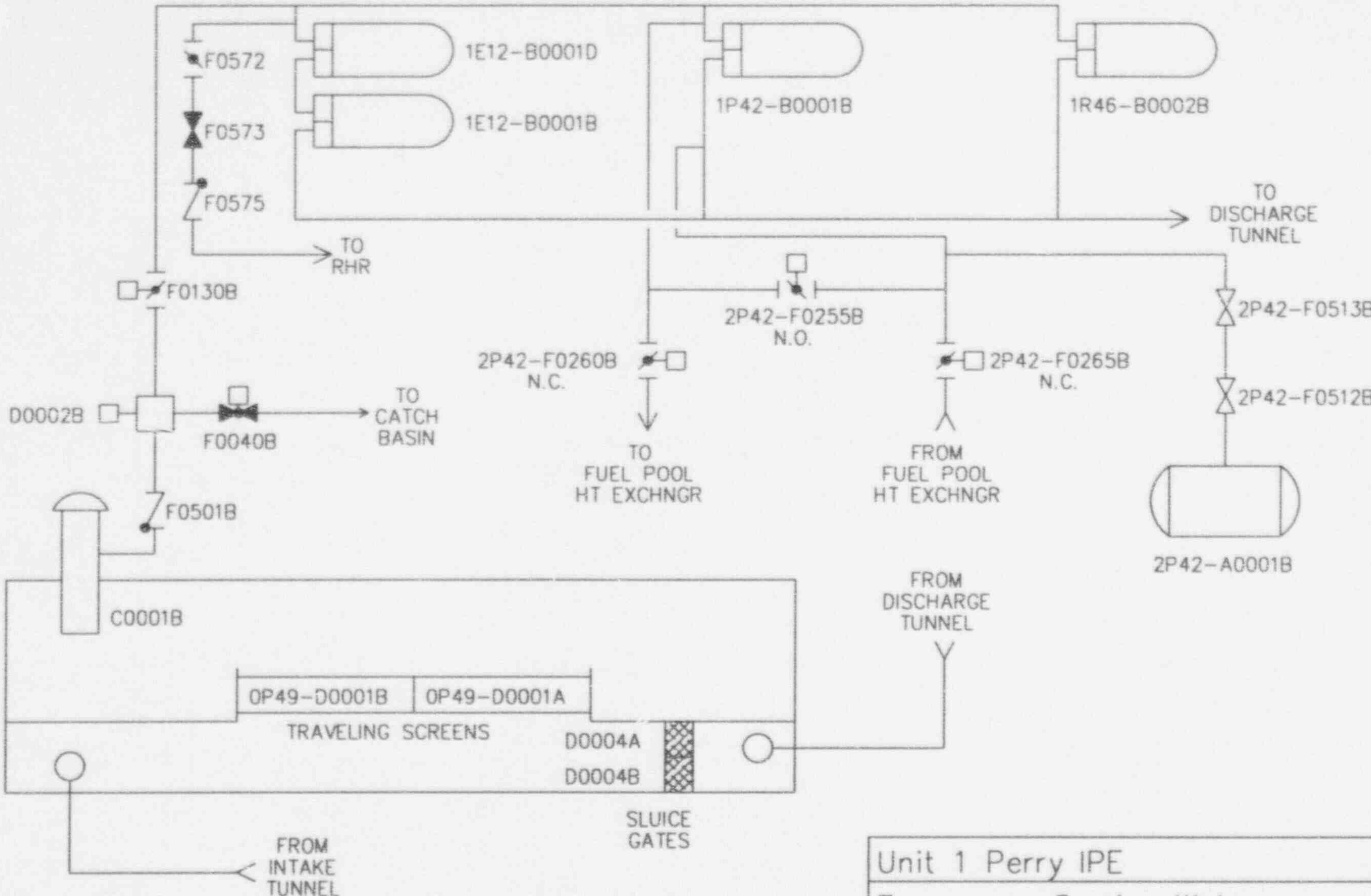


Unit 1 Perry IPE

Suppression Pool Clean-Up

Alternate Injection

Figure 3.2.22-1

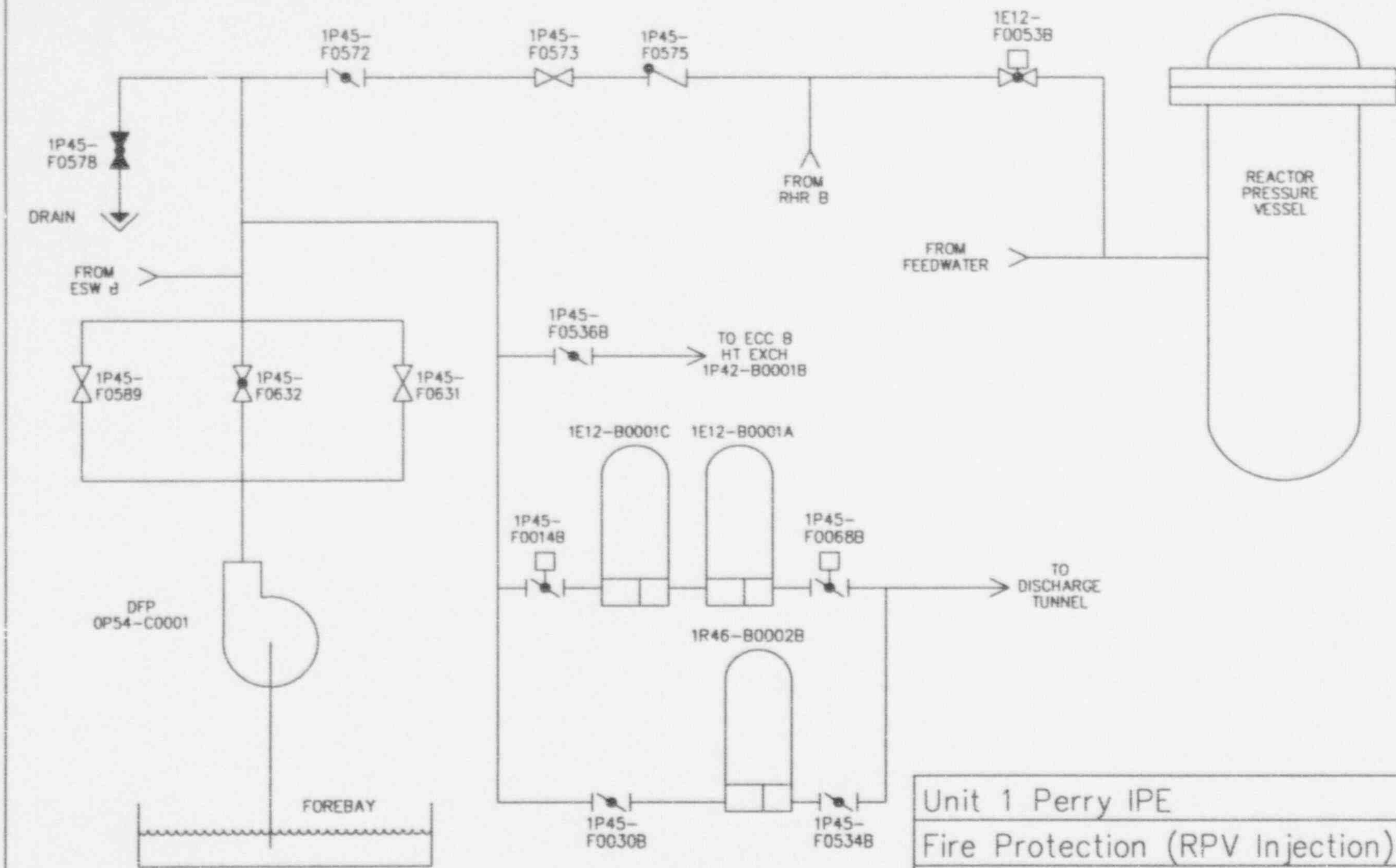


Unit 1 Perry IPE

Emergency Service Water

Train B

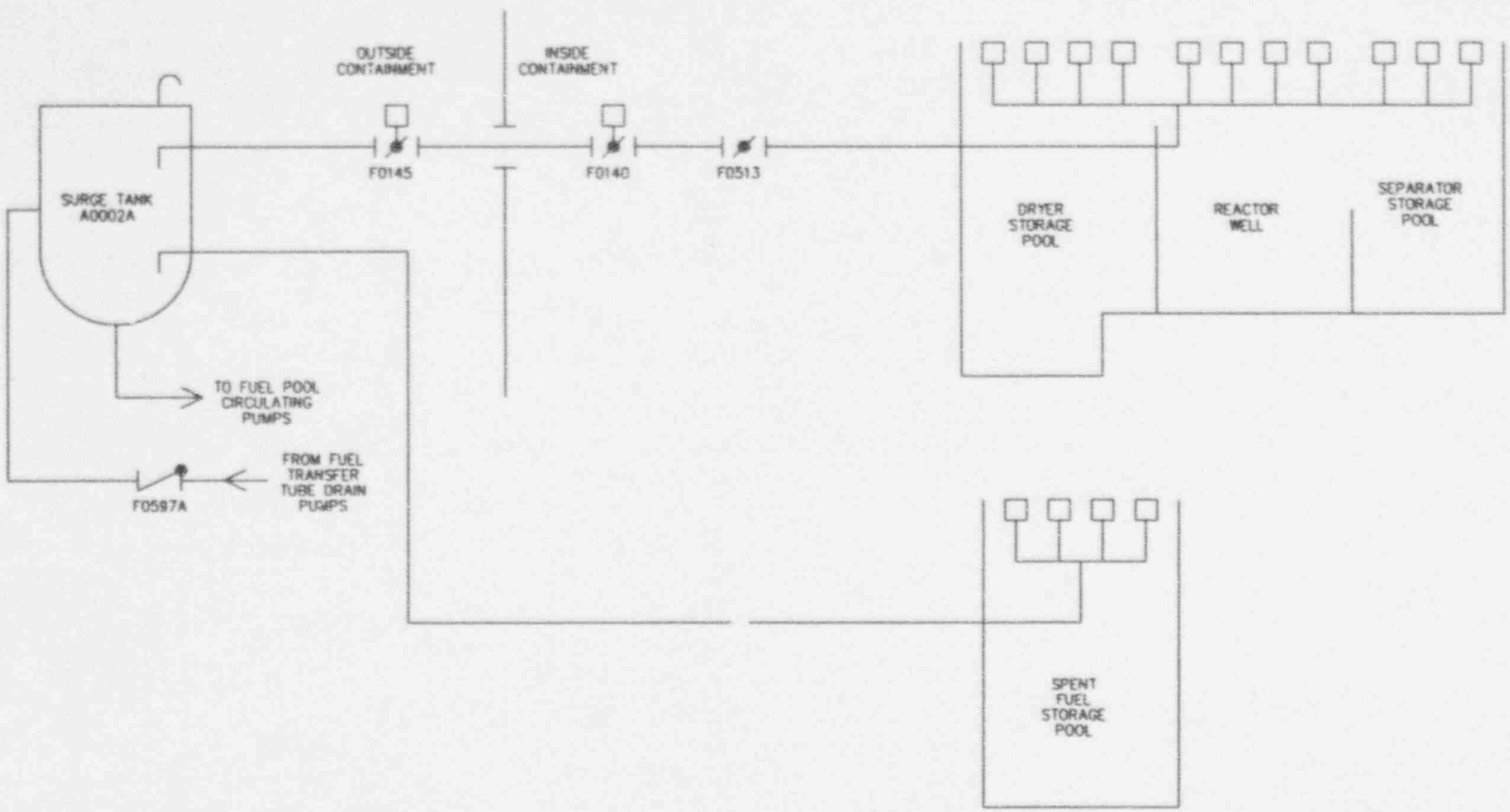
Figure 3.2.8-2



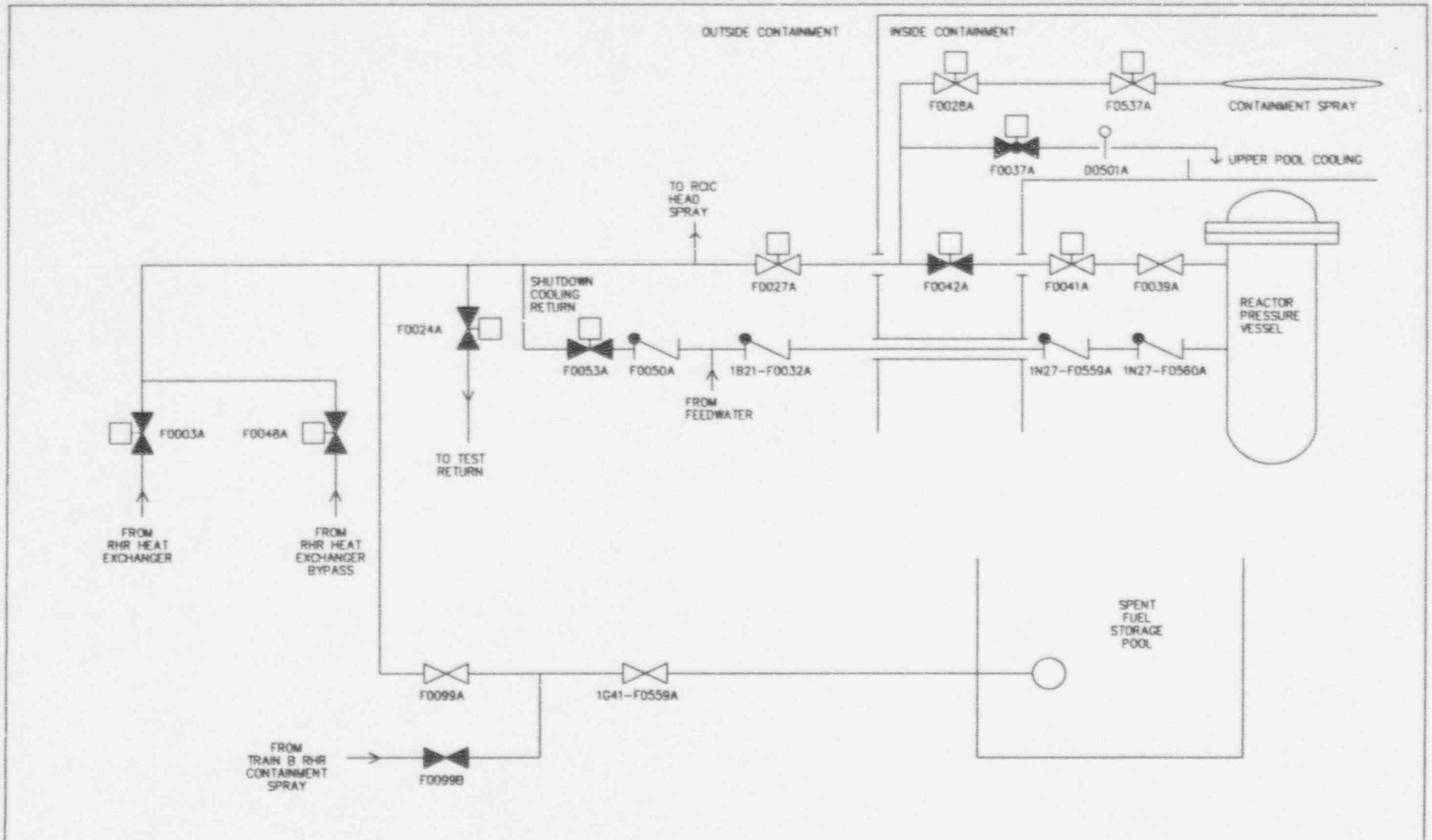
Unit 1 Perry IPE

Fire Protection (RPV Injection)

Figure 3.2.11-1



Unit 1 Perry IPE
Containment Venting
Fuel Pool Clng & Cleanup
Figure 3.2.17-1

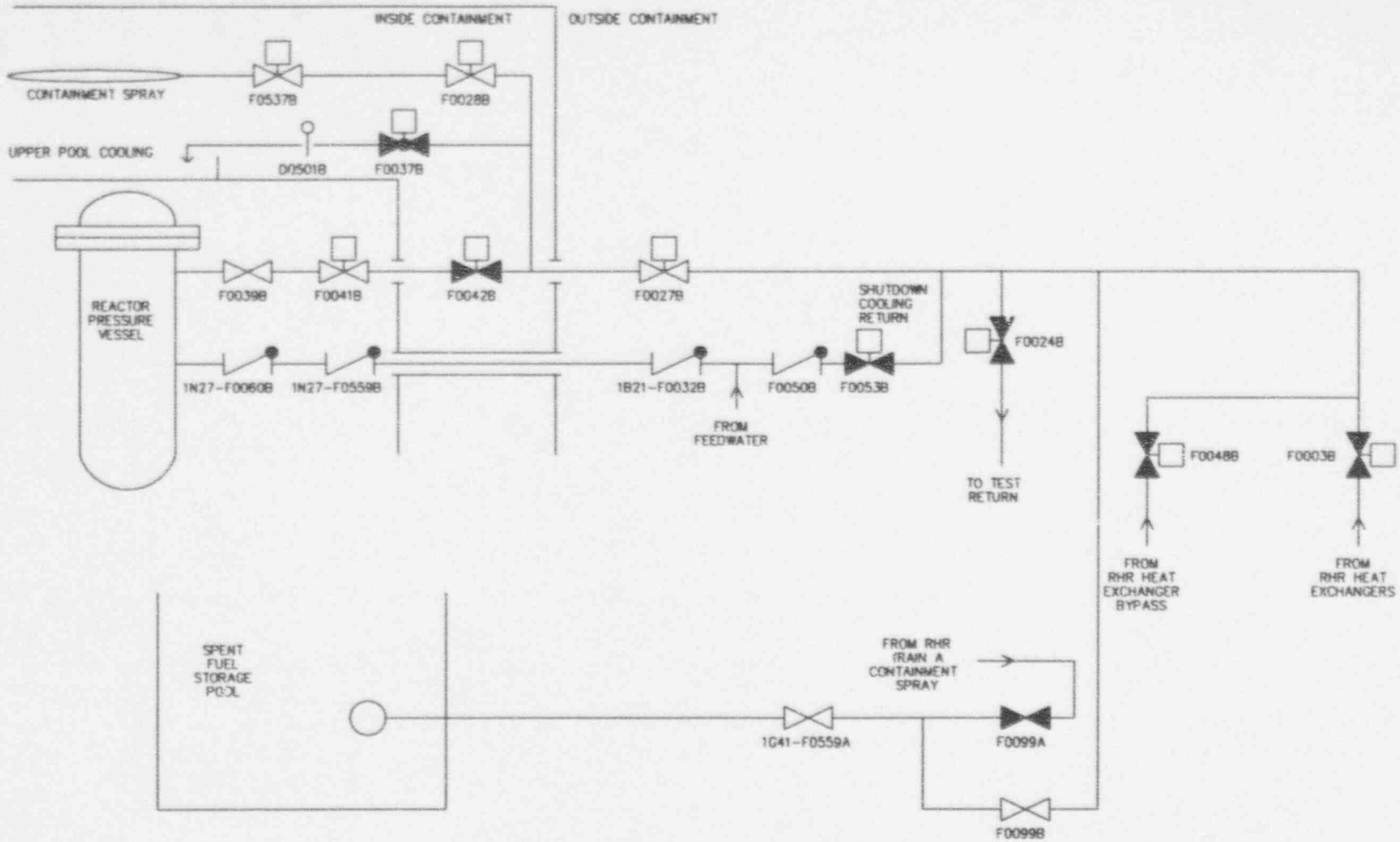


Unit 1 Perry IPE

Containment Venting

RHR Containment Spray – Train A

Figure 3.2.18-1



Unit 1 Perry IPE
Containment Venting
RHR Containment Spray - Train B
Figure 3.2.18-2