

Susquehanna Steam Electric Station
Loss of Fuel Pool Cooling Design Deficiencies

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INTRODUCTION

- Technical concerns
 - Susquehanna SES has serious design defects for handling loss of fuel pool cooling events resulting from a Design Basis Accident Loss of Coolant Accident (DBA LOCA).
 - Very high risk accident (risk = probability * consequences)
 - Because of post-DBA LOCA radiation levels, operators powerless to intervene or even monitor fuel pool conditions.
 - Most BWRs have same basic design (approximately 1/3 of U.S. plants)
- Other concerns
 - << To be handled separate from this presentation at NRC's request >>

OUTLINE OF ACCIDENT SCENARIO OF CONCERN

- Licensing basis includes all accidents/events described in FSAR and *all mechanistic consequences*.
- DBA LOCA is one of the accidents described in the FSAR.
- The Spent Fuel Pool (SFP) cooling system is not designed for post-LOCA hydrodynamic and environmental conditions and will fail mechanistically as a result of the DBA LOCA.
- If the SFP cooling system fails, per the FSAR, boiling is the consequence (SFP is in the reactor building).
- SFP boiling is one of the mechanistic consequences of a DBA LOCA alone and, therefore, is within the licensing basis.
- Combination accidents also described in the FSAR: LOCA + LOOP, LOCA + LOOP + single failure, LOCA + Seismic Event, LOCA + Seismic Event + single failure
- All these combination accidents also cause SFP boiling and, therefore, are within the licensing basis.

OUTLINE OF ACCIDENT SCENARIO OF CONCERN

- Emergency Service Water (ESW) makeup valves to SFP are in the reactor building.
- For DBA LOCA with required Reg Guide 1.3 source terms, reactor building is inaccessible for many days.
- Therefore, ESW makeup valves cannot be opened without excessive exposure.
- If makeup water cannot be provided, fuel in the SFP will be uncovered and suffer damage outside primary containment.
- Unanalyzed catastrophic results.
- Safety-related equipment in the reactor building is not qualified for temperatures and water collection resulting from SFP boiling.
- Therefore, this safety-related equipment will fail.
- After this safety-related equipment fails, the core will meltdown.

PP&L'S POSITIONS

- Before the 10CFR21 Report
 - The accident scenario of LOCA with SFP boiling was not explicitly described in the FSAR.
 - The FSAR had been reviewed and approved by the NRC.
 - PP&L had an "unwritten agreement" with the NRC that LOCA with SFP boiling did not have to be considered.
 - PP&L was not required to consider Reg Guide 1.3 source terms.
 - The PP&L operators could take needed "heroic" actions.
 - The PP&L emergency management organization could handle any condition even if it had not been analyzed.

PP&L'S POSITIONS

- Since the 10CFR21 Report
 - PP&L still claims that LOCA with SFP boiling is not part of the SSES licensing basis, therefore, they are not required to be designed for it.
 - PP&L finally concedes that Reg Guide 1.3 source terms are applicable for operator access to the reactor building and that airborne radiation must be considered.
 - PP&L has made numerous equipment, procedure, analysis and training changes - all for a condition they maintain was of "minimal" safety significance.
 - Despite all of these changes, PP&L admits that numerous shortcomings and equipment failures remain for the LOCA with SFP boiling scenario.
 - Despite these changes and remaining failures, PP&L contends there is not now and never was a safety problem. And, PP&L is asking the NRC to accept these positions.

SPECIFIC POINTS OF CONTENTION

- Fuel pool instrumentation is seismically qualified.
 - Instrumentation is only seismically mounted, not seismically qualified.
 - Instrumentation is also not qualified for LOCA or boiling SFP environments.
- Fuel pool instrumentation is Class 1E qualified.
 - It can be powered from a 1E source, but the circuitry is non-1E and the instruments are not 1E qualified.
 - In 1984, 1988, and 1992, PP&L's Nuclear Safety Assurance Group recommended that the instrumentation be upgraded. At the time of our Part 21 report, the instrumentation was not upgraded.

SPECIFIC POINTS OF CONTENTION

- Standby Gas Treatment System (SGTS) is qualified for boiling spent fuel pool conditions.
- Equipment in the SGTS rooms is not qualified for temperature resulting from boiling fuel pool. Questionable ability to handle volume of condensate that will be generated in SGTS ductwork.
- At the time of the Part 21 report, fire dampers in the SGTS inlet ducts closed at 165F. Boiling spent fuel pool generates 180F temperatures.
- Reactor building HVAC recirculation system can be isolated to prevent the boiling SFP heat and moisture from reaching the safety-related equipment in the reactor building.
- This would be an unanalyzed condition. Recirculation is required for mixing of the reactor building atmosphere for temperature control and for dilution of primary containment leakage.

SPECIFIC POINTS OF CONTENTION

- Emergency procedures/training at time of Part 21 report addressed SFP boiling; changes are just enhancements.
- Procedures at time of our Part 21 report did not address this scenario. Current changes address this scenario for the first time.
- Procedure was changed in 1988 to add step to de-energize non-1E power to the reactor building. This change created an unreviewed safety question, but was not reported by PP&L.
- The design basis source term required by Reg Guide 1.3 is a "severe accident", i.e., outside the SSES design/licensing bases.
- Reg Guide 1.3 source terms are within the SSES design/licensing bases as clearly indicated in NRC Standard Review Plan 15.6.5.
- "Severe accident" is only properly *applied* to accidents which are actually outside licensing basis, such as ATWS.

SPECIFIC POINTS OF CONTENTION

- ESW makeup valves may be operated within the 5 Rem exposure limit.
- PP&L time-motion study determined that one trip to the ESW valves resulted in 4.2 Rems exposure.
- To prevent overflowing the SFP, ESW makeup is specified to be in batch mode. Therefore, each batch exposes operator and HP tech to an entire accident duration dose.
- Flood water from boiling pool can be sent to radwaste.
- Sump pumps are not 1E powered or seismically or environmentally qualified.
- Operators do not have access due to radiation levels.
- Radwaste is not 1E powered or seismically qualified.
- Radwaste is not designed to handle accident volumes or content.
- This would constitute breach of secondary containment.
- No place to release or store the processed accident water.

SPECIFIC POINTS OF CONTENTION

- RHR could be used in the fuel pool cooling assist mode.
- Critical valves are inaccessible after a DBA LOCA due to radiation levels.
- PP&L's analysis showed RHR pumps had insufficient NPSH in this mode.
- Pre-op testing confirmed that RHR pumps could not deliver required flow.
- Fuel pool temperature at time of RHR FPC Assist initiation would probably exceed 125F, providing even less NPSH.
- Spray pond does not have sufficient capacity at this time for fuel pool heat load in addition to LOCA and shutdown loads.
- Single failure cannot be tolerated in this mode.
- Not all of the involved piping is seismically qualified.
- Critical RHR valves were removed from the ISI program.

SPECIFIC POINTS OF CONTENTION

- Failure of core spray pump due to flooding is acceptable because there is another pump to handle cooldown.
- No failure of safety-related equipment due to inadequacies in the design is acceptable.
- With only one pump, single failure leaves no pumps for cooldown.
- With actual volumes of water that will be generated, the watertight door to the second core spray pump room will fail causing loss of the second pump.
- LOOP can last only 24 hours.
- Reg Guide 1.137 requires emergency diesel generators to have minimum of 7 days fuel supply.
- Turkey Point had LOOP that lasted six and one half days.
- Credible long-term LOOP mechanisms: Natural events, operator error and sabotage.

OTHER VIOLATIONS AND FAILURES

- Even with these described safety-related equipment failures documented by PP&L, PP&L has not made any 10CFR50.72/50.73 reports to the NRC (violation of 10CFR50.9).
- Fuel pool instrumentation is not environmentally qualified for LOCA of boiling SFP conditions (violation of 10CFR50.49, Reg Guide 1.97, 10CFR50 App. A GDC 63, and Reg Guide 1.13).
- These safety-related room coolers are not designed for latent heat cooling and will potentially fail upon SFP boiling with resultant failure of the safety-related equipment they serve (violation of 10CFR50.49, 10CFR50 App. A GDC 4, and 10CFR50 App. B Criterion III Design Control):

Core spray pump rooms

RHR pump rooms

HPCI and RCIC pump rooms

- The safety-related HVAC ductwork is not designed to handle condensation and will produce unanalyzed leaks and/or will fail due to condensate accumulation or blockage of flow path (violation of 10CFR50 App. B Criterion III Design Control).
- "Draft" analyses for this scenario have not been reviewed and approved (violation of 10CFR50 App. B Criterion III).

QUALIFICATIONS OF PERSONS MAKING PART 21 REPORT

- Don Prevatte's Education and Experience
 - Bachelor of Science in Mechanical Engineering
 - Officer in engineering consulting company
 - Over 22 years commercial nuclear power experience in design, startup, and management.
 - 13 years experience with BWRs
 - 9 years experience with PP&L
 - 4 years experience performing NRC inspections at more than 25 nuclear plants
 - 2 1/2 years experience as design engineer on SSES power uprate project
 - 2 years as A/E discipline manager

QUALIFICATIONS OF PERSONS MAKING PART 21 REPORT

- Dave Lochbaum's Education and Experience
 - Bachelor of Science in Nuclear Engineering
 - Over 14 years commercial nuclear power experience in design, startup, operations, and licensing
 - 7 years experience as reactor engineer
 - 3 years experience as BWR Shift Technical Advisor (STA)
 - 1 year experience as Reactor Engineering and STA Supervisor
 - 1 year experience as licensing engineer
 - 2 years experience as design engineer on SSES power uprate project
 - 1 year experience on Design Bases Document project and handling design bases discrepancies
 - Experience with BWR Mark I, II, and III containment designs

HISTORY OF THIS CONCERN

- Prevatte prepared updated reactor building heat load calculation for power update.
- Lochbaum performed technical review of updated calculation.
- We discovered and reported to PP&L supervision in March 1992 that original and updated calculations non-conservatively neglected any mode of spent fuel pool cooling and the latent heat load from boiling spent fuel pool(s).
- Updated calculation was revised to assume FPCS operation in non-LOOP case and RHR FPC Assist mode operation in LOOP case.
- Research to support assumptions determined that boiling SFP could result from DBA LOCA. We would not sign calculation since it was not bounding. EDR G20020 was generated in April 1992 on loss of fuel pool cooling concerns to allow calculation to be issued.

HISTORY OF THIS CONCERN

- PP&L EDR process repeatedly failed to completely and adequately address the EDR G20020 concerns.
- PP&L management failed to properly determine operability and reportability for the concerns.
- On November 17, 1992, PP&L submitted inaccurate, incomplete, and misleading report under 10CFR50.9, failing to properly report concerns under 10CFR50.72 and 10CFR50.73.
- When it became apparent that PP&L would not make complete and accurate report to the NRC, we submitted a report under 10CFR21 on November 27, 1992.

REASONS WE MADE 10CFR21 REPORT

- High risk accident
- Serious generic implications of the concerns
- Ethical responsibility
- Legal obligation under 10CFR21
- To bring regulatory attention to PP&L's culture adverse to nuclear safety
- What's in it for us?

WHY WE KNOW WE ARE RIGHT

- Washington Public Power Supply System reported same problems under 10CFR50.72 and 10CFR50.72 in April and May 1993.
- General Electric issued warning letter to all domestic BWRs on this concern in March 1993.
- Four independent PP&L engineering evaluations agreed with the essences of our technical assessments.
- We spent two years before the discovery researching the systems involved. After the discovery, we concentrated research on the concerns. All research confirmed concerns.
- PP&L also researched concerns. PP&L resolved 2 of the 9 original concerns, but was unable to resolve the rest.
- PP&L has made and will make extensive modifications to plant hardware, procedures, training and analyses to cope with a problem they contend has "minimal" safety significance.
- Massachusetts Assistant Attorney General's consultant found concerns valid.

WHAT SHOULD BE DONE NOW? WHAT DO WE WANT NRC TO DO?

- Perform thorough review of current SSES condition versus regulatory requirements and ensure SSES is made safe.
- Determine the generic impact of this discovery on other BWRs, PWRs, and independent onsite fuel storage facilities.
- Determine SSES condition at time of our Part 21 report versus regulatory requirements.
- Investigate PP&L's actual response to our discovery before the Part 21 report.
- Investigate counter-to-nuclear-safety management attitudes at PP&L.
- Bring issue to closure as soon as practicable.
- Don't take our positions at face value; don't take PP&L's positions at face value. If the facts are examined impartially, we are confident that our conclusions will be supported.

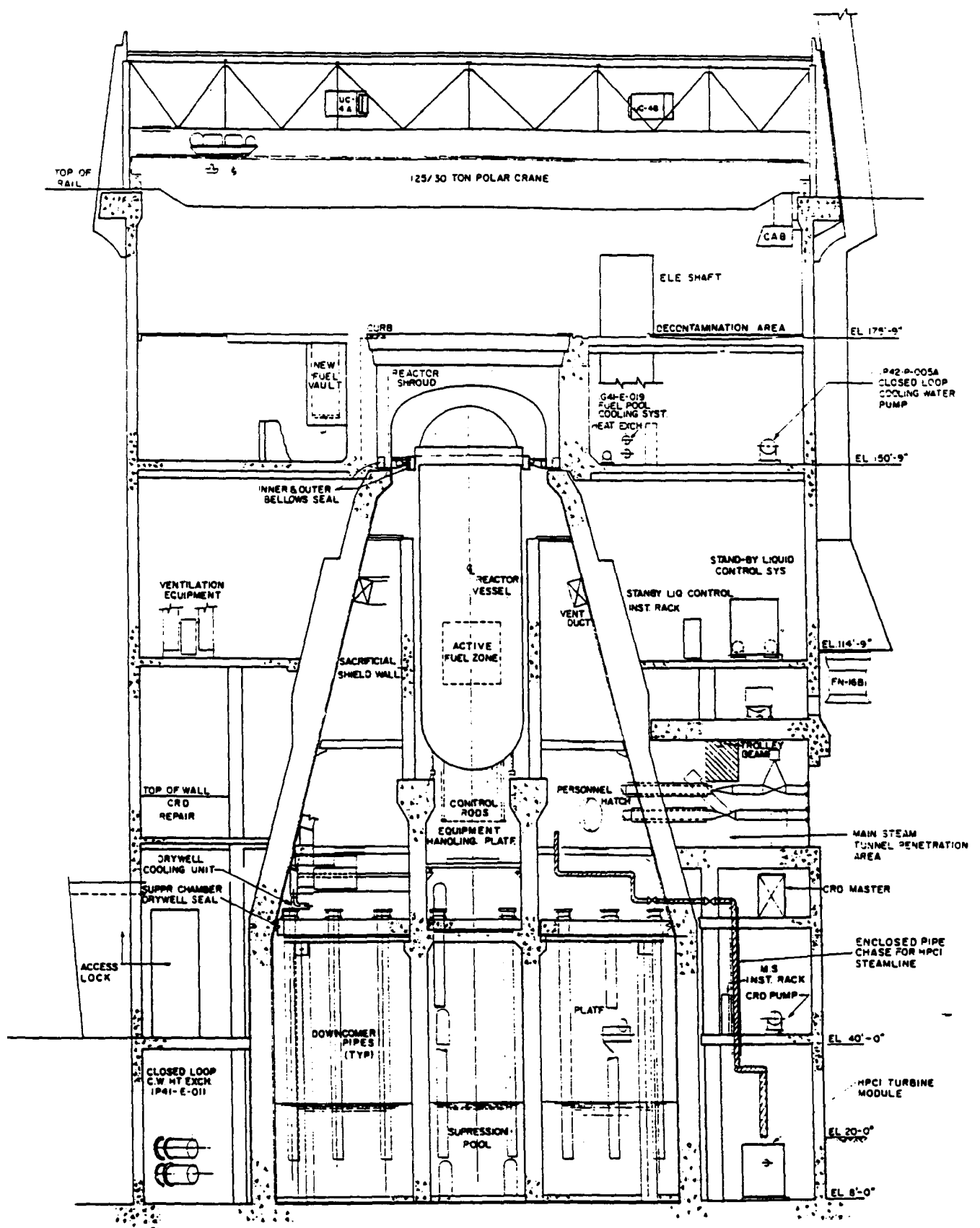
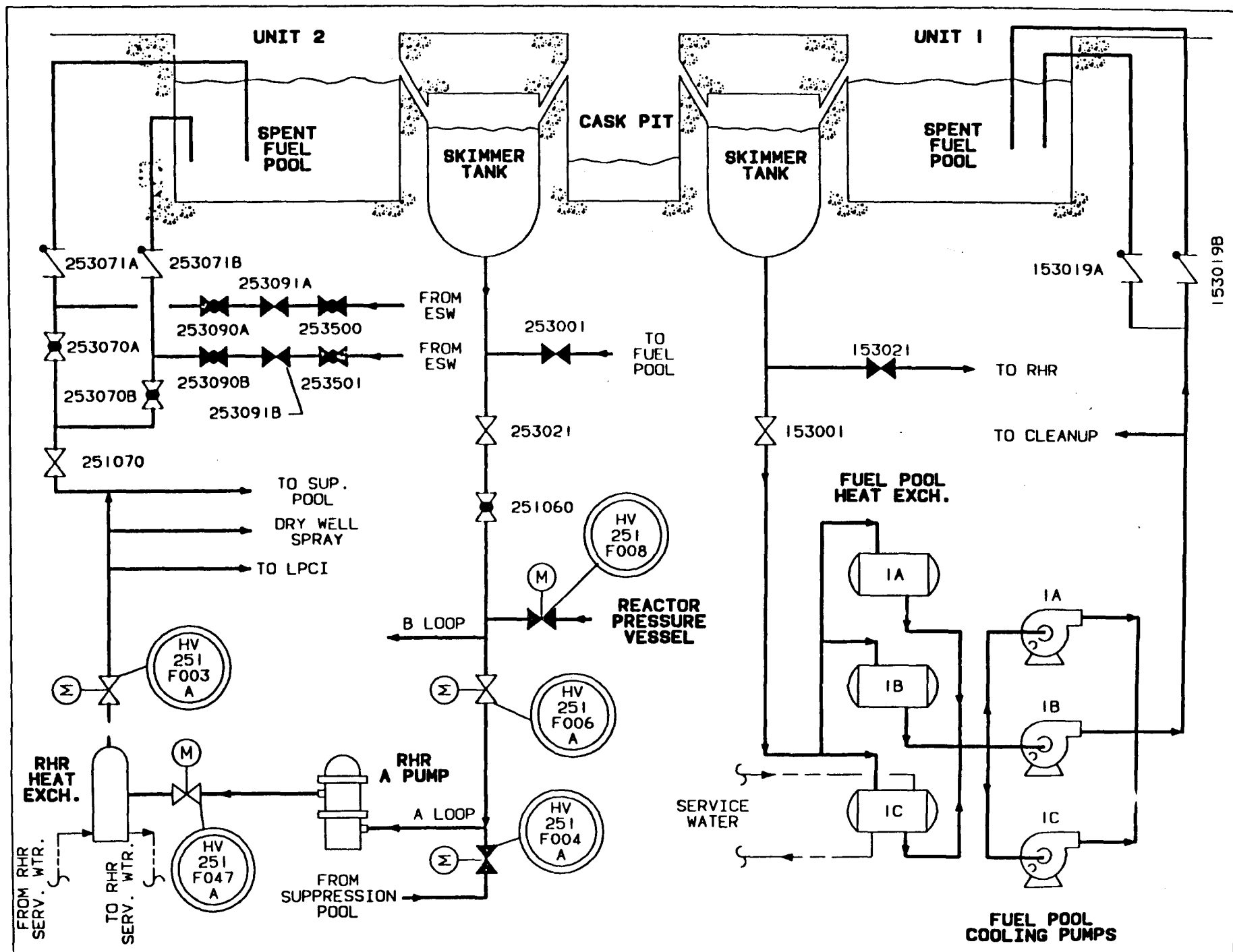
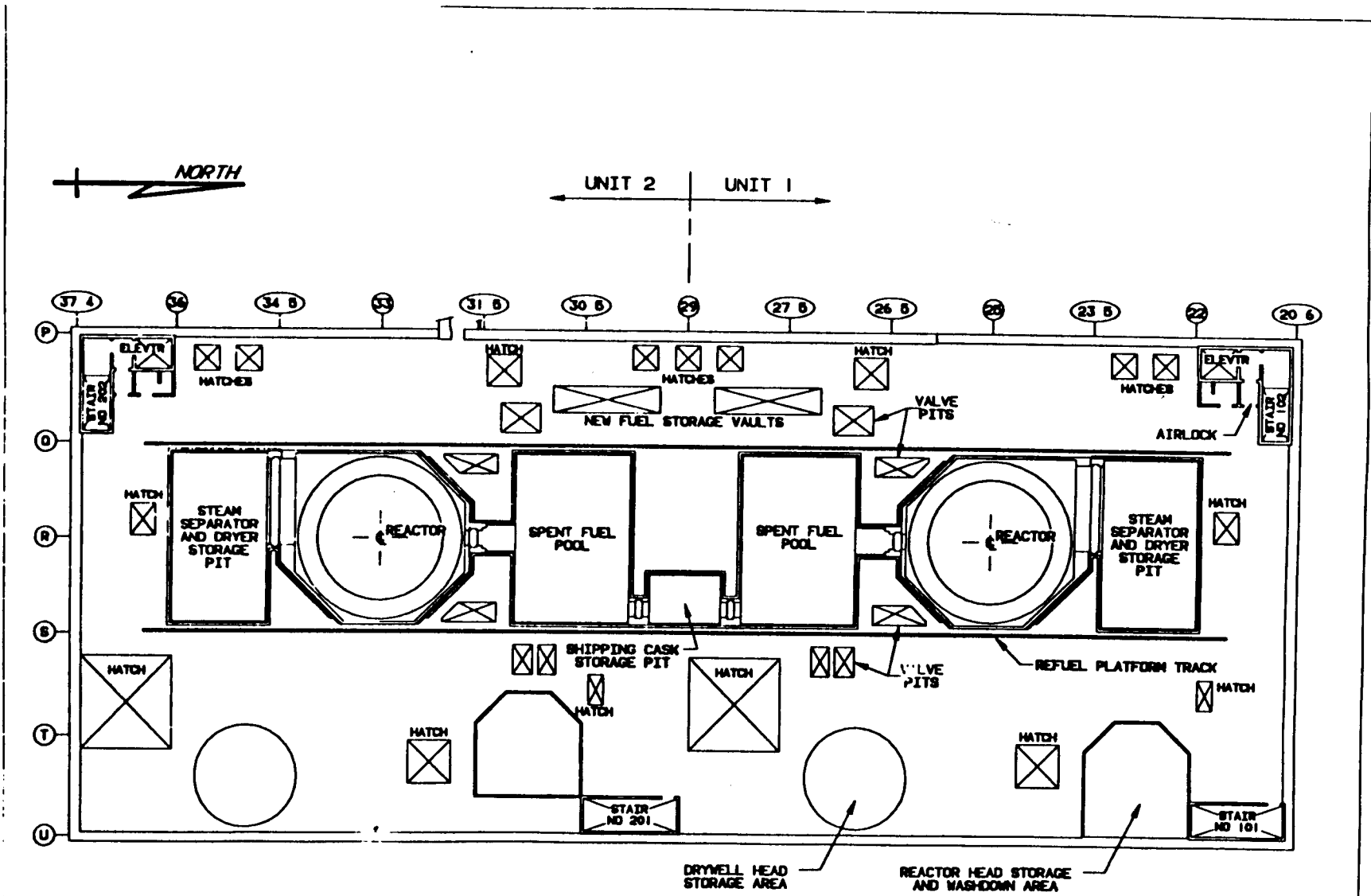


Figure 1. Shoreham containment.





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