VERMONT YANKEE
NUCLEAR POWER CORPORATION

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October 30, 1998
BVY 98-153

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

References:
- (a) Letter, USNRC to VYNPC, Generic Letter 96-06 Supplement 1, "Assurance of Equipment Operability and Containment Integrity During Design Basis Accident Conditions", dated November 13, 1997
- (b) Letter, USNRC to VYNPC, Generic Letter 91-18 Revision 1,"Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Degraded and Nonconforming Conditions", dated October 8, 1997
- (c) NRC/NEI Workshop on GL 96-06, held December 4, 1997
- (d) Letter, VYNPC to USNRC, "Vermont Yankee 30-day Response to Generic Letter 96-06", BVY 96-136, dated October 30, 1996
- (e) Letter, VYNPC to USNRC, "Vermont Yankee 120-day Response to Generic Letter 96-06", BVY 97-17, dated January 28, 1997
- (f) EPRI NP-6766, "Water Hammer Prevention, Mitigation and Accommodations", Volume 5, Part 1, July 1992
- (g) Letter, VYNPC to USNRC, "Schedule Extension for Resolving Generic Letter 96-06", BVY 98-19, dated February 9, 1998
- (h) Letter, USNRC to VYNPC, "Request for Additional Information Regarding Generic Letter (GL) 96-06 at Vermont Yankee Nuclear Power Station", NVY 98-97, dated July 10, 1998

Subject: **Vermont Yankee Nuclear Power Station**
License No. DPR-28 (Docket No. 50-271)
<u>Response to NRC RAI Related To GL 96-06 Response</u>

A072

In Reference (e) Vermont Yankee provided requested information on the susceptibility of Vermont Yankee systems to the conditions identified in Generic Letter 96-06. In Reference (h), the staff requested additional information concerning our response. As discussed with your staff, our submittal date to answer these questions was revised to October 30, 1998. The attachments to this letter provides our response to your request for additional information.

Should you have any questions regarding this submittal, please contact this office.

Sincerely,

VERMONT YANKEE NUCLEAR POWER CORPORATION

Don M. Leach
Vice President, Engineering

Attachment

cc USNRC Region 1 Administrator
USNRC Project Manager - VYNPS
USNRC Resident Inspector - VYNPS
Vermont Department of Public Service

SALLY A. SANDSTRUM
NOTARY PUBLIC
WINDHAM COUNTY, VERMONT

STATE OF VERMONT)
)ss
WINDHAM COUNTY)

Then personally appeared before me, Don M. Leach, who, being duly sworn, did state that he is Vice President, Engineering of Vermont Yankee Nuclear Power Corporation, that he is duly authorized to execute and file the foregoing document in the name and on behalf of Vermont Yankee Nuclear Power Corporation, and that the statements therein are true to the best of his knowledge and belief.

Sally A. Sandstrum, Notary Public
My Commission expires February 10, 1999

Docket No. 50-271
BVY 98-153

ATTACHMENT 1

Response to Request for Additional Information Concerning GL 96-06

1. Provide a detailed description of the "worst case" scenarios for waterhammer and two-phase flow, taking into consideration the complete range of event possibilities, system configurations, and parameters. For example, all waterhammer types and water slug scenarios should be considered, as well as temperatures, pressures, flow rates, load combinations, and potential component failures. For the LOCA scenario, identify the maximum amount of steam that could be generated, and explain why this amount of steam does not constitute a waterhammer concern. Also, while heat transfer considerations may not be of concern for the two-phase flow issue, structural and system integrity considerations must still be addressed (this aspect of the two-phase flow issue was not addressed in the licensee's submittals). For example, the following two-phase flow effects are relevant:

   - the consequences of steam formation, transport, and accumulation;
   - cavitation, resonance, and fatigue effects; and
   - erosion considerations.

   Licensees may find NUREG/CR-6031, "Cavitation Guide for Control Valves," helpful in addressing some aspects of the two-phase flow analyses. To the extent that the possibility for waterhammer and two-phase flow to occur are eliminated, describe the minimum margin to boiling that will exist.

RESPONSE TO QUESTION 1

SPECIFIC SYSTEM CONFIGURATION:

As discussed in Reference (e), Vermont Yankee has one closed loop cooling water system, Reactor Building Closed Cooling Water (RBCCW), supporting the cooling of drywell equipment. The existing containment penetration design includes a check valve on the inlet penetration and a motor operated valve on the outlet, with a closed seismic loop inside primary containment. None of the equipment served by the RBCCW system, including the containment air coolers (RRUs) are required to function following a Design Basis Accident (DBA).

RBCCW circulates continuously through each RRU during normal operation. Power for the RBCCW pumps is from 480V buses that receive backup electrical power from the Emergency Diesel Generators (EDGs). In the event normal power is lost, the RBCCW pumps are automatically restarted approximately 60 seconds after emergency power is restored to the bus. Under DBA conditions, the RBCCW pump would restart approximately 73 seconds after the initiation of the postulated accident. The accident signal (high drywell pressure or low-low reactor water level with low reactor pressure) will trip the RRU fan motors.

The RBCCW system is a closed loop system, vented to the atmosphere via the RBCCW surge tank. The normal surge tank elevation provides a water column of sufficient pressure to prevent boiling of the fluid in the drywell RRUs for temperatures up to approximately 272°F.

SCENARIOS CONSIDERED:

DBA LOCA:

The driving force for heat transfer to the RBCCW cooling water is the ambient condition in the drywell following a LOCA. The DBA-LOCA at Vermont Yankee is a guillotine break of a recirculation line (FSAR 14.6.3.3) with a coincident loss of off-site power (LOOP) and is expected to cause drywell temperature to exceed 272°F for approximately 15 seconds (FSAR Figure 14.6-6). Drywell temperature is expected to drop below 272°F approximately 16 seconds into the postulated event and remain below 272°F thereafter. A preliminary heat transfer study has shown that the cooling water temperature will lag the increase in containment temperature. Since the containment temperature will be decreasing below 272°F when the cooling water temperature is still rising towards saturation, boiling of the containment cooling water is not expected to occur. Therefore, during the DBA-LOCA there is reasonable assurance that water hammer will not occur when RBCCW flow through the containment coolers is restored approximately 73 seconds into the event.

MAIN STEAM LINE BREAK:

Vermont Yankee has also considered a Main Steam Line Break (MSLB) event with a coincident LOOP. Analysis was performed on a number of steam line breaks ranging in size from 0.02 ft^2 to 0.5 ft^2. The analysis concluded that the drywell temperature would remain below the saturation temperature of the RBCCW for the first 73 seconds of the postulated event. This would envelop the expected period of time for re-establishment of RBCCW flow. Therefore, for this spectrum of break sizes, RBCCW flow would be restored prior to conditions developing that could cause void formation within the RBCCW piping in the drywell, providing reasonable assurance that a water hammer would not occur when the RBCCW pumps were restarted.

Steam line breaks larger than 0.5 ft^2 will most likely create higher ambient temperatures than a recirculation line break during the first 73 seconds of an event, therefore the potential for generating voids in the RRU cooling coils is greater. The potentially higher temperature associated with a larger steam break is based, in part, on the design basis information used in the Vermont Yankee Equipment Qualification Program.

EFFECTS OF LOCALIZED HEATUP:

The above described scenarios are based upon bulk average drywell temperatures. Based upon walkdowns of the drywell RBCCW piping, we have concluded that the RRUs could be subjected to the effects of localized heatup due to their close proximity to potential pipe break regions. Specifically, the drywell RRUs are located within close proximity to recirculation, main steam and feedwater piping. The Vermont Yankee drywell design does not afford sheltering of the RRUs with cubicles, solid floors, etc.; therefore Vermont Yankee has conservatively concluded that voiding and the potential for water hammer could occur for such an event.

Vermont Yankee plans to implement a modification to the RBCCW system during the next refueling outage in lieu of performing any additional analysis to disprove the potential for a water hammer to occur in this piping.

2. If a methodology other than that discussed in NUREG/CR-5220, "Diagnosis of Condensation-Induced Waterhammer," or in EPRI NP-6766, "Water Hammer Prevention, Mitigation, and Accomodations," was used in evaluating the effects of waterhammer, describe this alternate methodology in detail. Also, explain why this methodology is applicable and gives conservative results (typically accomplished through rigorous plant-specific modeling, testing, and analysis).

3. Identify any computer codes that were used in the waterhammer and two-phase flow analyses and describe the methods used to bench mark the codes for the specific loading conditions involved (see Standard Review Plan Section 3.9.1).

4. Describe and justify all assumptions and input parameters (including those used in any computer codes) that were used in the waterhammer and two-phase flow analyses, and provide justification for omitting any effects that may be relevant to the analyses (e.g., fluid structure interaction, flow induced vibration, erosion). Confirm that these assumptions and input parameters are consistent with the existing design and licensing basis of the plant. Any exceptions should be explained and justified.

5. Explain and justify all uses of "engineering judgement" that were credited in the waterhammer and two-phase flow analyses.

6. Discuss specific system operating parameters and other operating restrictions that must be maintained to assure that the waterhammer and two-phase flow analyses remain valid (e.g., surge tank level, pressures, temperatures), and explain why it would not be appropriate to establish Technical Specification requirements to acknowledge the importance of these parameters and operating restrictions. Also, describe and justify use of any non-safety related instrumentation and controls for maintaining these parameters.

<u>RESPONSE TO QUESTIONS 2-6</u>

Items 2,3,4,5 & 6 request information relative to an analytical approach to resolving GL 96-06. At this time, Vermont Yankee does not plan to pursue an analytical solution to ultimately prove that two-phase flow and subsequent water hammer do not occur in our RBCCW piping inside containment. Based on initial evaluations performed in conjunction with our response to GL 96-06, we have concluded that a modification is the preferred solution to the concerns described in the Generic Letter.

7. Implementing measures to assure that waterhammer will not occur, such as managing post-accident operation of the CACs or establishing and maintaining system overpressure requirements, is an acceptable approach for addressing the waterhammer concern. However, all scenarios must be considered to assure that the vulnerability to waterhammer has been eliminated. Confirm that all scenarios have been considered, including those where the affected containment penetrations are not isolated (if this is a possibility), such that the measures that have been established (or will be established) are adequate to prevent the occurrence of waterhammer during (and following) all applicable accident scenarios.

RESPONSE TO QUESTION 7

Post-accident operation of the Drywell RRUs is not required for Vermont Yankee. Therefore, the cessation or subsequent re-start of RBCCW flow prior to conditions necessary to result in a water hammer event, or isolation of the containment penetration in the event of a pipe break are potential modification options. Conceptually, the design change planned will be responsive to the need to isolate the containment penetrations in the event of a pipe break, while providing the highest possible level of operational flexibility for the RBCCW system, both inside and outside containment.

8. Confirm that the waterhammer and two-phase flow analyses included a complete failure modes and effects analysis (FMEA) for all components (including electrical and pneumatic failures) that could impact performance of the cooling water system and confirm that the FMEA is documented and available for review, or explain why a complete and fully documented FMEA was not performed.

9. Describe the uncertainties that exist in the waterhammer and two-phase flow analyses, including uncertainties and shortcomings associated with the use of any computer codes, and explain how these uncertainties were accounted for in the analyses to assure conservative results.

RESPONSE TO QUESTIONS 8 & 9

Items 8 & 9 request information relative to an analytical approach to resolving the concerns described in GL 96-06. At this time, Vermont Yankee does not plan to pursue an analytical solution to prove that two-phase flow and subsequent water hammer will not occur in the RBCCW piping inside of containment.

10. Provide a simplified diagram of the affected system, showing major components, active components, relative elevations, lengths of piping runs, and the location of any orifices and flow restrictions.

RESPONSE TO QUESTION 10

A simplified diagram is included as Attachment 2.

11. Describe in detail any plant modifications or procedure changes that have been made or are planned to be made to resolve the waterhammer and two-phase flow issues, including completion schedules.

RESPONSE TO QUESTION 11

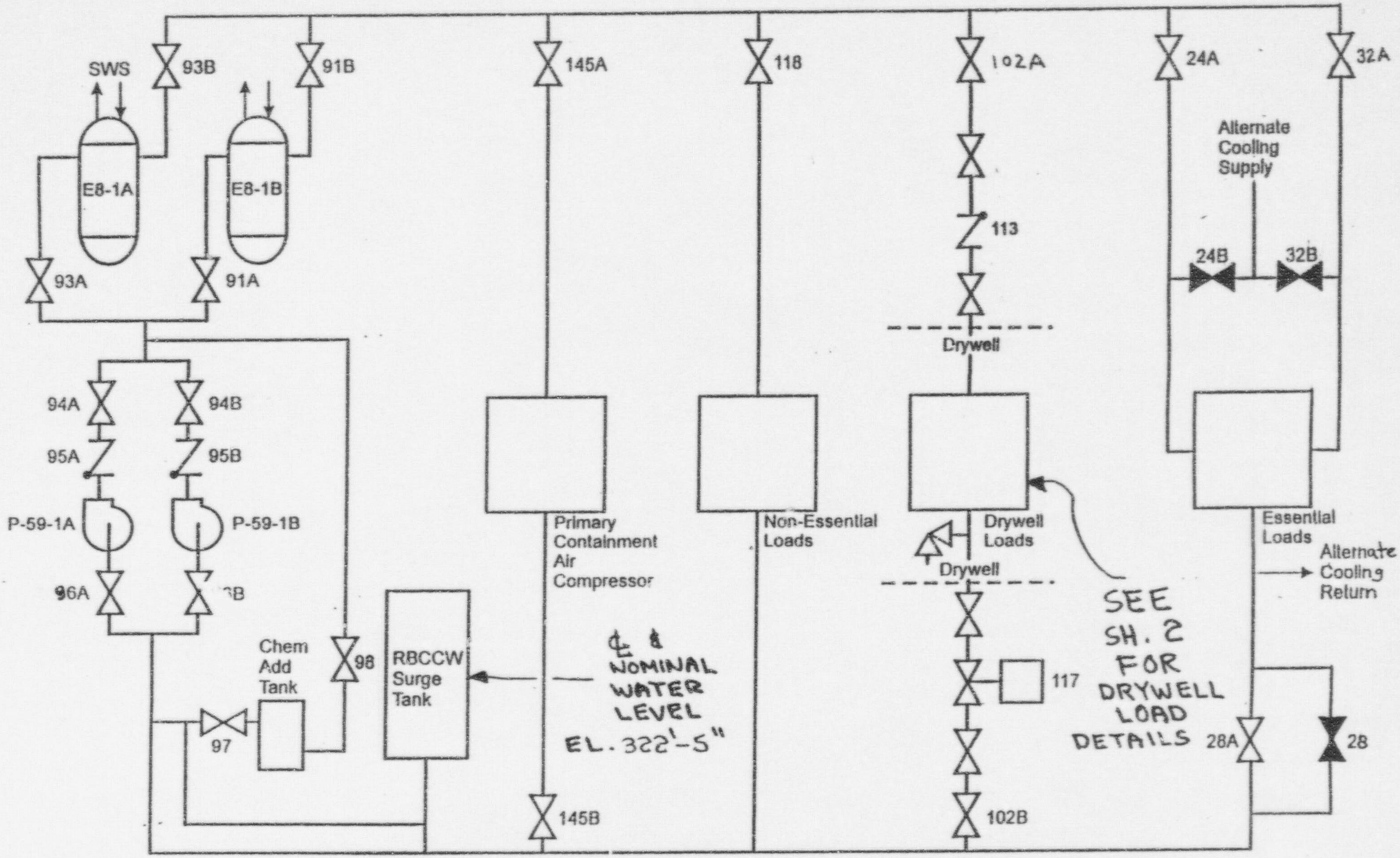
As discussed in Reference (g), Vermont Yankee's schedule for resolving the GL 96-06 issue is startup from our planned Fall 1999 refueling outage.

Specific details of the planned modification will be prepared consistent with our outage preparation activities and are not complete at this time, however the primary objectives of any modification will be to:

1) Ensure that containment integrity is maintained for postulated scenarios

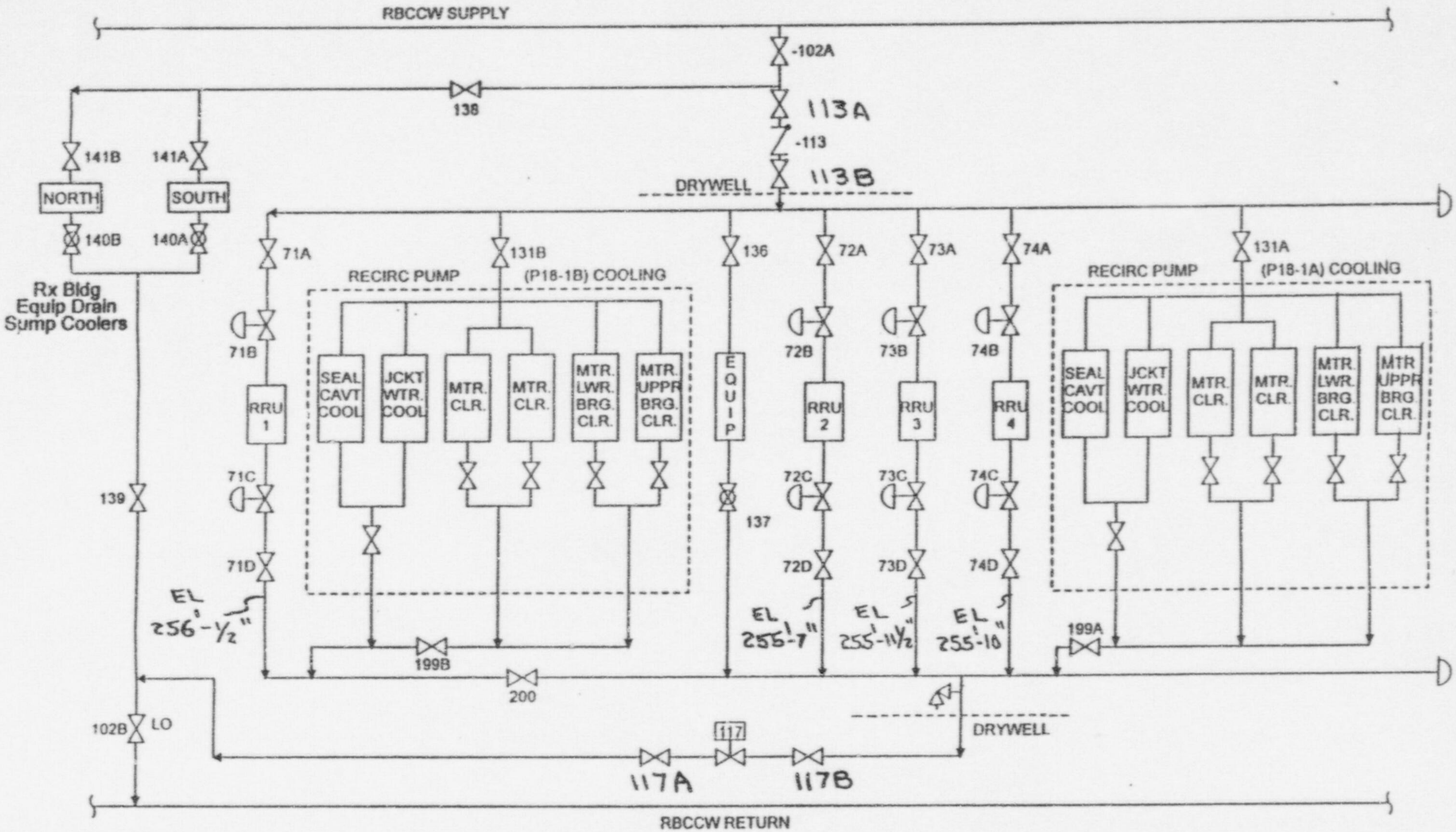
2) Ensure that RBCCW availability, post accident, is preserved to the highest extent possible

ATTACHMENT 2
Sheet 1 of 2



Simplified Reactor Building Closed Cooling Water System

ATTACHMENT 2
Sheet 2 of 2



Simplified Reactor Building Closed Cooling Water System Drywell Loop