Florida
Power
CORPORATION
Crystal River Unit 3
Docket No. 50-302

October 16, 1995
3F1095-15

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Subject: Appendix R Exemption Request, Reactor Containment Building

References: FPC to NRC letter, 3F0195-03, dated January 6, 1995

Dear Sir:

Pursuant to 10 CFR 50.12(a), Florida Power Corporation (FPC) requests an exemption from Section III.G.2 of 10 CFR 50, Appendix R as it applies to certain redundant cables and equipment in the Reactor Containment Building at Crystal River Unit 3 (CR-3). This request is supported by an attached analysis which includes (1) the specific exemption requested, (2) information on fire protection systems at CR-3 and for the area where the exemption request applies, and (3) the bases for the exemption and a technical evaluation of the request. The attached analysis demonstrates that the combination of existing conditions and fire protection features provides adequate protection of the public health and safety and satisfies the exemption criteria of 10 CFR 50.12(a). Accordingly, the exemption should be granted.

This exemption request is prompted by the NRC's recent position on the acceptability of Thermo-Lag when used as a radiant energy heat shield inside containment. As stated in NRC Information Notice 95-27, the NRC has determined that Thermo-Lag is technically combustible. FPC acknowledges that the NRC intends to now treat these barriers as combustible. The specific fire protection aspects of the Thermo-Lag installation inside containment at CR-3 supports the safety and special circumstance findings that satisfy the NRC's exemption criteria. Accordingly, FPC has determined to pursue the regulatory alternative that has traditionally been applicable to special circumstances involving compliance with Appendix R. However, by choosing this alternative, FPC does not intend to indicate that it considers the Thermo-Lag barriers that had previously been relied on to achieve compliance inside the Reactor Containment Building now to be combustible. The credible fire conditions to which these barriers would

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be exposed are insufficient for combustion of Thermo-Lag, and FPC considers that these barriers in containment remain in compliance. FPC simply chooses to pursue the exemption alternative as a permanent solution to this Thermo-Lag issue.

FPC committed to having an action plan for resolution of the Thermo-Lag radiant energy shields and containment penetration barriers inside the Reactor Containment Building in Reference A. This was stated in "FPC Response to VI.B.2," item 4 with a due date of October 31, 1995. This exemption request constitutes FPC's action plan for those Thermo-Lag barriers.

Should you have any questions concerning this request, please call Mr. Bill Rossfeld at (904) 563-4374.

Sincerely,

Gary Boldt

G. L. Boldt
Vice President
Nuclear Production

GLB/SCP:ff

Attachment

xc: Regional Administrator, Region II
NRR Project Manager
Senior Resident Inspector

ATTACHMENT

APPENDIX R EXEMPTION REQUEST
REACTOR CONTAINMENT BUILDING

1. Summary

Florida Power Corporation (FPC) requests an exemption from the requirements of 10 CFR 50, Appendix R, III.G.2, for certain redundant safe shutdown cables in the Reactor Containment Building (RB) Elevations 95 and 119. The cables are for pressure, temperature, and level instrumentation for the Reactor Coolant System and Steam Generators. To protect these cables from fire in accordance with Appendix R, FPC installed Thermo-Lag fire barriers to enclose one train of redundant safe shutdown equipment and cables inside the RB. Based on vendor information available at the time, these barriers were considered to be non-combustible radiant energy shields. Recent findings indicate that, by some test methods, Thermo-Lag demonstrates a limited amount of combustible content. FPC considers that the existing design and separation of the safe shutdown equipment and circuits inside the RB, and fire detection not previously taken credit for, ensure an adequate level of fire protection without radiant energy shields or Thermo-Lag barriers. These features, plus strong administrative controls, together provide defense in depth protection which justifies this exemption request. Accordingly, the granting of this exemption will continue to ensure an adequate level of fire protection inside the Reactor Containment Building.

2. Background

Crystal River Unit 3 (CR-3) was licensed to operate in December 1976. All plants licensed to operate before January 1, 1979 are required to comply with, inter alia, 10 CFR 50, Appendix R, Section III.G and 10 CFR 50.48(b). FPC modified CR-3 by adding fire protection features that, taken together, were considered adequate to comply with Section III.G of Appendix R. Those modifications included installation of Thermo-Lag fire barriers at CR-3. These were installed in 1984 and 1985 in support of FPC's due date for implementation of Appendix R in July 1985. An NRC Team Inspection was performed at CR-3 in July and August of 1985 in the areas of fire protection and FPC actions regarding the implementation of the requirements of Appendix R, Sections III.G, III.J, III.L, and III.O. No violations or deviations were identified.

FPC continues to maintain a strong program of administrative controls over fire protection activities. Particular strengths include effective housekeeping, control of fire barrier breaches, control of hot work, control of transient combustible materials, and control of chemicals and flammable liquids. NRC Inspection Reports have recognized effective FPC fire brigade performance during drills and the effectiveness of CR-3 Pre-Fire Plans. The history of fire protection Inspections at CR-3 shows that although some minor violations and deviations have occurred, overall performance has been very good. This trend of continued good performance is reflected in the consistently positive evaluations during NRC Systematic Assessment of Licensee Performance (SALP), as reported in SALP Inspection Reports for CR-3.

Recently discovered problems with the manufacturer's rating of Thermo-Lag fire barriers have resulted in a re-evaluation of our basis for Appendix R compliance,

and our use of Thermo-Lag to achieve compliance. FPC is now completing our re-evaluation, and determining the most effective measures to return to compliance. These measures include plant modifications, plant operations changes, installation of other fire barrier material over Thermo-Lag, replacement of Thermo-Lag, and submittal of exemption requests where justified.

FPC was granted approval for one exemption to Appendix R criteria in 1983, and six in 1985 which were important in establishing initial compliance. We anticipate that two of these will be determined to be unnecessary and two others will be modified. We further anticipate that up to three additional exemption requests will be submitted.

3. <u>Specific Exemption Requested</u>

10 CFR 50, Appendix R, Section III.G.2 provides six options for the protection of cables and equipment of redundant safe shutdown trains within the same fire area. There are three protection options available for areas outside of containment, and three less stringent options available only for areas inside containment. The three options specifically available inside containment are repeated below:

a. 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; or

b. Installation of fire detectors and an automatic fire suppression system in the fire area; or

c. Separation of cables and equipment and associated non-safety circuits of redundant trains by a noncombustible radiant energy shield.

This request proposes to exempt the Reactor Containment Building from compliance with one of the specific options for protection of redundant trains of safe shutdown equipment and circuits listed above. In lieu of the options defined in Section III.G of Appendix R, FPC proposes an alternative fire protection configuration that takes into account the special features of the CR-3 Reactor Containment Building. The proposed alternative fire protection configuration will ensure that one train of equipment necessary to achieve safe shutdown remains free of fire damage. The proposed alternate fire protection configuration will consist of a combination of:

(1) separation of cables and equipment of redundant safe shutdown trains in most locations by a horizontal distance of more than 20 feet with minimal intervening combustibles and fire hazards; and

(2) cables for at least two redundant safe shutdown instrument strings routed in steel or black iron conduit; and

(3) use of IEEE 383 rated cables with EPR/hypalon thermoset material for insulation and jacket, which remains free of fire damage to 700°F; and

(4) in the areas where there is less than 20 feet of separation, there are no credible ignition sources or fire hazards.

In addition, the alternative fire protection configuration includes thermal fire detection in the cable tray system throughout both fire areas and in the vicinity of the Reactor Coolant Pumps.

The enclosed detailed analysis of this alternative configuration shows that under the specific circumstances in these fire areas, the public health and safety goals of Appendix R are met.

4. Satisfaction of Exemption Criteria

Exemptions from the NRC's requirements are authorized by 10 CFR Section 50.12. An exemption will be granted if it is authorized by law, will not present an undue risk to the public health and safety, is consistent with the common defense and security, and is supported by one or more of the special circumstances in 10 CFR 50.12(a)(2). All of those criteria are satisfied here.

The exemption is authorized by law because the underlying requirement is established by an NRC rule for which an exemption may be granted under 10 CFR 50.12. The following evaluation of safety significance shows that the exemption will not result in undue risk to the public health and safety because an adequate level of fire protection is maintained. Common defense and security are not implicated because the equipment in question is unrelated to safeguards. Thus, the criteria in 10 CFR Section 50.12(a)(1) are met.

Two of the special circumstances recognized by the Commission are applicable here. First, strict application of the rule under these circumstances would not improve the protection for safe shutdown equipment from damage due to a realistically expected fire over the protection that exists. As the safety evaluation shows, the specific circumstances, including the presence of additional fire protection features would render nugatory any increase in fire protection that could be expected to result from strict application of the rule.

Second, strict compliance would result in costs which significantly exceed those contemplated when the rule was adopted [10 CFR 50.12(a)(2)(iii)]. Originally contemplated costs were limited to the cost of installing barrier material which had been demonstrated to meet barrier requirements. Scant consideration would have been given to the possibility that the material originally accepted and reasonably relied upon as qualified would later be adjudged as unacceptable, and thus, necessitate its replacement under conditions which would be costly. Therefore, strict compliance would result in costs significantly in excess of those contemplated.

For these reasons, the NRC's criteria for issuance of this exemption are amply satisfied and the exemption should be granted.

5. General Information on Fire Protection Systems at CR-3

Fire Protection has been provided at CR-3 using a "defense-in-depth" philosophy. The objectives are (1) to prevent fires from starting, (2) to rapidly detect and suppress those fires which do occur, while limiting their damage, and (3) to design plant systems such that essential plant functions will not be damaged from the effects of fires.

Administrative Controls

Since the RB is unoccupied during power operation, and only limited entries are allowed, the principal means of limiting fire hazards is by limiting the materials allowed to remain in the building and assuring equipment and systems are returned to 'as designed' status following maintenance. This control is enforced by the performance of two procedures. Prior to plant start-up following a major outage at cold shutdown conditions, Administrative Instruction AI-1305, "Administrative Inspection of Reactor Containment" is performed. Following any outage or reactor containment entry for maintenance or inspection, Surveillance Procedure, SP-324, "Containment Inspection" is performed.

AI-1305 inspections are performed by designated plant managers who execute detailed walkdowns of assigned areas following specific instructions and checklists. Managers are assigned areas by procedure, according to their expertise and functional responsibilities. In general, all inspectors have responsibility for inspecting areas for housekeeping and for ensuring equipment, piping, insulation, valves, pumps, cable trays, wiring, etc., are in good working condition. A specific checklist for fire protection includes instructions for fire detection systems, transient combustibles, and fire fighting equipment. Other checklists include Reactor Coolant Pump oil collection enclosures and collection tanks inspections. A specific acceptance criterion in the procedure is that "All transient combustible material will be removed from Reactor Containment."

SP-324 is designed to confirm, in part, that no loose materials or debris are present in the containment that could be carried to the RB sump. To perform this inspection, the plant operations staff walks down all RB levels inside and outside of the secondary shield walls prior to ascending to power following an outage. When RB entries are made at power, limited inspections are performed and documented for the areas that were occupied to assure that nothing was left in the work areas or pathways. The inspectors look for plastics, wood, tools, or other materials that could interfere with the capability to recirculate water from the sump. This criterion effectively eliminates materials that may also be considered transient combustibles. Our experience with these two procedures show that together, they effectively establish safe conditions in the RB and assure that they are maintained during operation.

Fire Extinguishing Systems

Fire extinguishing capability is provided to various areas and equipment at CR-3 by using automatic water systems, an automatic carbon dioxide system, an automatic Halon 1301 system, hose stations, fire hydrants, and portable fire extinguishers. These systems have been selected and designed based on the characteristics of the equipment or area they protect.

Water Supply System - The fire protection system includes two dedicated fire service water storage tanks with 360,000 gallon capacity each. The tanks are equipped with level monitors with indication provided in the Control Room. Each tank can be isolated from the system in the event of a failure. There are three (3) fire service pumps, two (2) diesel engine driven and one (1) electric motor driven located in a pump house which is separated from the other plant buildings and structures. Each diesel driven pump is equipped with its own dual starting batteries and automatic battery charging system. The fire service yard main loop

completely surrounds the plant. Each of the three fire service pumps can feed into the loop or the system can be supplied by the adjacent Unit 1 and 2 fire service system. Headers from either end of the loop supply the Turbine Building fixed water spray system, sprinkler systems and manual hose station standpipes.

Manual Fire Suppression - The plant has a trained Fire Brigade consisting of a minimum of five members per shift whose responsibility is to combat fires at CR-3. The Fire Brigade maintains operational knowledge of the plant to aid in fire fighting activities, and brigade composition cannot include individuals who have operational responsibility for the safe shutdown of the unit. Mobile fire and foam carts are located in the plant for use by the Fire Brigade. Fire extinguishers are located throughout the plant area and are of the ABC dry chemical, CO_2, or Halon 1211 types. A class II standpipe system is installed throughout the plant except for the RB which has a class III system.

Fire Detection Systems - Fire and smoke detection are accomplished by locating product of combustion (POC) and thermal detectors in most safety related areas where a significant potential for fire exists. These systems provide alarms locally and at remote panels located in the plant and the Control Room. Two types of fire detection systems are provided for the Reactor Containment Building. These are (1) "Protect-O-Wire" thermal line type fire detectors, and (2) 190°F non-self restoring fixed temperature type spot detectors. The line detectors utilize a continuous heat sensitive wire thermistor running across the top or sides of cable trays. This system is separated into nine zones. The second type of detector system is comprised of three fixed temperature heat detectors spaced equally around each of the Reactor Coolant Pumps. These are configured such that at least one of each group of three detectors alarms in a separate zone at the alarm panel. There are two alarm panels for these systems, one just outside of the Reactor Containment building personnel hatch and the second in the Control Room. These two systems initiate alarms only and are engineered as Class "A" supervised systems, whereby an open circuit will initiate a trouble signal and the circuits will remain operable.

Manual Fire Fighting

Manual fire fighting at CR-3 is performed by the Shift Fire Brigade. The Brigade is composed of a Fire Team Leader and a minimum of four Fire Brigade members. Fire Brigade members are qualified by the completion of classroom training, passing a medical physical, certification with respiratory protection devices, completion of a fire protection familiarization walkdown, and participation in an initial fire drill. Annual requalification is required, which includes quarterly classroom training and at least annual fire drill participation.

The Fire Team Leader is supplied from the Operations Department. The Team Leader must be a member of the Operations staff who possesses an Operating License or equivalent knowledge of plant safety related systems as determined by the Nuclear Shift Supervisor. The Fire Team Leader must be qualified as a Fire Brigade member, and in addition must receive advanced training on fire incident command.

To aid the Fire Team Leader, FPC maintains detailed Pre-Fire Plans to provide information on each area of the plant. These include color layout drawings of each area showing the locations of area entrances, fire fighting equipment, fire or safety hazards, and important plant components. Written descriptions accompany each drawing which lists information important to successfully combat

a fire such as important equipment, hazards, tactics, ventilation and construction information, and suppression equipment available.

6. Cables and Equipment for Which an Exemption is Requested

The cables and equipment for which an exemption is sought are located in the Reactor Containment Building. This exemption covers cables for Reactor Coolant System (RCS) and Steam Generator (SG) instrumentation. Specifically the circuits are associated with the following functions:

Pressurizer Level
RCS Pressure
Steam Generator Level

The primary instruments and transmitters for these signals are separated by more than 20 feet with negligible intervening combustibles.

Instrumentation differs from equipment such as pumps or power sources in that each train of instruments may be composed of many redundant individual instruments measuring the same parameter. Also, since no power sources for any of the instruments are threatened by a fire within the RB, instruments of the same train may be considered to be redundant to each other. This offers multiple combinations of redundancy providing high assurance of the survival of sufficient instrumentation for safe shutdown.

7. REACTOR CONTAINMENT BUILDING FIRE AREAS RB-95-301 and RB-119-302

Location and Construction

Fire Areas RB-95-301 and RB-119-3C2 are the lowest two levels of the RB located outside of the biological or secondary shield walls. The areas are shown in Figures 1 and 2. The secondary shield wall is a four foot thick concrete wall with unsealed penetrations. The only combustible material that is in the vicinity of the penetrations or passing through them is IEEE 383 rated cable. The thickness of the wall and the lack of combustible materials provides significant resistance to fire propagation. The inner liner of the containment building is welded steel construction inside a reinforced concrete shell. The ceiling/floor that separates the two areas is constructed of reinforced concrete and has numerous unsealed penetrations. This ceiling/floor is not credited as a rated three hour fire barrier.

Fire Protection Equipment

These fire areas are equipped with thermal line type heat detectors which are located within cable trays in both areas and which alarm in the Control Room. Fire suppression equipment in the area consists of a Class III Standpipe system. The RB standpipe system can utilize both 1 1/2" and 2 1/2" hoses. Dedicated hoses are staged at the RB personnel hatch for manual suppression inside.

Layout and Contents of Fire Area RB-95-301

The layout of this fire area is shown on Figure 1. It encompasses the space within the reactor containment building outside the secondary shield wall, above elevation 95 and below the floor at elevation 119. One room in the area extends above the 119 elevation. It is located in the northeast quadrant of the area, but is not open to the elevation above.

The area inside the secondary shield wall contains the reactor vessel, the once through steam generators, the pressurizer, the 4 reactor coolant pumps, and the reactor coolant pump oil collection reservoirs. There are some unsealed penetrations at floor level, but these would not be paths for fire propagation. The only combustible that could be present at this level inside the shield wall is reactor coolant pump oil leakage that may have bypassed the oil collection system. Significant quantities of oil are not expected to accumulate because most of the oil reaching the floor would be drained away to the reactor building sump by floor drains.

Fire area RB-95-301 contains 44,802 pounds of cable, 332 pounds of Thermo-Lag, and 60 pounds of plastics. (Note that for conservatism the total amount of Thermo-Lag in these fire areas has been included as a combustible.) The cable is IEEE 383 rated cable with demonstrated resistance to combustion and fire propagation. It is a design objective at CR-3 to use only IEEE 383 rated cable in all applications. When special applications have prevented the use of this cable, the offending cables are routed in conduit. Transient combustibles are strictly limited during power operation as noted above. There is a possibility that oil leakage bypassing the reactor coolant pump oil collection system can collect in the Reactor Building sump. The sump is open to this area through its cover grate, however oil collected in the sump would be floating on the surface of the water in the sump and is not considered an ignition threat.

There are a limited number of possible ignition sources in this fire area. As discussed below most are not realistic concerns:

AHF-1B & 1C Reactor building cooling fans. These are driven by 480VAC 3 phase motors with the fan and motor enclosed within a heavy gage steel enclosure.

AHF-4A & 4B Steam generator cooling fans. These are driven by 480VAC 3 phase motors with the fan and motor enclosed within a heavy gage steel enclosure.

WDP-2A & 2B Reactor building sump pumps. These are submersible pump and motor combinations which are sealed and do not represent a threat as an ignition source.

WDP-7 & 8 Reactor coolant drain tank pumps. These small pumps and motors are located within a concrete walled room with a labyrinth entry way designed to shield the reactor coolant drain tank. There are insignificant combustibles in this room and due to the design of the entry there is no possibility that these motors would be a credible ignition source for combustibles in the larger area.

Layout and Contents of Fire Area RB-119-302

The layout of this fire area is shown on Figure 2. It encompasses the space within the reactor containment building, outside the secondary shield wall, above elevation 119 and below the floor at elevation 160. There is no floor at this elevation within the secondary shield wall.

Fire area RB-119-302 contains 43,531 pounds of cable and 1731 pounds of Thermo-Lag. The cable is IEEE 383 rated cable with demonstrated resistance to combustion and fire propagation. (See additional information above on use of IEEE 383 cable.) Transient combustibles are strictly controlled during power operation as noted above. Reactor coolant pump oil is added to the pumps periodically from stations located in this area. No more than 15 gallons of oil is taken in at a time, it is constantly attended while oil addition is proceeding, and none is allowed to remain when personnel leave.

There are a limited number of possible ignition sources in this fire area. As discussed below most are not realistic concerns:

AHF-1A — Reactor building cooling fan. This is driven by a 480VAC 3 phase motor with the fan and motor enclosed within a heavy gage steel enclosure.

AHF-2A & 2B — Reactor cavity cooling fans. These are driven by 480VAC 3 phase motors with the fan and motor enclosed within a heavy gage steel enclosure.

AHF-3A & 3B — Reactor building air supply fans. These are driven by 480VAC 3 phase motors with the fan and motor enclosed within a heavy gage steel enclosure.

RCDP-1 ⇒ 7 — Pressurizer heater breaker panels. These are 480VAC breaker panels which supply power to the pressurizer heaters. These panels are mounted on a raised platform eight feet above the 119 elevation floor. Safe shutdown cables for one RCS pressure instrument is routed below the platform, and cables for three 'A' SG level instruments are routed high above these panels.

Configuration of Safety Trains

The following information describes the layout of safe shutdown instruments and circuits inside the RB. It also illustrates the high level of redundancy that exists in the capability to monitor RCS and SG parameters during post fire safe shutdown. Figures 1 and 2 depict the circuit routings for the various instrument functions. These are not exact routings, but rather show the general paths of the various circuits between the signal transmitters and their containment penetrations. As noted below most of the safe shutdown circuits are routed in black iron or steel rigid conduit, however at the penetrations and at the transmitters short runs of flexible steel conduit are used.

Pressurizer Level

There are three pressurizer level instruments capable of providing the required level indication. The cables for all three enter the RB through the same penetration area in the northwest quadrant of the building. These circuits enter on the 119 elevation, and after a short horizontal run, turn down to the 95 elevation where they are routed to their respective instruments. The circuits for RC-1-LT1 and RC-1-LT3 are both routed in conduit and follow parallel paths for a distance. The circuit for RC-1-LT2 is routed partially in tray and partially in conduit. The transmitter for RC-1-LT3 is mounted on the northwest portion of the secondary shield wall, and transmitters for RC-1-LT1 and RC-1-LT2 are mounted on the northeast portion,and are separated from RC-1-LT3 by greater than 20 feet with negligible intervening combustibles. There are no credible ignition sources in this area of the 95 elevation.

RCS Pressure

There are four reactor coolant system instruments capable of providing wide range pressure indication (RC-3A-PT3, RC-3B-PT3, RC-158-PT, and RC-159-PT.) The pressure transmitters for these are mounted on the outside of the secondary shield wall, with one located in each quadrant. The circuits for RC-3A-PT3, RC-3B-PT3, and RC-158-PT all penetrate the RB through the northwest penetration area at the 119 elevation. The three circuits are run in conduit for a short distance on the 119 elevation, and then penetrate to the 95 elevation to route to their respective pressure transmitters. The circuits for RC-159-PT enter the RB through the northeast penetration area on the 119 elevation and from there the circuits, routed in conduit, run west and then south. Subsequently, the conduit passes down to the 95 elevation to the pressure transmitter in the southeast quadrant of the secondary shield wall. The closest approach of this circuit to redundant circuits in the north half of the RB is between the core flood tank room and the northwest penetration area. This distance is greater than 20 feet, however there are intervening IEEE 383 qualified cables located high overhead. For a fire in the south half of the building, circuits for the two instruments located in the north portion of the building would be unaffected.

Steam Generator Level

There are 22 SG level instruments (SP-XX-DPT or SP-XX-LTX). Half of these are for the 'A' SG located in the north end of the RB and half are for the 'B' SG in the south end. All of the SG level transmitters are mounted on the outside of the secondary shield wall at either the north or south end according to the location of the associated SG.

All of the SG level instrument cables enter the RB through the northwest penetration area at the 119 elevation. Cables for two of the 'A' SG instruments route east and north from the penetration area on the 119 elevation to the area near AHF-3A and then penetrate down to the 95 elevation. The cables then run south to the transmitters on the shield wall. These are run entirely in steel conduit. The remaining cables for the 'A' SG exit the penetration on the 119 elevation and immediately descend to the 95 elevation where they route east to the shield wall and terminate at their respective transmitters. Six of these circuits are run entirely in steel conduit; three run partially in cable tray and partially in steel conduit. There are only two locations where these two groups of circuits are in close proximity. These are at the penetration area on

elevation 119, and where the conduits cross near the shield wall on the 95 elevation. There are no credible ignition sources in either of these areas.

Cables for seven of the 'B' SG level instruments immediately descend from the penetration area in the northwest of the building on the 119 elevation to the 95 elevation. These run southward on the 95 elevation to the south end of the secondary shield wall where they terminate at the level transmitters. Four of these are run entirely in steel conduit; three run partially in cable tray and partially in steel conduit. Cables for the remaining four 'B' SG instruments are routed on the 119 elevation from the penetration area to a point south of the secondary shield wall where they descend to the 95 elevation and route north for a short distance to the transmitters on the shield wall. These are run entirely in steel conduit.

The only areas where less than 20 feet of separation exists between the two groups of 'B' SG instruments circuits are at the penetration area and between selected instruments at the south end of the shield wall. There are no credible ignition sources in either of these areas.

Only the instruments for one SG are required for safe shutdown. The only area common to all SG level circuits in the RB is at the penetration area. There are no ignition sources near the penetration area. The closest ignition sources would be the pressurizer heater breaker panels, however these are not a credible threat since they are located 6 feet above the penetrations and approximately 20 feet horizontally away.

If a fire were to occur in either the north half of the building or the south half, there are insufficient combustible materials for it to propagate to the opposite end. The only combustible material available is IEEE 383 rated cable which has been tested and demonstrated to be resistant to fire propagation. Therefore, for a fire in any location assurance is provided that sufficient SG level instrument signals would remain available to achieve safe shutdown.

<u>Fire Loading and Calculated Fire Severity</u>

The fire loading for fire area RB-95-301 is 41,282 BTU's/ sq. ft. with a calculated fire duration of 0.51 hours or 31 minutes. The fire loading for fire area RB-119-302 is calculated to be 45,310 BTU's/ sq. ft. with a calculated fire duration of 0.57 hours or 34 minutes. Calculation of fire loading and duration in the Fire Hazards Analysis is extremely conservative in that it assumes every cable tray is filled to at least 50%, and actual fill is used where it is greater than 50%. The combustible load is almost completely IEEE 383 qualified cable insulation, except for 60 pounds of plastics.

IEEE 383 qualified cable is extremely difficult to ignite and is demonstrated not to propagate fire as part of its qualification. Testing by EPRI documented in report NP-1881 provides good insight regarding the difficulty involved in igniting IEEE-383 qualified cables. These tests were designed to evaluate extinguishment methods and employed an ignition fire with a heat release rate (HRR) on the order of 1650 Btu/s for approximately 6.5 minutes in order to ensure a fully developed fire. This size ignition fire, which was placed only 8 inches below the cable trays, is extremely large when compared with common plant ignition sources such as electrical cabinets (HRR = 65 Btu/s). Fire test nos. 10-12 on EPR/Hypalon cables in EPRI NP-1881 show that these cables were very

difficult to ignite even with such a robust source. Ignition was only achieved when the cables were loosely arranged in the trays with alternating single, straight layers of cable interspersed with cable laid in an S-shape. This maximized surface area and air supply (a configuration similar to wood cribbing.)

Additionally, the Fire Hazards Analysis assumes 100% of the combustibles will burn when calculating fire durations. NUREG/CR 4566 reports that based on testing, 50%-70% of cable insulation will burn. EPRI NP-1881 reports fractions of less than 50%. Accordingly, when a conservative combustion efficiency of 70% is used, a fire involving all the combustibles would have only a 24 minute duration. However, based on the type of combustible material that is available, and given that the material is widely dispersed throughout the areas, it is highly improbable that a fire would start or propagate.

It is appropriate to consider these realistic circumstances when deciding to pursue an exemption. Exemptions are intended for situations which do not meet specific regulatory requirements. They usually are based on analyses which show that the level of conservatism applied in generally applicable standards are not needed to provide adequate protection in specific situations. FPC considers that this is clearly the case here.

8. Bases and Technical Evaluation of Exemption Request

Bases

The design of the fire protection system inside the RB meets the Appendix R objective of protecting one train of safe shutdown equipment. FPC meets the Appendix R option for separation of redundant circuits and equipment by greater than 20 feet with negligible intervening combustibles in most portions of these two fire areas. Where less than 20 feet of separation exists, adequate protection is provided by the steel conduit in which redundant circuits are routed. Also, there are no credible ignition sources in the areas where less than 20 feet of separation exists.

Additionally, CR-3 has an automatic fire detection system installed in the RB. The system uses linear thermal detection in the cable tray system (Protect-O-Wire) and spot thermal detectors in the vicinity of the Reactor Coolant Pumps. These alarm in the Control Room and would provide early warning to Control Room Operators to initiate fire fighting response of the Fire Brigade. The existence of automatic fire detection is in excess of the Appendix R requirements for protection inside non-inerted containments where protection is provided by separation alone.

The alternatives to the existing Thermo-Lag barriers in the RB include:

a) removal and replacement of barriers with radiant energy shields constructed of a non-combustible material,

b) overlaying existing barriers with a non-combustible material thereby making them non-combustible radiant energy shields, or

c) installation of sprinklers inside the RB.

FPC's analysis has shown that the protection provided by any of these alternatives would not be a significant improvement over the existing protection. However, the implementation cost of any of these alternatives would be significant. Accordingly, they could not be judged as prudent expenditures when compared to other more safety beneficial projects.

In addition to the financial costs, implementing any one of these alternatives would result in a large radiation dose, and the generation of large quantities of radioactive waste.

Technical Evaluation

FPC concludes that the protection for safe shutdown cables inside the CR-3 RB provided by well separated routing of the circuits and routing in steel conduit, even excluding consideration of the Thermo-lag barriers, is equivalent to that which would be provided by non-combustible radiant energy shields. The relatively low combustible loading, the type of combustible material in the building, and the scarcity of ignition sources all contribute to a low probability that fire would damage safe shutdown cables.

The CR-3 Fire Hazards Analysis estimates the amounts of combustibles in fire areas RB-95-301 and RB-119-302 to be 41,033 and 43,880 BTU/sq. ft. respectively. These are conservative estimates as noted above and the combustible material is virtually all IEEE 383 rated cable insulation. IEEE 383 fire resistance qualification is established by exposure of a vertical array of cable to a 1500°F gas burner flame for 20 minutes. Cables which self-extinguish when the flame source is removed pass the qualification test. Therefore, the principal fuel source in the RB will not readily support combustion.

A fire involving the lubricating oil for the reactor coolant pumps (RCPs) will not be a threat to safe shutdown cables or equipment in the RB. The RCPs are located inside the secondary shield wall. Any leakage from the RCPs will either 1) be contained within the RCP oil collection system, 2) will remain on the floor within the secondary shield wall, or 3) will migrate to the RB sump.

The ignition sources listed above have a low potential for igniting the combustible materials in these two fire areas. The fan motors listed are all contained inside heavy gage steel enclosures which provide both structural support and air flow intake and distribution. If a fire were initiated in one of these motors, it would be contained within the enclosure and would not propagate to outside combustibles. The small pump motors for WDP-2A & 2B are sealed submersible motors located well away from safe shutdown circuits. The small motors for WDP-7 & 8 are located inside a concrete walled room and no safe shutdown cables are routed through the enclosure.

The pressurizer heater breaker panels, RCDP-1 through 7, contain very few internal cables to allow fire to propagate within the cabinet and the contained cables are IEEE 383 rated. These panels are not fully enclosed but have wire mesh on the front to facilitate cooling. Cables entering and exiting these panels are all run in steel conduit so they would not be a pathway for fire propagation. The panels are fed from breakers outside the RB so they would automatically clear in the event of a short circuit, or could readily be de-energized in the event of a fire.

If a fire was to start within the RB the huge volume of the building and the unsealed openings between floors would preclude the formation of a hot gas layer at any elevation where it would affect safe shutdown cables. Considering 1) the proximity and geometry of the limited amount of fuel, 2) the equally limited number of ignition sources and 3) the low flammability of the principal fuel source, the conditions to which safe shutdown cables will be exposed are insufficient to cause anything but minor cable damage to limited numbers of circuits.

CR-3 has an automatic fire detection system installed in the RB. The system uses linear thermal detection in the cable tray system (Protectowire) and spot thermal detectors in the vicinity of the Reactor Coolant Pumps. These alarm in the Control Room and would provide early warning to Control Operators to initiate fire fighting response of the Fire Brigade. The existence of automatic fire detection is in excess of the Appendix R requirements for protection inside non-inerted containments where circuit protection is provided by separation.

9. Conclusion

FPC has Thermo-Lag fire barriers constructed of 5/8" thick material protecting one train of safe shutdown cables inside the CR-3 RB. These barriers were installed in 1985 during our plant upgrade to implement Appendix R requirements. FPC chose Thermo-Lag enclosures over traditional radiant energy shields because these were believed to provide more effective protection. Also, installation required less labor, therefore lower radiation exposure. These barriers were found to be acceptable to the NRC. Recently, information on the behavior of Thermo-Lag has determined it to be technically combustible and therefore no longer acceptable as a non-combustible radiant energy shield.

Considering the factors described above relating to the type and amount of fixed combustibles, the absence of transient combustibles, and the limited number of ignition sources, it is extremely unlikely that a fire would start in any area that contains safe shutdown circuits. If a fire were to start, it would not grow to any significant size or propagate to involve more than a small localized area. FPC therefore determined that circuits in steel conduit, without either radiant energy shields or rated fire barriers, would provide sufficient protection from any fire that could credibly occur. In addition, FPC has automatic fire detection systems in the RB to provide early warning of a fire for timely Fire Brigade response. FPC has concluded that these factors taken together demonstrate sufficient defense in depth to meet the intended protection of safe shutdown circuits inside the RB. The protection provided by steel conduit, separation, and automatic fire detection are deemed to be sufficient justification for an exemption to Appendix R Section III.G.2, as equivalent to the protection provided by one of the specific options of Appendix R. Therefore, this exemption should be granted.