Progress Energy

Crystal River Nuclear Plant
Docket No. 50-302
Operating License No. DPR-72

Ref: 10 CFR 50, Appendix R

February 3, 2005
3F0205-05

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: Crystal River Unit 3 – 10 CFR 50 Appendix R Exemption Request for Pressurizer Level Instrumentation

Dear Sir:

Pursuant to 10 CFR 50.12, Florida Power Corporation, doing business as Progress Energy Florida, Inc. (PEF), hereby requests an exemption to certain 10 CFR 50, Appendix R requirements for selected safe shutdown instrumentation located within the Crystal River – Unit 3 (CR-3) reactor building.

The proposed exemption specifically requests that the pressurizer level instrumentation be exempted from the requirements of 10 CFR 50, Appendix R, Section III.G.2. Attachment 1 contains the justification for this request. Attachments 2 – 5 contain salient portions of the CR-3 fire modeling calculation performed to support this request. PEF requests approval of the proposed exemption by August 1, 2005.

There are no new regulatory commitments contained in this request.

If you should have any questions regarding this submittal, please contact Mr. Sid Powell, Supervisor, Licensing & Regulatory Programs, at (352) 563-4883.

Sincerely,

Michael J. Annacone
Manager Engineering

Attachments:
1. Justification for Exemption
2. Calculation M04-0014, Summary of Bases and Assumptions
3. Calculation M04-0014, Summary of Calculational Methodology
4. Calculation M04-0014, Summary of Conclusions
5. Calculation M04-0014, Graphical Layouts

cc: NRR Project Manager
Regional Office
Resident Inspector

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A006

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER - UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

10 CFR 50 APPENDIX R EXEMPTION REQUEST FOR PRESSURIZER LEVEL INSTRUMENTATION

ATTACHMENT 1

JUSTIFICATION FOR EXEMPTION

JUSTIFICATION FOR EXEMPTION

1.0 INTRODUCTION

In April, 2004, Crystal River – Unit 3 (CR-3) nuclear condition report (NCR) 124391 was written to document a past Generic Letter (GL) 86-10 evaluation which non-conservatively concluded that a fire inside the CR-3 reactor building "D rings" (biological shield walls) could not occur. The graphical layouts of the reactor building are in Attachment 5.

For conservatism, the evaluation should have assumed a fire due to a failure of the Reactor Coolant Pump (RCP) Oil Collection System or an Oil Collection System component, and the subsequent release of oil within the D ring. Although a catastrophic failure is unlikely, evaluation of the consequences of a potential leak and subsequent fire should have been pursued.

Should a fire occur due to failure of the RCP Oil Collection System / Component, the integrity of three redundant pressurizer level instrumentation sensing lines (or tubing) could be compromised. Two of the redundant pressurizer level instruments are temperature compensated and one is uncompensated. These instrument sensing lines are routed from the pressurizer pressure taps where the required separation is not possible. Analyses, including fire modeling of the reactor building fire zone RB-95-300, have indicated that the temperature compensation for the two compensated instruments could be lost. (The reactor building fire zone RB-95-300 is the area inside the D rings from the 95 ft elevation (the lowest level in the reactor building) to the top of the D rings at the 180 ft elevation.) This leaves only the redundant uncompensated instrument available for use during safe shutdown of the plant. This condition does not meet the requirements of 10CFR50, Appendix R, Section III.G2. This was documented in NRC Inspection Report 05000302/2004005 as a Licensee Identified Non-Cited Violation (Section 4OA7).

Extensive inspections of each RCP motor lubrication system and associated RCP Oil Collection System are conducted during each refueling outage and after any necessary maintenance on the system. These inspections are performed to ensure continued operability of the RCP Oil Collection System. This precludes the buildup of oil due to minor leaks from the RCP Oil Collection System and thus limits the amount of oil that could be pooled on the reactor building D ring floor during the operating cycle.

A reactor building walkdown is performed prior to each reactor startup during the operating cycle and any discrepancies such as those identified in NCR 136775 are identified in the CR-3 corrective action program and resolved. In September 2004, CR-3 NCR 136775 documented that, during a reactor building walkdown, a small amount of oil was discovered which had leaked from the RCP Oil Collection System. The source of the leakage (leaking joints) was repaired. This event was documented in NRC Inspection Report 05000302/2004005 as a Licensee Identified Non-Cited Violation (Section 4OA7). The Inspection Report noted that the amount of leaking oil was very small and was less than that required to sustain a fire.

2.0 DESCRIPTION OF PROPOSED EXEMPTION

The exemption requested by Florida Power Corporation, doing business as Progress Energy Florida, Inc. (PEF), addresses the portion of 10CFR50, Appendix R which sets forth the requirement that fire protection features shall be provided for Structures, Systems, and Components important to safe shutdown. Specifically, the requirement is for fire protection provisions that limit fire damage such that one train of systems necessary for safe shutdown is not damaged by fire.

The pressurizer level instrumentation is necessary for safe shutdown of the plant. There are three sets of pressurizer level instruments: two are temperature compensated and one is not temperature compensated. The redundant uncompensated level instrument will be relied upon in post-fire scenarios, where fires affect the temperature compensation, for safe shutdown of the plant. In these scenarios, the resistance temperature devices (RTDs) which provide the compensation for level are assumed to be affected by a reactor building fire (see Attachment 2, Item 23). The redundant uncompensated instrument is unaffected by the loss of the RTD temperature compensation.

For a fire in the RB-95-300 area, the redundant uncompensated level instrument will be credited for safe shutdown. However, the redundant uncompensated instrument sensing line does not meet the protection requirements of 10CFR50, Appendix R, Section III.G2.

All instrument tubing in the area affected by a fire in the reactor building, other than the pressurizer level instrument tubing, (e.g., reactor coolant system (RCS) pressure, RCS temperature, and steam generator level instrumentation tubing) meet the requirements of Appendix R, Section III.G2.d due to availability of a redundant component in an area away from the fire (e.g., in the alternate D ring). Although within the same fire area, this configuration ensures redundancy with adequate separation of train components. The instruments associated with the tubing are outside the D rings (outside the fire area) and are protected. It is only the uncompensated pressurizer level instrumentation tubing which fails to meet the separation and protection requirement of Appendix R, Section III.G2.

The fire modeling performed in support of this exemption request demonstrates that any credible fire in the vicinity of the uncompensated pressurizer level instrumentation sensing lines will not cause the failure of the sensing lines nor will it render the instrumentation inoperable. It also demonstrates that while the fire may result in flashing of the fluid within the uncompensated instrument tubing, thereby temporarily affecting the indicated pressurizer level, the integrity of the instrument tubing is maintained. This is due to the postulated fire being of very short duration (less than two minutes) after which the fluid temperature decreases and any vapor pockets collapse. Additionally, the tubing is sloped such that any vapor pockets can migrate to the pressurizer.

Therefore, a specific exemption to 10CFR50, Appendix R, Section III.G2 should be granted for the uncompensated pressurizer level instrumentation and associated tubing.

3.0 BACKGROUND

During a review of the CR-3 Fire Study (Safe Shutdown Analyses), it was identified that the fire area inside the reactor building D rings had a non-conservative GL 86-10 evaluation that was not addressed in the CR-3 Fire Hazards Analysis. The basis of the non-conservative evaluation was the assumption of a complete lack of combustibles in the area. Since all of the combustible oil in the fire area is housed within the RCP oil reservoirs and leakage from these pumps would be collected by a seismically qualified RCP Oil Collection System, a design basis fire was not deemed credible.

The evaluation should have assumed the failure of an RCP Oil Collection System and thus the presence of combustibles in the fire area to support a fire.

There are no transient combustibles within the D rings and all exposed cables (i.e., not in conduit) have asbestos jacketing material that would not contribute significant quantities of heat if exposed to a fire.

A review of the 10CFR50, Appendix R criteria and safe shutdown strategies revealed that CR-3 has safe shutdown instrumentation and instrumentation tubing within the affected area of a postulated oil fire from a failed RCP Oil Collection System. This instrumentation and tubing is unprotected as required by Appendix R, Section III.G.2.

The non-conservative GL 86-10 evaluation was the basis for not postulating a fire in this area and thus not needing to apply the requirements of Appendix R, Section III.G.2 to these instruments and instrument tubing.

Hughes & Associates were contracted to perform a calculation to determine the total effects of an oil fire from a postulated failed RCP Oil Collection System(s) anywhere with the CR-3 D rings. That calculation is the basis for this exemption request.

4.0 REGULATORY REQUIREMENTS AND GUIDANCE

10CFR50.12, Specific Exemptions, Section (a) states:

(a) The Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of the regulations of this part, which are--

(1) Authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security.

(2) The Commission will not consider granting an exemption unless special circumstances are present. Special circumstances are present whenever--

(i) Application of the regulation in the particular circumstances conflicts with other rules or requirements of the Commission; or

(ii) Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule; or

(iii) Compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated; or

(iv) The exemption would result in benefit to the public health and safety that compensates for any decrease in safety that may result from the grant of the exemption; or

(v) The exemption would provide only temporary relief from the applicable regulation and the licensee or applicant has made good faith efforts to comply with the regulation; or

(vi) There is present any other material circumstance not considered when the regulation was adopted for which it would be in the public interest to grant an exemption. If such condition is relied on exclusively for satisfying paragraph (a)(2) of this section, the exemption may not be granted until the Executive Director for Operations has consulted with the Commission.

10CFR50, Appendix R, Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979, Section III.G2 states:

> Except as provided for in paragraph G.3 of this section, where cables or equipment, including associated non-safety circuits that could prevent operation or cause maloperation due to hot shorts, open circuits, or shorts to ground, of redundant trains of systems necessary to achieve and maintain hot shutdown conditions are located within the same fire area outside of primary containment, one of the following means of ensuring that one of the redundant trains is free of fire damage shall be provided:
>
> a. Separation of cables and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating. Structural steel forming a part of or supporting such fire barriers shall be protected to provide fire resistance equivalent to that required of the barrier;
>
> b. Separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustible or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area; or
>
> c. Enclosure of cable and equipment and associated non-safety circuits of one redundant train in a fire barrier having a 1-hour rating, In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area;
>
> Inside non-inerted containments one of the fire protection means specified above or one of the following fire protection means shall be provided:
>
> d. Separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustibles or fire hazards;
>
> e. Installation of fire detectors and an automatic fire suppression system in the fire area; or
>
> f. Separation of cables and equipment and associated non-safety circuits of redundant trains by a noncombustible radiant energy shield.

5.0 TECHNICAL ANALYSIS

PEF contracted with Hughes & Associates to perform fire modeling of fire area RB-95-300 to determine the impact on instrumentation and instrumentation tubing (or sensing lines) located in the area and to ensure the Reactor Building (RB) design basis temperatures and pressures are not exceeded. Specifically, the fire analysis addresses the following:

- Determine the location, size, and length of time of a postulated fire in fire area RB-95-300 and its effects on the Safe Shutdown instrumentation located in this area.

  The lube oil volume used for the analysis was determined from the specific scenario being analyzed. Factors included lubricant leakage source and quantity and area physical configuration (floor drain location, floor slope, proximity to a potential target). For example, the postulated failure of two RCP Oil Collection Systems resulted in an oil fire of about 40 gallons. In all scenarios, the quantities of oil evaluated greatly exceed the as-found RCP Oil Collection System leakage documented since the RCP Lube Oil System and Oil Collection System upgrade in 1997. Only very small amounts of oil have been found within the D rings (e.g., about half a gallon in 1999, small puddles and thin film in 2003, insignificant amount of oil in early 2004, less than one gallon in late 2004).

- Evaluate the instrument sensing line integrity due to the type of fire postulated above. Ensure that the instrument sensing lines maintain reactor coolant pressure boundary integrity.

- Evaluate the resultant building temperatures from the postulated scenarios to ensure that the Reactor Building design basis temperatures and pressures are not exceeded.

The Bases and Assumptions for the calculation are summarized in Attachment 2. The Calculational Methodology is summarized in Attachment 3. The Conclusions of the calculation are summarized in Attachment 4. Graphical layouts associated with the calculation are in Attachment 5.

Two conclusions in Attachment 4 are repeated here for emphasis:

(1) The calculation determined that oil fires due to the failure of the RCP Oil Collection System will not propagate from one D ring to the other. This validates that the redundant instrumentation in alternate D rings are protected by adequate separation as required. (Conclusion d)

(2) The calculation also demonstrates that none of the instrumentation / instrumentation tubing in the North D–Ring would be damaged by a fire. Thus none of the pressurizer level instruments and /or instrument tubing are damaged by a fire. The compensation (RTD) for the compensated instruments is lost however, and therefore the compensated instruments should not be relied upon for safe shutdown.

Maintaining the integrity of the instrument and instrument tubing for the uncompensated pressurizer level instrument is the basis for utilizing the uncompensated pressurizer level instrument for the safe shutdown of the plant, fulfilling the underlying purpose of 10 CFR 50, Appendix R, Section III.G.2. (Conclusion f)

6.0 REGULATORY ANALYSIS

Pursuant to 10CFR50.12, the Commission may grant exemptions from the requirements of 10CFR50 when:

The exemptions are authorized by law;
The exemptions will not present an undue risk to the public health and safety;
The exemptions are consistent with the common defense and security; and
Special Circumstances are present.

The exemptions are authorized by law

The NRC authority to grant exemptions from the requirements of 10CFR50 is codified in 10CFR50.12. As discussed below, this exemption will not present an undue risk to the public health and safety and are consistent with the common defense and security. Therefore, the NRC is authorized to issue the exemption.

The exemptions will not present an undue risk to the public health and safety

As determined by the referenced calculation, the credible fire will not damage the uncompensated pressurizer level instrumentation sensing lines. Thus, protecting the sensing lines as required by 10CFR50, Appendix R, Section III.G2 is not necessary for safe shutdown. Therefore, this exemption presents no undue risk to the public health and safety.

The exemptions are consistent with the common defense and security

To ensure that the common defense and security are not endangered, the exemption request must demonstrate that the loss or diversion of Special Nuclear Material (SNM) is precluded. CR-3 has systems and processes in place that provide protection for the public from diversion of SNM that is licensed to be possessed on site. These systems and processes are those embodied in the "Crystal River Nuclear Power Plant Security, Training and Qualification, and Safeguards Contingency Plans, Revision 0."

The request for exemption from the requirements of 10 CFR 50, Appendix R, Section III.G.2, does not affect the systems and processes discussed above. Therefore, this exemption does not affect the common defense or security.

Special Circumstances are present

10CFR50.12 (a) states that the Commission will not consider granting an exemption unless special circumstances are present. Special circumstances are present whenever-- (ii) Application of the regulation in the particular circumstances ... is not necessary to achieve the underlying purpose of the rule.

In this specific circumstance, protection of the uncompensated pressurizer level instrumentation sensing lines is not necessary to achieve the underlying purpose of the rule. 10CFR50, Appendix R, Section III.G2 requirements are meant to ensure Structures, Systems, and Components are available for safe shutdown. The uncompensated pressurizer level instrumentation sensing lines will not be damaged by any postulated fire and will thus be available for safe shutdown of the plant without the additional protection or separation required by 10CFR50 Appendix R, Section III.G2.

7.0 PRECEDENTS

Specific exemptions to certain requirements of 10 CFR 50 Appendix R, Section III.G2 have been approved by the Commission pursuant to 10 CFR 50.12 as follows:

Station	Date	Accession No.
Davis-Besse	December 26, 2002	ML020100366
St. Lucie	December 24, 2004	ML033570260
Monticello	October 28, 2004	ML042460220

The St. Lucie exemption dealt with equipment inside the reactor building.

8.0 REFERENCES

PEF Nuclear Generation Group Calculation # M04-0014, Fire Modeling of Fire Area RB 95-300, Reactor Building D rings, Rev. 0.

NRC Inspection Report 05000302/2004005

CR-3 Nuclear Condition Report (NCR) 124391

CR-3 NCR 136775

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ATTACHMENT 2

CALCULATION M04-0014, SUMMARY OF
BASES AND ASSUMPTIONS

CALCULATION M04-0014, SUMMARY OF BASES AND ASSUMPTIONS

1. There is an ignition source present. This is a conservative assumption because credit is not taken for the general lack of ignition sources, especially on the 95 ft elevation.

2. The sump drains on the 95 ft elevation are not plugged before or during the fire scenario. Normally, there are no materials that would cause the drains to clog on this elevation, and they are inspected during outages. The drains were found free of obstructions during the most recent outage. In addition, scenarios are not postulated to cause the drains to become plugged (i.e., result in the dispersal of material that could plug the drains such as fibrous insulation).

3. Catastrophic failure of a reactor coolant pump (RCP) that leads to destruction of the lube oil collection system, abrupt spillage of lubricant reservoirs onto the 95 ft elevation, and/or projection of lubricant beyond the areas postulated in this calculation is not considered in this analysis. The oil collection system is designed, engineered, and installed such that failure will not lead to fire during normal or design basis accident conditions. Branch Technical Position (BTP) APCSB 9.5-1 Section III.a, "Defense in Depth," states "Postulated fires or fire protection system failures need not be considered concurrent with other plant accidents or the most severe natural phenomena; e.g., loss of coolant accident (LOCA) and fire." Consistent with the BTP, the CR-3 basis is that fires need not be postulated to be concurrent with nonfire-related failures in safety systems, other plant accidents, or the most severe natural phenomena.

   This assumption/basis is supported by internal and external operating experience. No such catastrophic pump/motor failures have occurred, and no oil collection systems have been incapacitated by a pump/motor failure.

4. Based on Design Inputs and survey observations, sources of lubricant on the 95 ft elevation are small leaks in the RCP lubricant collection systems. The leakage characteristics are such that there would be no continuous leakage lubricant source. All leakage is via dripping and involves lubricant drops or very short intermittent streams.

5. Pool fires reach the peak heat release rate nearly instantaneously. A growth rate is not assumed for these fire scenarios.

6. Air velocities in the free air space within the D rings are low enough to ensure an oil drop will not deflect or redirect from a point directly beneath where it originates. This is supported by survey observations indicating that personnel present in the motor vicinity during motor operation have reported that the air-flow is nearly imperceptible by movement.

7. Due to the floor drainage system, the slow leakage of oil, and the slope of the floor on the 95 ft elevation, there are limits as to where lubricant could pool beneath the RCP pumps. The maximum distance from a direct path to the drain that lubricant is expected to pool is

predicted by connecting a line from the point on the floor directly beneath where a lubricant drop originates and the drain centerline. That horizontal distance is 6.5 ft.

8. The maximum thickness that lubricant can pool on the 95 ft elevation is 0.11 inches as recommended by Gottuk and White. This is based on large lubricant volumes (25 gal) on flat concrete surfaces. This value is expected to be conservative because the floor on the 95 ft elevation is sloped with a variation of 3 inches between high and low points and within the range of imperfections (0.25 inches, or plus or minus 0.13 inches) as determined from the design of the floor drain system and visual observations in the D ring. Note that the assumed thickness exceeds the range for hydrocarbon fuels involving quantities less than 25 gal and is nearly four times greater than the recommended depth of 0.03 inches for oil based hydrocarbons.

9. The components within the Reactor Building, including those within the D rings, excluding the enclosure around the reactor vessel, occupy less than ten percent of the enclosed volume. Also, there are no other significant objects within the Reactor Building that would collectively account for ten percent of the volume enclosed by the Reactor Building. Ten percent is therefore a bounding estimate.

10. The leakage area between the Reactor Building and the external surroundings is 0.15 inches^2. This is consistent with NRC requirements.

11. The pressure within Pressurizer instrument tubing is approximately equal to the pressure in the Pressurizer. Temperature and phase changes within the tubing will not result in an increased pressure within the system since the volume of the Pressurizer is much larger than the volume of water in the instrument tubing segments exposed to fire. Pressure differentials within the tubing are due to elevation changes and density changes in the water.

12. If water temperature exceeds 648°F, it is assumed to form a vapor pocket given an internal pressure of 2,165 psig. When evaluating the thermal response of the instrument tubing, if a vapor pocket is predicted to form, convection and radiation losses to the water are ignored and an adiabatic boundary condition is applied to the inner instrument tubing boundary. This is a conservative assumption insofar as some radiation and conduction losses would occur after the formation of a vapor pocket. Ignoring these effects results in an overestimate of the instrument tubing steel temperature.

    An additional conservatism is introduced when evaluating the thermal response of the tubing at elevations below the Pressurizer. In this case, if a vapor pocket forms, it could migrate to the Pressurizer tank while being replaced with water at the heated location, depending on the orientation of the tubing and the net buoyancy force on the vapor pocket. The internal temperature of the steel tubing would never exceed the boiling point of the water, or 648°F when the pressure is 2,165 psig. When the fire exposure ends, the instrument tubing will refill with the Pressurizer water.

13. If the tubing is immersed in the flames or thermal plume, carbon deposition increases the emissivity and absorption coefficients to 0.95.

14. The Pressurizer vessel has sufficient thermal inertia to resist significant temperature increases if exposed to the scenarios postulated. The volume of the Pressurizer and the mass of the water therein is several orders of magnitude greater than the quantity of water/steam within the instrument tubing sections heated by the postulated fire scenarios.

15. The mechanical ventilation systems in the Reactor Building and the D rings re-circulate the air within the containment structure. If the mechanical ventilation system remains functional during a fire, they would tend to provide mixing, and in a limiting sense, would result in a one-zone environment throughout the Containment Building. Since the mechanical ventilation system is designed to provide cooling where it is most needed, a true one-zone environment may not result. The additional mixing by the ventilation system would likely cause a greater degree of mixing than would be predicted if modeled as a one-zone environment. Hence, a situation that lies between a one-zone and two-zone environment is possible. To account for this, the fire scenario effects are bracketed by modeling the Containment Building as a one-zone and a two-zone environment.

16. The Limiting Oxygen Index (LOI) is a function of the smoke layer temperature. This relationship is approximated by Beyler, Peatross and Beyler, and the National Institute of Standards and Technology:

    - Ten percent when the temperature is less than 752°F;
    - Seven percent when the temperature is between 752°F and 1,112°F; and
    - Zero percent when the temperature is greater than 1,112°F.

17. The Lube Oil Collection Tanks (LOT 4A/B) are assumed to be sufficiently robust so as to prevent rupture and release of oil contents if exposed to an oil fire on the 95 ft elevation. The tanks are constructed of steel, they are not pressurized, they are located outside the D rings, and have flame arrestors. Given this, it is reasonable to assume that they would not become involved or contribute fuel to an exposure fire.

18. All surfaces are gray, such that their emissivity and absorbance are equal. This is a reasonable assumption for the heat flux sources and target materials considered.

19. The convection coefficient for buoyant convection heat transfer between a hot smoke layer and a target is 0.0005 Btu/s-ft^2-°R.

20. The convection coefficient between a heat flux gauge and the flames/plume is 4.9×10^{-4} Btu/s-ft^2-°R and the heat flux gauge temperature is 81°F. Assuming a greater convection coefficient results in a less conservative estimate of the net heat flux boundary condition at the surface of a target.

21. The Prandtl Number for air is constant over the temperature range of interest and is equal to 0.7. The Prandtl Number is used only when raised to the 1/3 power and varies from 0.69 – 0.71 over the temperature range of interest. The maximum error introduced by this assumption is therefore less than one-half percent. The heat capacity of air is also constant over the temperature range of interest and is equal to 0.00024 Btu/lb-°F. The maximum error introduced by this assumption is less than three percent.

22. Thermal losses to the reactor building (RB) steel liner and other building contents are ignored. The energy absorbed by the steel liner would reduce the temperature in the Reactor Building space and moderate the flux to the concrete containment structure. Ignoring these effects results in a conservative result.

23. Resistance Temperature Devices (RTDs) in the North D ring are damaged due to localized and indirect fire effects (flame impingement, immersion in the thermal plume, exposure to a hot gas layer).

24. Manual fire suppression is ignored. Manual and automatic fire suppression would mitigate the effects of a fire scenario and it is therefore conservative to ignore them.

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ATTACHMENT 3

CALCULATION M04-0014, SUMMARY OF CALCULATIONAL METHODOLOGY

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The goal of the calculation was threefold:

1. Determine the location, size, and length of time of the credible fire in fire area RB-95-300 and its effects on the Safe Shutdown instrumentation located in this area.

2. Evaluate the instrument sensing line integrity due to the type of fire postulated above. Ensure that the instrument sensing lines maintain reactor coolant pressure boundary integrity.

3. Evaluate the postulated resultant fire temperatures in the above scenarios to ensure that the Reactor Building design basis temperatures and pressures are not exceeded.

For the purposes of this analysis, the terms "source fire" and "fire scenario" are used interchangeably. A source fire is a burning fuel package, a term used to identify a combustible material (liquid or solid) that, if ignited, would sustain a fire. Instrumentation and instrumentation tubing are collectively treated as targets. A source fire has an adverse effect on a target by causing the target temperature to increase; targets are assumed to fail if this temperature increase exceeds pre-determined critical values.

The methodology adopted to accomplish the goals involves the following:

a. Identify targets of interest and their associated critical temperatures (performance criteria).

b. Identify the key characteristics of the D ring and Reactor Building space that would influence the temperature exposure to a target.

c. Develop credible fire scenarios in the D ring area based on the expected fuel packages and the key characteristics identified.

d. Determine the temperature conditions to which a target is subjected during each of the postulated fire scenarios. The temperature conditions may be the result of immersion in a hot smoke layer (an indirect effect) or they may be the result of direct fire effects (flame impingement, plume exposure, thermal radiation from the flames).

e. Determine the Maximum Expected Fire Scenario (MEFS). The MEFS is the most severe credible fire scenario for a given target. This is the scenario that causes the greatest increase in target temperature or, if the target temperature is not monitored, the scenario that results in the highest exposure temperature to the target. Each target will have a separate MEFS.

f. Determine the Limiting Fire Scenario (LFS). The LFS is a fire scenario that causes the target to exceed the performance criteria. The LFS was determined by changing one or more model input parameters, such as the fire size, location, or quantity of fuel available, until the performance criteria for a target was exceeded.

g. Determine the safety margin. The safety margin is determined by contrasting the LFS with the MEFS. The safety margin may have multiple components: the fire size and an increase in the available quantity of fuel. The acceptability of the safety margin is a function of the uncertainty in the input parameters and the accuracy of the methods used.

Indirect fire exposures were evaluated using the computer model CFAST. CFAST has been validated for various conditions, including containment structures, and was validated and verified for use at CR-3.

Direct fire exposure effects were calculated using correlations of flame height, temperature, thermal plume conditions, and thermal radiation heat flux. The methods are available in Society of Fire Protection Engineers Fire Handbook of Fire Protection, which forms the basis for many of the NUREG 1805, "Fire Dynamics Tools (FDTs) Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program," November 2004, calculation modules.

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ATTACHMENT 4

CALCULATION M04-0014, SUMMARY OF CONCLUSIONS

CALCULATION M04-0014, SUMMARY OF CONCLUSIONS

Source fires evaluated in the Fire Modeling Analyses predominantly include postulated fires at instruments and instrument tubing located in the North D ring. These scenarios were selected because they are the most limiting and most challenge safe shutdown of the plant because the North D ring is the location of the Pressurizer. A fire affecting the Pressurizer/Pressurizer instrumentation would leave the plant without alternate equipment to support safe shutdown (there is no alternate Pressurizer instrumentation in the South D ring)

Because two fires cannot develop simultaneously, a fire in the South D ring would leave the Pressurizer instrumentation in the North D ring available for safe shutdown, as well as the other required safe shutdown components. (The calculation concludes adequate separation exists between D rings and that a fire would not propagate from one D ring to the other).

For the scenarios modeled (and all potential scenarios), if a comparable fire were to develop in the South D ring, similar results would be calculated and would be bounded by the Fire Model Analyses performed.

The potential for postulated fire scenarios to damage various targets in the Reactor Building was assessed (as noted above). Indirect (smoke layer heating) and direct effects were considered.

Following are some key conclusions based on the results of the Fire Model Calculation:

a. Potential fires in the D ring include pump motor fires and lubricant pooled on the 95 ft elevation. Lubricant fires bound the winding fires in all respects.

b. The most significant lubricant fires were postulated to occur in the region beneath the reactor coolant pump (RCP) from which it originated, and the nearest floor drain. Up to two pumps could contribute lubricant to the same pool based on the drain configuration in the D ring.

c. The most credible scenario involved a lubricant leaking from RCP–1B that exposes the Pressurizer instrument tubing. The lubricant collection system for RCP–1A has been upgraded and is not expected to leak oil to the extent other RCPs collection systems could.

d. Maximum Expected Fire Scenarios (MEFSs) are not predicted to propagate between D rings.

e. Instrument tubing located above the fire and instrumentation located in the Reactor Building space and the South D ring were most limiting.

f. Instrumentation and instrument tubing in the North D ring would not be damaged.

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ATTACHMENT 5

CALCULATION M04-0014, GRAPHICAL LAYOUTS

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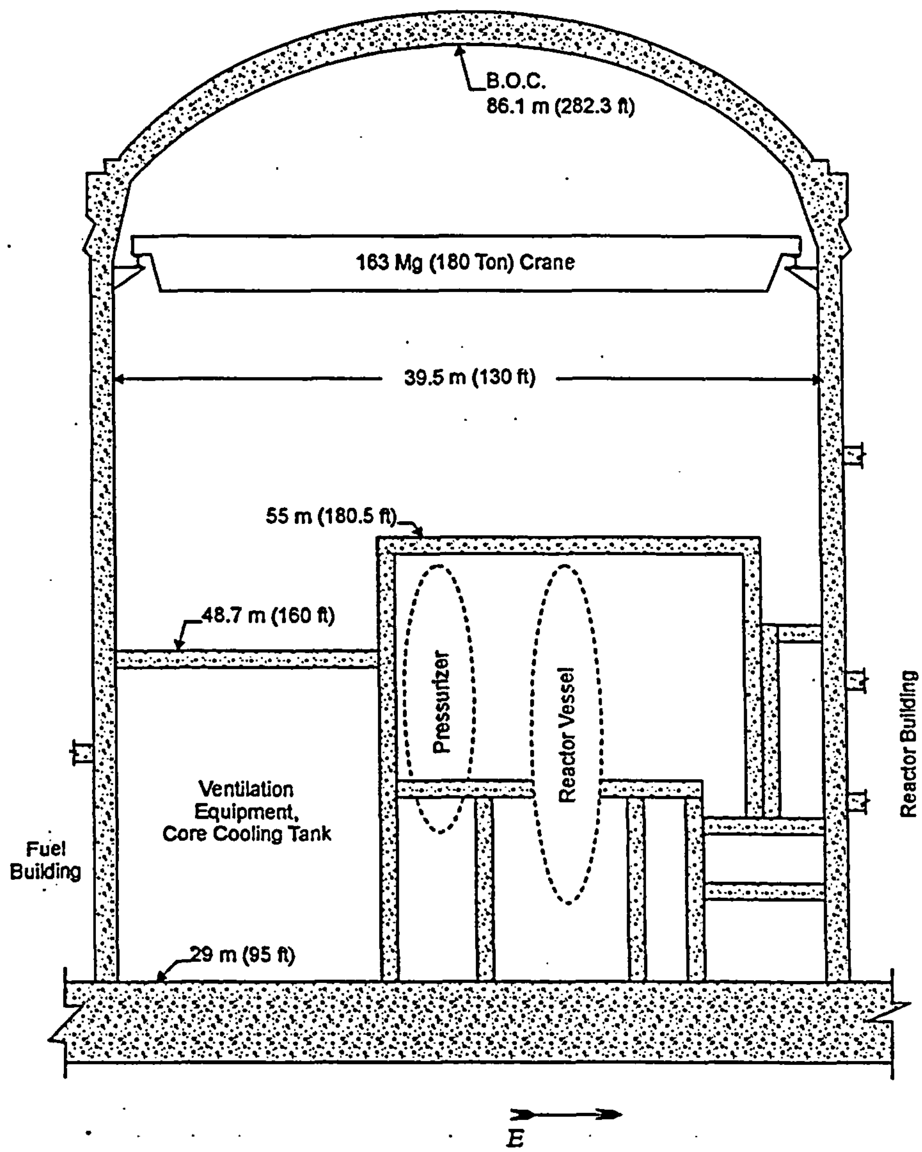
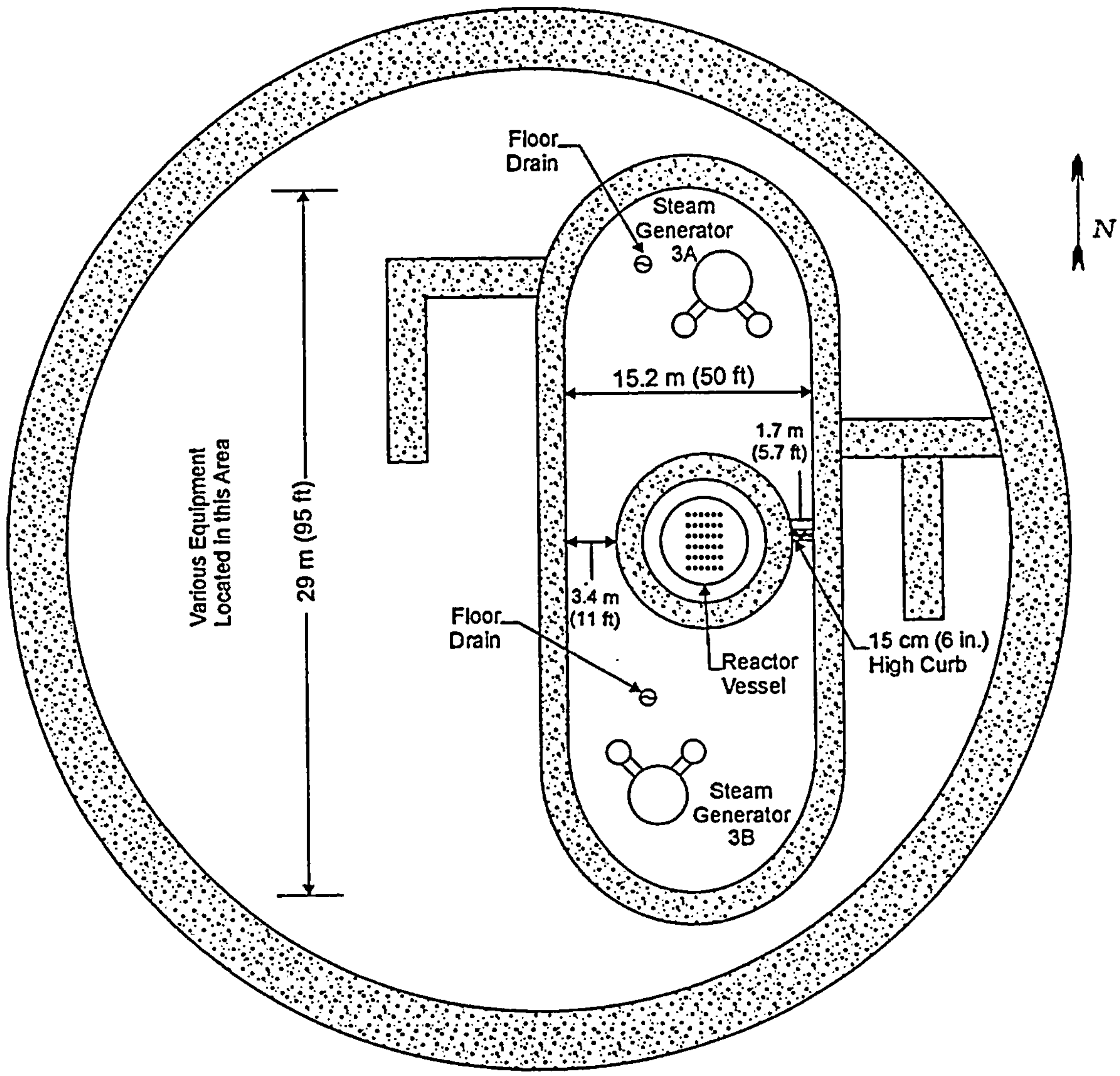
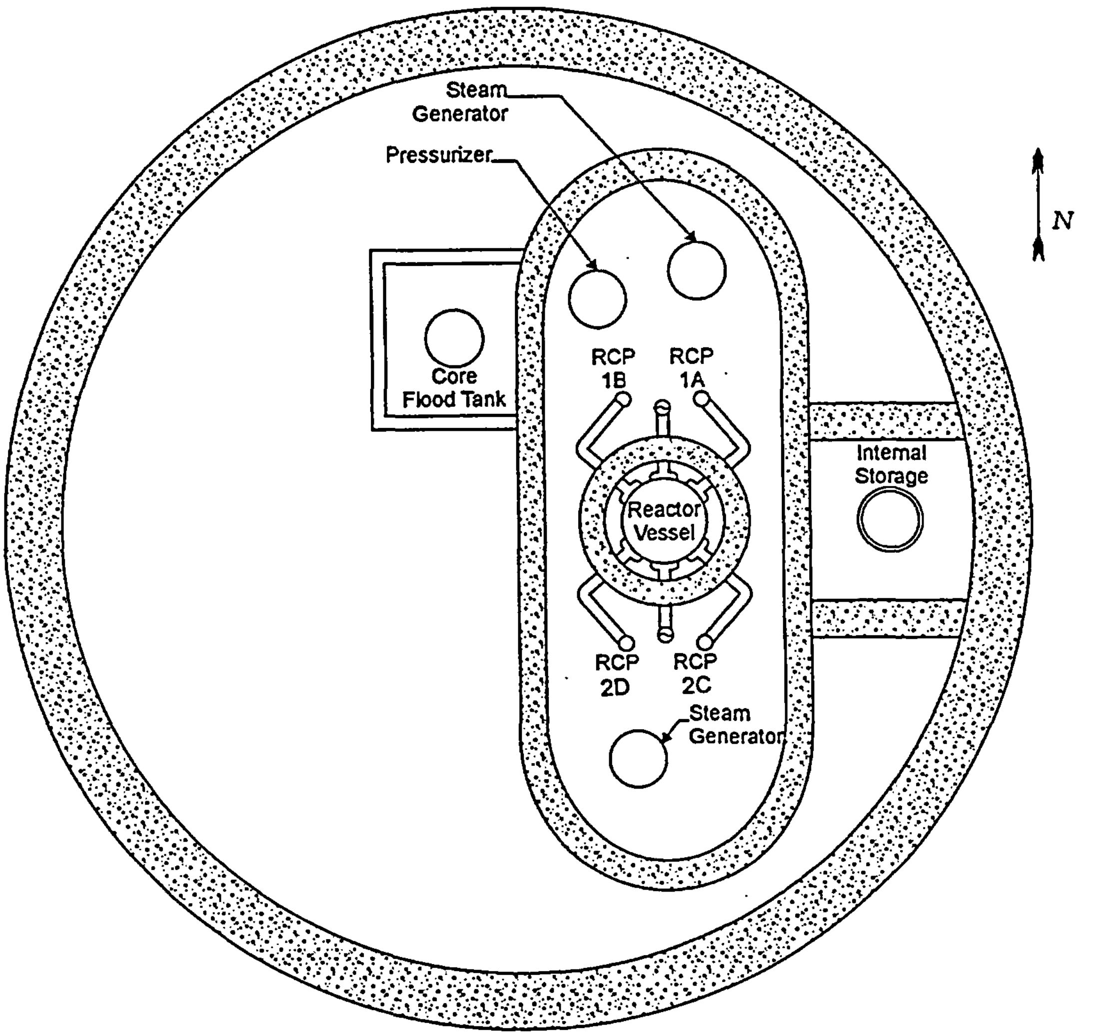


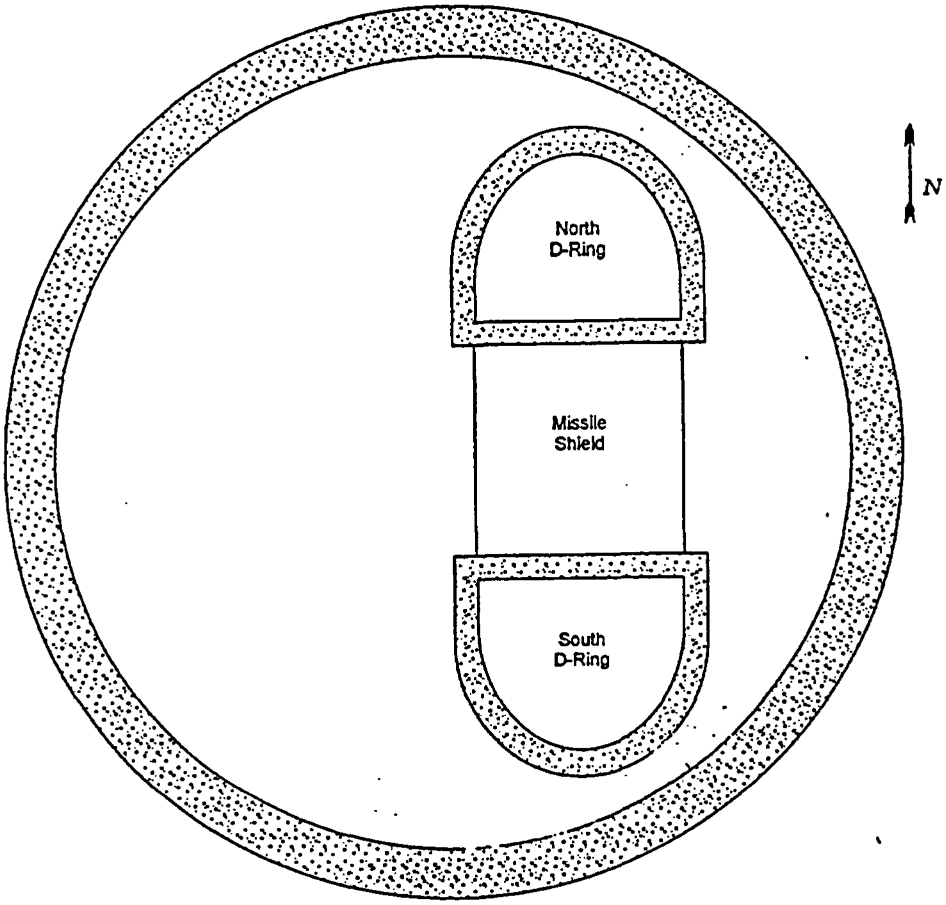
Section View of the Reactor Building
(For general orientation only, not to scale)



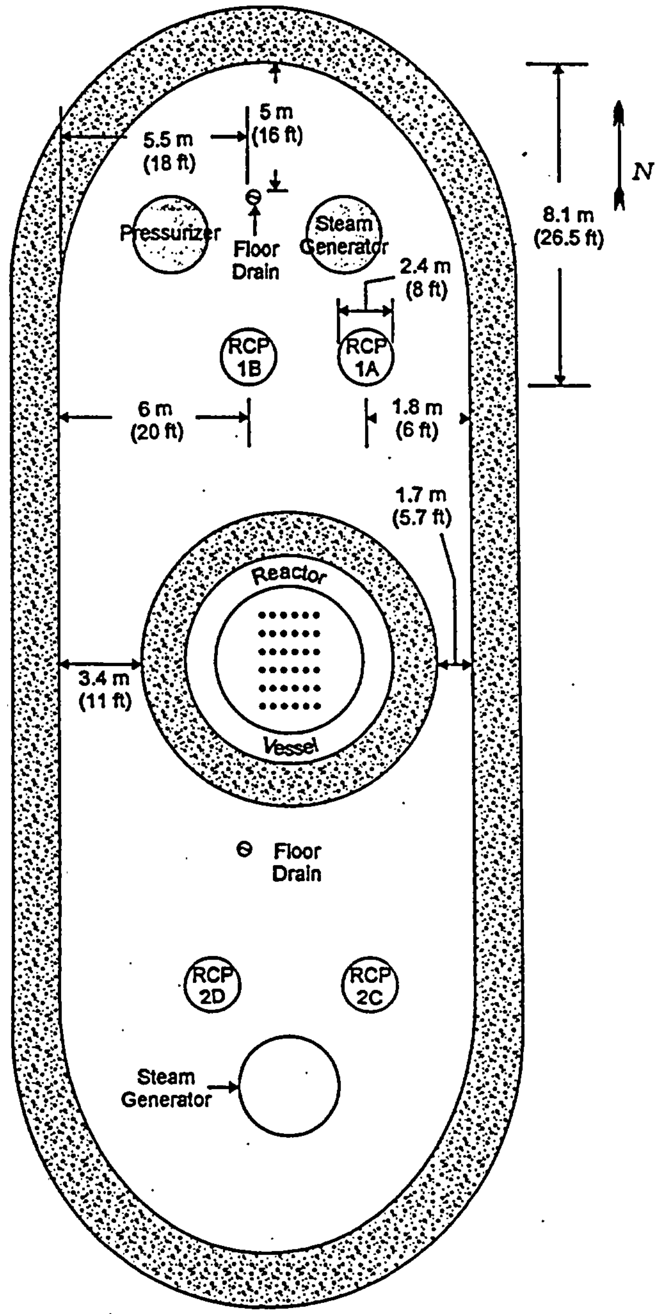
Plan View of the Reactor Building – 29 m (95 ft) Elevation
(For general orientation only, not to scale)



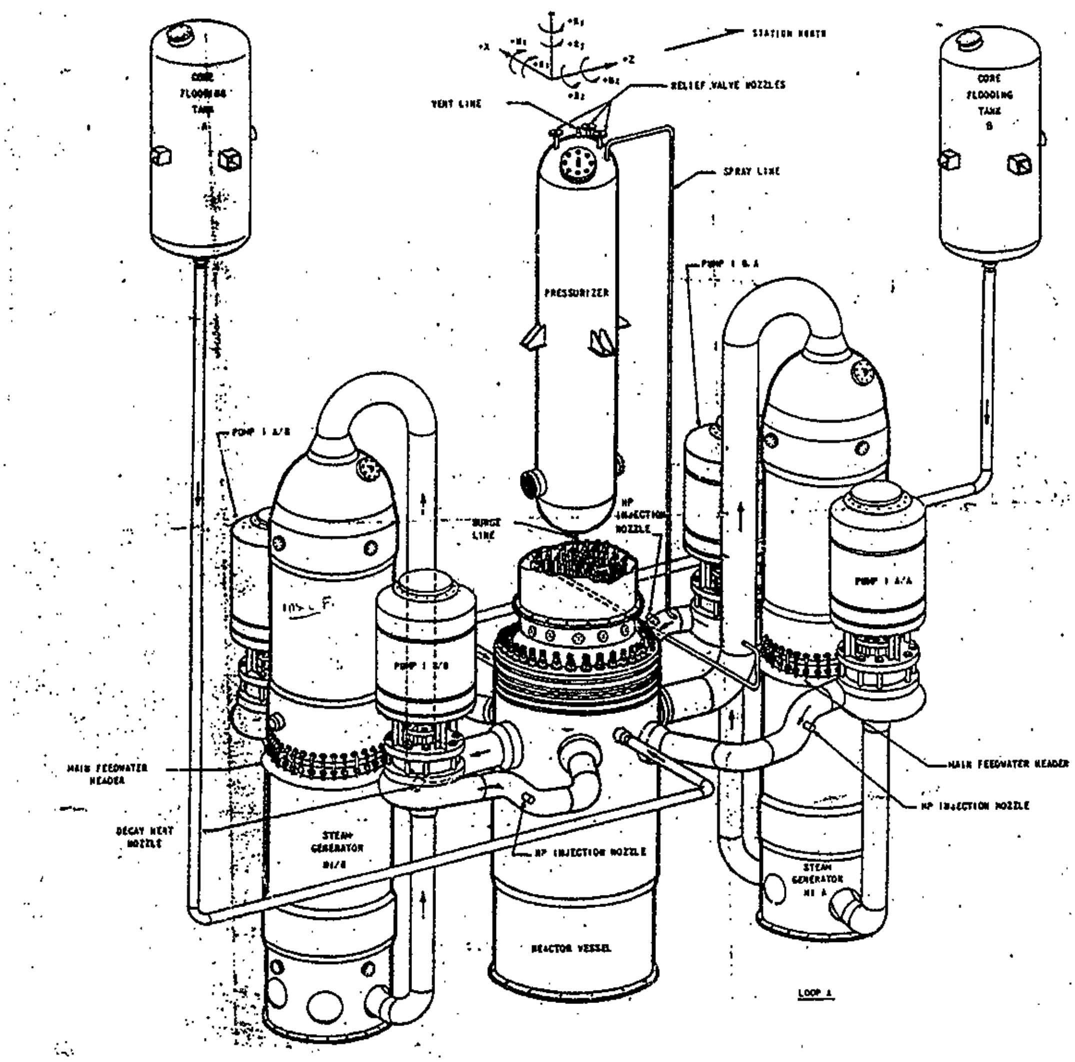
Plan View of the Reactor Building – 36 m (119 ft) Elevation
(For general orientation only, not to scale)



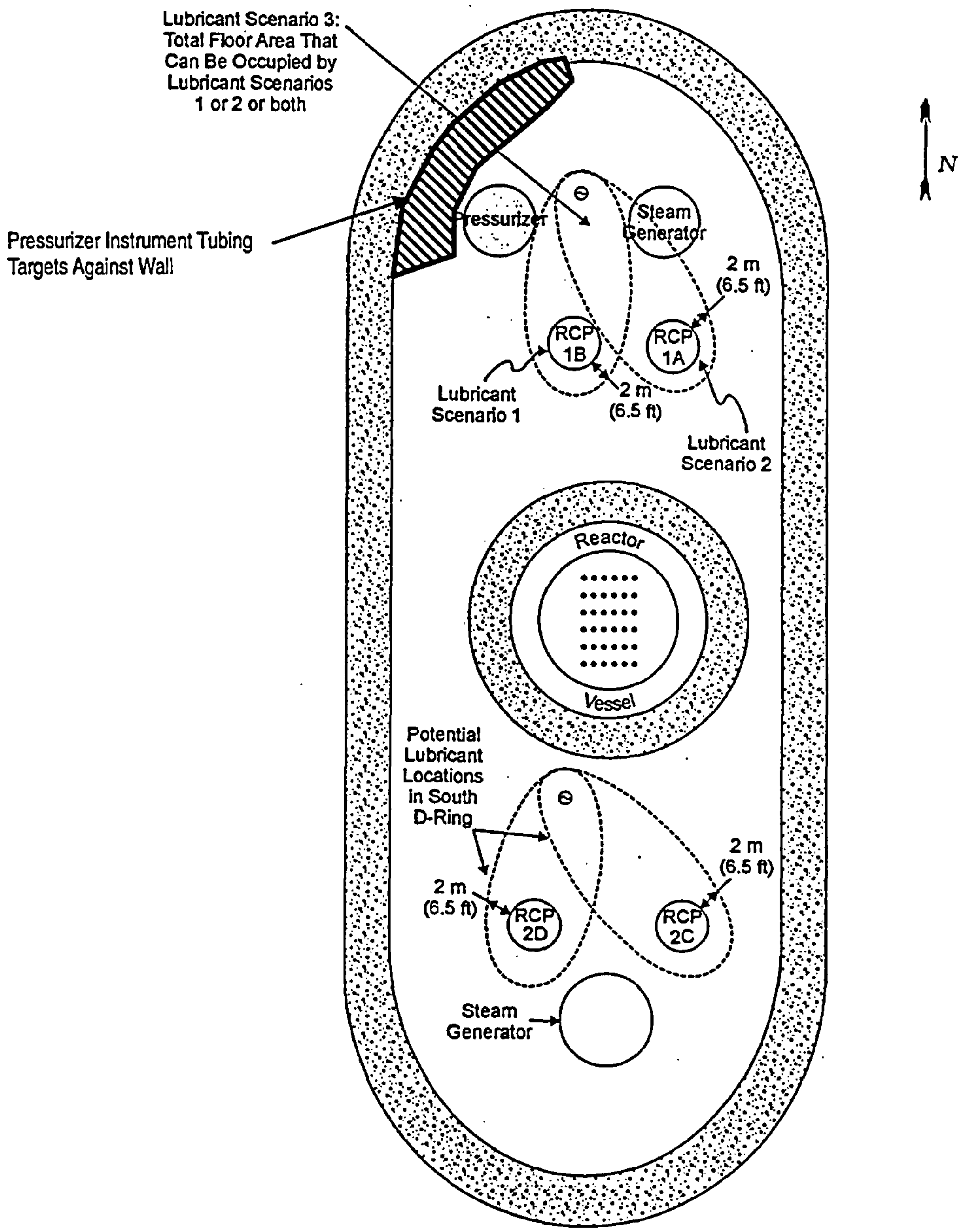
Plan View of the Reactor Building – 55 m (180.5 ft) Elevation
(For general orientation only, not to scale)



Plan View of the D-Ring Showing Dimensions
(For general orientation only, not to scale)



Isometric View of the Reactor Coolant Pumps, Pressurizer,
Reactor Vessel, and the Steam Generators



Fire Scenario Locations in the D-Ring Area
(For general orientation only, not to scale)