# VERMONT YANKEE
# NUCLEAR POWER CORPORATION

Ferry Road, Brattleboro, VT 05301-7002

REPLY TO
ENGINEERING OFFICE
580 MAIN STREET
BOLTON, MA 01740
(508) 779-6711


May 21, 1996
BVY 96-67

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

References:
(a) License No. DPR-28 (Docket No. 50-271)
(b) Letter, VYNPC to USNRC, BVY 95-127, dated November 20, 1995
(c) NUREG-0562, "Fuel Rod Failure as a Consequence of Departure from Nucleate Boiling or Dryout," dated June 1979
(d) NRC Inspection and Enforcement Manual, Inspection Procedure 64100, "Postfire Safe Shutdown, Emergency Lighting and Oil Collection Capability at Operating and Near-Term Operating Reactor Facilities," dated March 16, 1987
(e) Letter, VYNPC to USNRC, FVY 85-38, dated April 24, 1985
(f) NUREG-0630, "Cladding Swelling and Rupture Models for LOCA Analysis," dated March 1980

Subject: Request for Exemption from 10 CFR Part 50, Appendix R, Section III.G, "Fire protection of safe shutdown capability" and Section III.L, "Alternative and dedicated shutdown capability"

In accordance with the provisions of 10 CFR Part 50.12, Vermont Yankee Nuclear Power Corporation hereby requests an exemption from certain provisions of 10 CFR Part 50, Appendix R, Section III.G "Fire protection of safe shutdown capability" and Section III.L "Alternative and dedicated shutdown capability." Specifically, an exemption from paragraphs G.1.a and L.2.b is requested to permit use of our Automatic Depressurization System (ADS) safety relief valves (SRVs) in conjunction with either the Core Spray (CS) system or Residual Heat Removal system in the Low Pressure Coolant Injection (LPCI) mode to achieve and maintain safe shutdown for fires in certain fire areas or zones where high pressure injection systems may not remain free of fire damage.

Discussion:
Vermont Yankee's safe shutdown analysis is designed to be consistent with Emergency Operating Procedures (EOPs). This results in a hot shutdown core cooling strategy that uses high pressure makeup systems [Feedwater, Reactor Core Isolation Cooling (RCIC), and High Pressure Coolant Injection (HPCI)] for makeup whenever possible. Depressurization and low pressure injection systems are used when high pressure systems are not available. The use of ADS/CS or ADS/LPCI to satisfy the reactor coolant makeup function of Section III.G.2 is appropriate for fire scenarios, because



A006
1/1

the high pressure makeup systems and depressurization/low pressure makeup systems are all designed for this function and are considered redundant. Per Reference (d), the NRC has previously approved use of ADS/LPCI to satisfy the reactor coolant makeup function under Section III.G.2.

Vermont Yankee is currently updating the safe shutdown analysis and verifying that appropriate safe shutdown strategies exist for all fire areas and fire zones. As reported in Reference (b), the original hot shutdown core cooling strategy, use of RCIC for a fire in reactor building zones RB-1, RB-2, and RB-3, may not be possible due to inadequate cable separation (See Figures 1 through 3 for plan views of reactor building elevations 252 feet, 232 feet, and 213 feet).

To satisfy the cable separation requirements, we are proposing a change to the core cooling strategy for reactor building fire zones RB-1, RB-2, RB-3, and RB-4 such that depressurization with two SRVs and makeup by one train of Core Spray will be relied upon for the core cooling function. This strategy is similar to the existing RB-4 core cooling strategy described in Reference (e), except that two SRVs are used in lieu of four SRVs. The proposed strategy change will require rerouting cables for two of the four SRVs outside of the unprotected portion of reactor building zone RB-3. A design change is being developed to separate the SRV cables in the reactor building. Cable routing for two of the SRVs will stay the same and run through RB-3 where they enter the drywell. Cables for the other two SRVs will be routed through the northwest suppression portion of RB-3 to RB-4 where they will enter the drywell. This design change will allow two SRVs and one train of Core Spray to remain available and operable from the Control Room for postulated fires in RB-1, 2, 3, and 4.

As an added feature in this design change, we are planning to provide isolation and transfer capability at an alternate shutdown location for two of the four SRVs. This change will eliminate the need for a cold shutdown SRV repair procedure, and will enhance our alternate shutdown system capability by providing the option to use either a high pressure makeup capability (RCIC) or a low pressure makeup capability (ADS/LPCI) for cable vault and control room fires.

10CFR 50, Appendix R, Section III.G, "Fire protection of safe shutdown capability," paragraph G.1.a, requires that:

> "One train of systems necessary to achieve and maintain hot shutdown conditions from either the control room or emergency control station(s) is free of fire damage;"

An exemption from the above requirement is requested to allow use of depressurization and low pressure injection. Using these strategies may allow or result in an early transition from hot shutdown to cold shutdown. Therefore, depending on the circumstances, the operators may not "maintain" hot shutdown conditions, choosing rather to proceed to cold shutdown conditions after depressurization. After depressurization, if the reactor is transitioned directly to cold shutdown without maintaining hot shutdown conditions, the intent of paragraph G.1.a is satisfied in that safe shutdown conditions are achieved and maintained.

10CFR 50, Appendix R, Section III.L, "Alternative and dedicated shutdown capability," paragraph L.2.b, requires that:

> "The reactor coolant makeup function shall be capable of maintaining the reactor coolant level above the top of the core for BWRs"

An exemption from the above requirement is requested to allow use of depressurization and low pressure injection strategies. Vermont Yankee has performed transient analyses to predict the reactor core's thermal-hydraulic response to postulated fire scenarios requiring depressurization with SRVs followed by low pressure injection from one train of either Core Spray or LPCI. As discussed below, the analyses demonstrate that although for a short duration the reactor coolant level will drop below the top of the core, no clad damage occurs. Therefore, the safety objective of paragraph L.2.b is satisfied.

Justification:
The SRV re-route design change, described above and planned for the 1996 refueling outage, will allow the use of a depressurization/low pressure injection strategy in lieu of a high pressure inventory makeup strategy for several fire areas or zones. This alternate strategy is proceduralized in the existing Emergency Operating Procedures and is therefore a proven core cooling strategy. This depressurization/low pressure injection strategy is also consistent with that used at other Boiling Water Reactors for Appendix R.

In addition, it should be noted that for Reactor Building fires, offsite power is not impacted by the fire. It is our understanding that, except for fires requiring alternate shutdown, a random loss of offsite power is not required to be assumed for Appendix R compliance. The feedwater pumps located in the turbine building, although not presently fully analyzed to comply with III.G.2, are therefore, expected to be available for makeup until the reactor can be depressurized at normal cooldown rates. This provides defense in depth for reactor building fires.

The design change to re-route SRV cables will also provide alternate shutdown isolation and transfer switches for two of the four SRVs. This eliminates the cold shutdown SRV repair currently needed for Control Room, Cable Vault, or RB-3 fires. More significantly, as discussed above, this design change enhances the current alternate shutdown capability by allowing prompt depressurization and LPCI injection if needed. This capability provides defense in depth protection and provides the operator with additional flexibility.

Transient analyses have been performed to ensure that no clad damage would occur due to the short duration core uncovery that is inherent in the depressurization/low pressure injection strategy. The objective of these analyses was to examine the core thermal-hydraulic response for the spectrum of postulated Appendix R fire scenarios and recovery strategies and to demonstrate that the proposed strategies would limit the clad heatup to below 1500 °F, and hence prevent clad damage [Reference (c)]. The analyses were performed using RELAP5YA (BWR), Vermont Yankee's LOCA analysis code. This code was chosen because it provides for detailed modeling of fuel rod behavior, including dynamic variations in gap conductance and metal-water reaction rates. However, since these analyses are not intended for examination of 10CFR50.46 acceptance criteria, they were not performed with all the 10CFR50 Appendix K input assumptions. Instead, an alternate set of conservative input assumptions were utilized. The most significant of these is that the decay heat is modeled with the 1979 ANS Standard, with uncertainties at the $2\sigma$ level. The input assumptions do include uncertainties. For example, an uncertainty of 2% in core power is included in bounding the decay heat values, uncertainties in ECCS flow rates were included, and core power shapes were selected to bound plant historical operating conditions. The methods also evaluate clad rupture in accordance

with NUREG-0630 [Reference (f)] requirements. The following table summarizes the limiting ADS/CS and ADS/LPCI cases analyzed. The ADS/CS case represents the depressurization/low pressure injection strategy for RB-1, 2, 3, and 4 following the Emergency Operating Procedures which instruct the operator to inhibit ADS until reactor level reaches top of active fuel (TAF). The ADS/ LPCI case represents a bounding (not expected) alternate shutdown scenario in which a stuck open SRV is assumed.

| Case | Number of SRVs | RPV Level When SRVs Opened | Time When SRVs Opened (sec) | Time When Injection Initiated (sec) | PCT (°F) |
|---|---|---|---|---|---|
| ADS/CS | 2 | TAF | 1180 (manual open) | 1680 | <1000 |
| ADS/LPCI | 1 | Normal | 0 (stuck open) | 1500 (manual injection) | <1500 |

The results show that the short duration peak clad temperature (PCT) would be below 1500°F and core heatup is quickly quenched soon after low pressure injection is initiated. In accordance with Reference (c), no clad damage is expected until prolonged clad temperatures well over 1500°F are experienced. Based on our analyses and comparison with Reference (c) and Reference (f) data, no clad damage is predicted for Vermont Yankee's depressurization / low pressure injection strategies for fire scenarios.

The exemption from paragraph G.1.a is necessary only to allow the operator to continue a prompt transition to cold shutdown after depressurization. Therefore, the intent of the regulation is being satisfied by this approach.

The exemption from paragraph L.2.b is necessary due to the inherent short duration core uncovery experienced when reactor depressurization strategies are applied. Since no clad damage is expected to occur and the level will recover quickly, the intent of the regulations is being satisfied by this approach.

Special Circumstances:
Special Circumstances, as defined in 10 CFR Part 50.12(a)(2)(ii) and 10 CFR Part 50.12(a)(2)(iv), are present which warrant granting an exemption from the requirements of the regulation. By making use of a depressurization/low pressure injection strategy, Vermont Yankee believes the underlying purposes of 10 CFR Part 50, Appendix R, Section III, paragraphs G.1.a and L.2.b are achieved. In addition, the alternate shutdown capability is being enhanced by adding the capability for prompt depressurization/low pressure injection as an alternative to the existing RCIC capability. This results in an increase in safety and a benefit to the public health and safety.

Conclusion:
Based on the technical justification and special circumstances detailed above, Vermont Yankee requests an exemption from the requirements of 10 CFR Part 50, Appendix R, Section III.G, "Fire protection of safe shutdown capability," paragraph G.1.a and 10 CFR Part 50, Appendix R, Section III.L "Alternative and dedicated shutdown capability," paragraph L.2.b. The exemption is requested

for the use of depressurization and low pressure injection strategies for fire zones RB-1, 2, 3, and 4 as well as alternate shutdown.

We trust that our request is acceptable; however, should you have any questions on this matter, please contact this office.

Sincerely,

VERMONT YANKEE NUCLEAR POWER CORPORATION

Jay K. Thayer
Vice President, Engineering

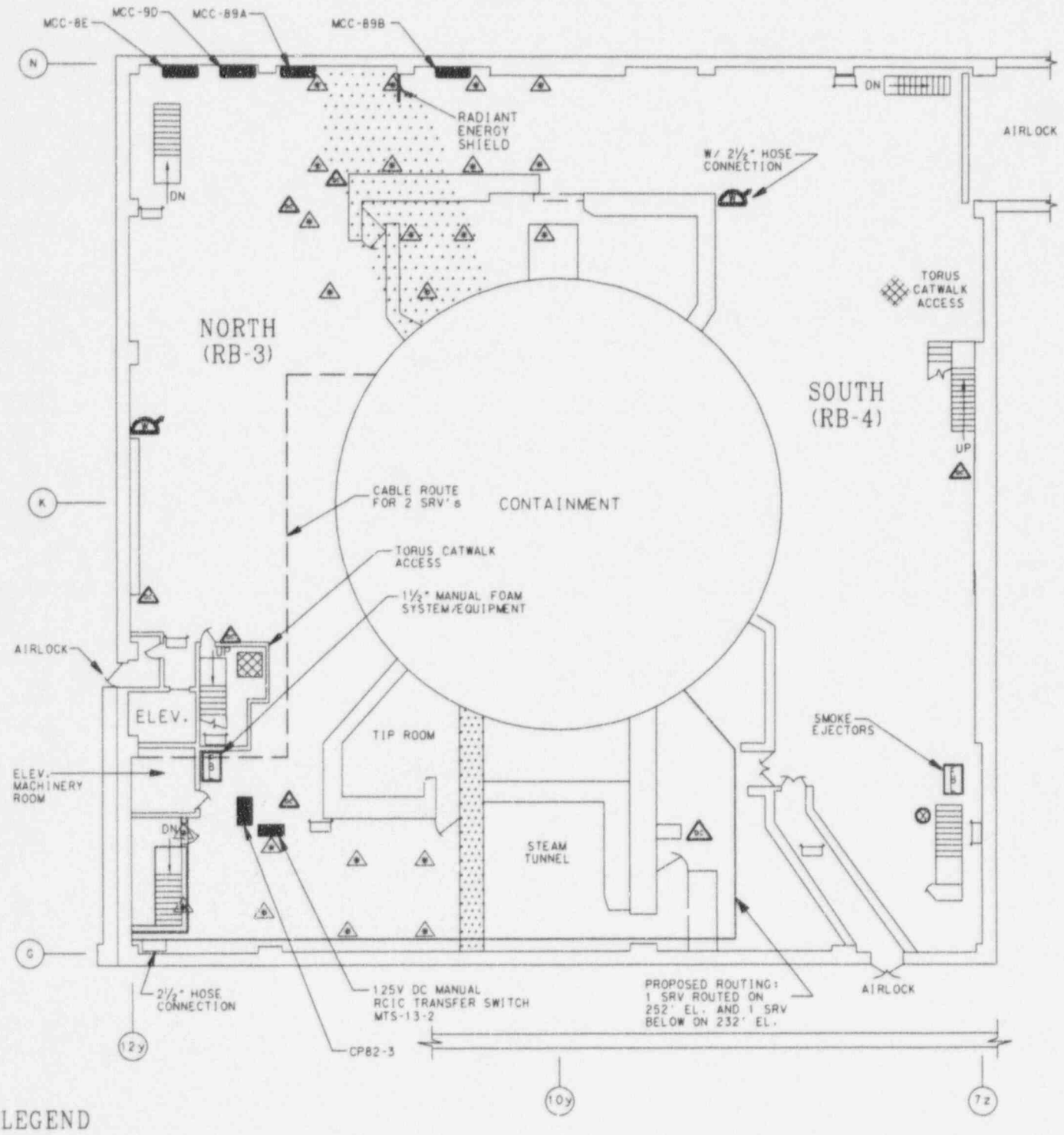
c: USNRC Region I Administrator
USNRC Resident Inspector - VYNPS
USNRC Project Manager - VYNPS

# FIGURE 1

# REACTOR BUILDING

## ELEVATION 252'-6"

(FOR ILLUSTRATION ONLY - NOT TO SCALE)




## LEGEND

- HAZARD
- SAFE SHUTDOWN EQUIPMENT
- SEPARATION ZONE
- LOCK HIGH RADIATION AREA
- FIRE BARRIERS
- FIRE BRIGADE LOCKER
- DRY CHEMICAL EXTINGUISHER
- HOSE STATION
- SMOKE DETECTORS
- AUTOMATIC SUPPRESSION (CEILING AND MID LEVEL)
- EMERGENCY LIGHTING

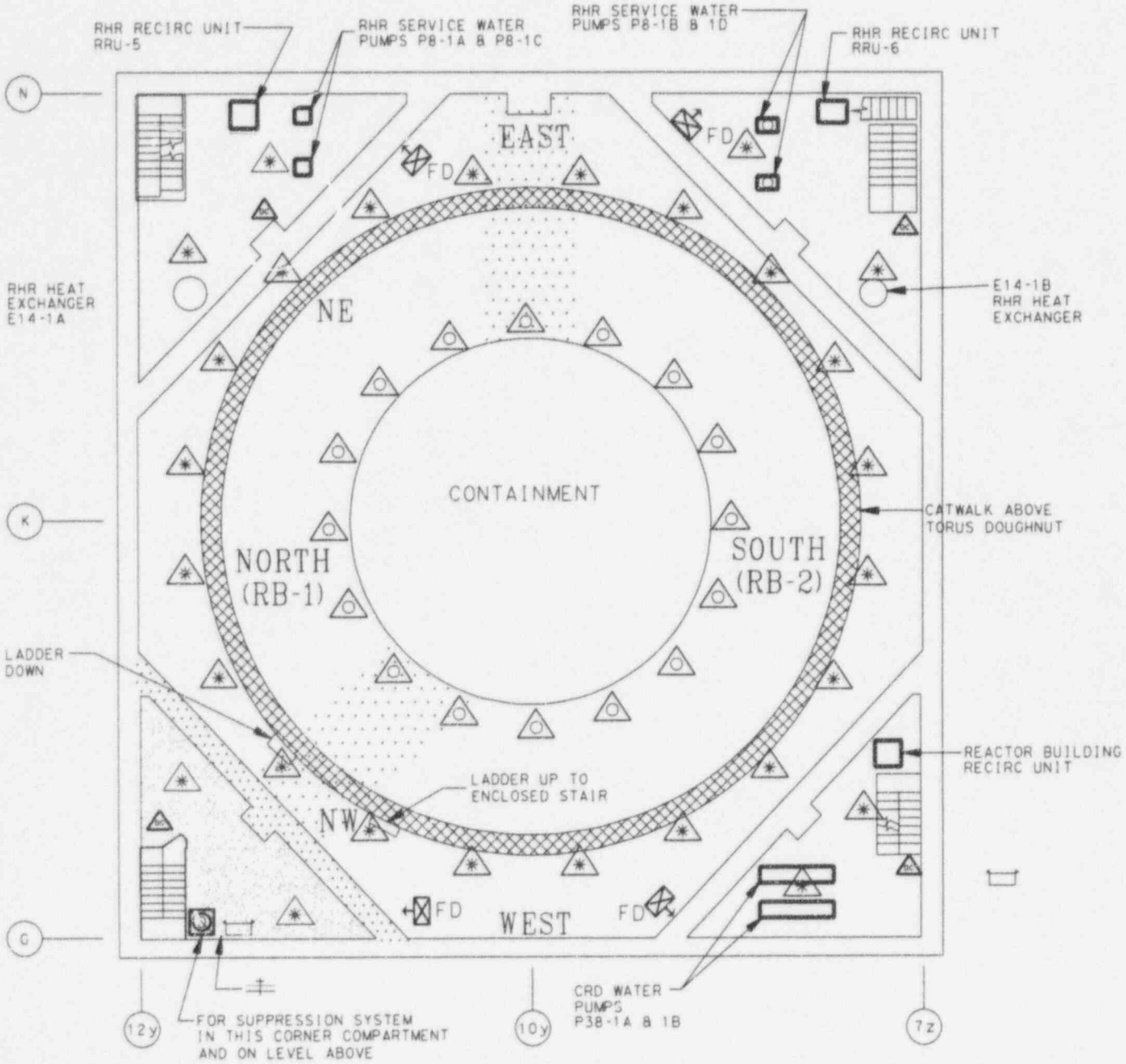
c:/vyfire/appendix/rb252-6.dgn

# FIGURE 2

# TORUS

## ELEVATION 232'-6"

(FOR ILLUSTRATION ONLY - NOT TO SCALE)




## LEGEND

- HAZARD
- SAFE SHUTDOWN EQUIPMENT
- SEPARATION ZONE
- VITAL FIRE BARRIERS
- VENTILATION GRILL SUPPLY
- FD — 3 HOUR FIRE DAMPER
- OS+Y VALVE FIRE PROTECTION
- DC — DRY CHEMICAL EXTINGUISHER
- REMOTE MANUAL TRIP STATION DELUGE
- EMERGENCY LIGHTING
- SMOKE DETECTORS
- HEAT DETECTORS
- AUTOMATIC SUPPRESSION

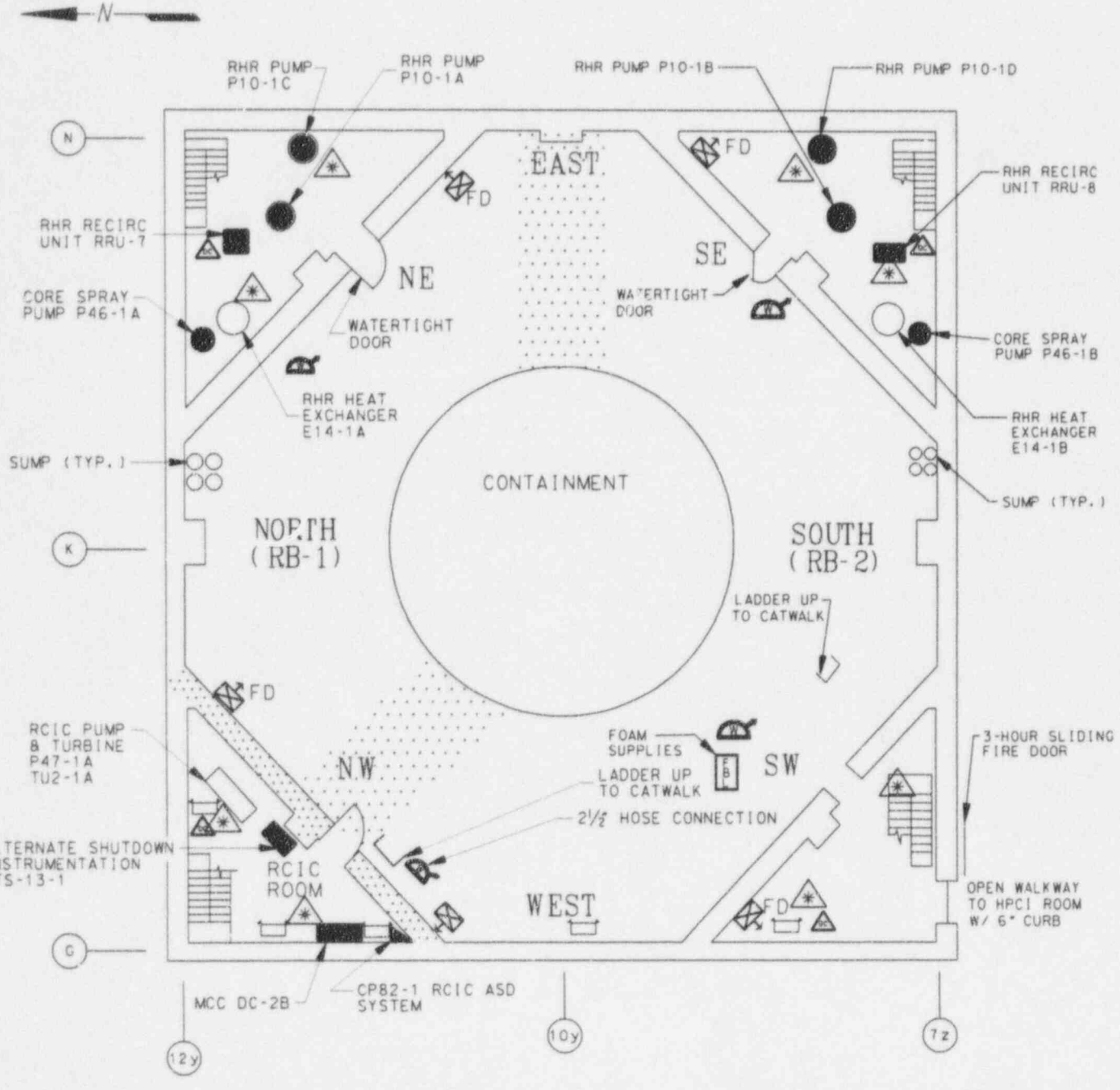
c:/vyfire/appendix/tor232-6.dgn

# FIGURE 3

# TORUS

## ELEVATION 213'-9"

(FOR ILLUSTRATION ONLY - NOT TO SCALE)




## LEGEND

- HAZARD
- SAFE SHUTDOWN EQUIPMENT
- SEPARATION ZONE
- FIRE BARRIERS
- DC — DRY CHEMICAL EXTINGUISHER
- FB — FIRE BRIGADE LOCKER
- VENTILATION GRILL SUPPLY
- FD — 3 HOUR FIRE DAMPER
- W — HOSE STATION
- EMERGENCY LIGHTING
- SMOKE DETECTORS

c:/vyfire/appendix/tor213-9.dgn