

September 27, 2006

Mr. Michael R. Kansler
President
Entergy Nuclear Operations, Inc.
440 Hamilton Avenue
White Plains, NY 10601

SUBJECT: JAMES A. FITZPATRICK NUCLEAR POWER PLANT - EXEMPTION FROM
THE REQUIREMENTS OF 10 CFR PART 50, APPENDIX R (TAC NO. MC7995)

Dear Mr. Kansler:

The Commission has approved the enclosed exemption from specific requirements of Title 10 of the *Code of Federal Regulations*, Part 50, Appendix R, for the James A. FitzPatrick Nuclear Power Plant. This action is in response to your application dated July 27, 2005, Agencywide Documents Access and Management System (ADAMS) accession number ML052210382, as supplemented on May 17, 2006, ADAMS accession number ML061530108. This application requested an exemption from the Appendix R, III.G.2.c, requirement for a 1-hour fire barrier for an electrical cable in Fire Area 1C.

A copy of the exemption is enclosed. The exemption has been forwarded to the Office of the *Federal Register* for publication.

Please contact me at (301) 415-2901 if you have any questions on this issue.

Sincerely,

/RA/

John P. Boska, Senior Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-333

Enclosure:
Exemption

cc w/encl: See next page

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ADAMS ACCESSION NUMBER: ML062190377 *See previous concurrence

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FitzPatrick Nuclear Power Plant

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ENTERGY NUCLEAR OPERATIONS, INC.
JAMES A. FITZPATRICK NUCLEAR POWER PLANT
DOCKET NO. 50-333
EXEMPTION

1.0 BACKGROUND

Entergy Nuclear Operations, Inc. (ENO or the licensee) is the holder of Facility Operating License No. DPR-59, which authorizes operation of the James A. FitzPatrick Nuclear Power Plant (JAF). The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the Nuclear Regulatory Commission (NRC or the Commission) now or hereafter in effect.

The facility consists of one boiling-water reactor located in Oswego County, New York.

2.0 REQUEST/ACTION

Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.48, requires that nuclear power plants that were licensed before January 1, 1979, of which JAF is one, must satisfy the requirements of 10 CFR Part 50, Appendix R, Section III.G. Subsection III.G.2 addresses fire protection features for ensuring that one of the redundant trains necessary to achieve and maintain hot shutdown conditions remains free of fire damage in the event of a fire. Subsection III.G.2.c provides use of a 1-hour fire barrier as one means for complying with this fire protection requirement. ENO proposes that the absence and/or control of ignition sources, the adequacy of detection and suppression systems, and the capability of the existing Hemyc

fire wrap in this fire area, satisfy the underlying intent of 10 CFR 50, Appendix R, Subsection III.G.2.c.

In summary, by letter dated July 27, 2005, Agencywide Documents Access and Management System (ADAMS) accession number ML052210382, as supplemented on May 17, 2006, ADAMS accession number ML061530108, ENO submitted an exemption request to the NRC for relief from the requirements of Subsection III.G.2.c of 10 CFR 50, Appendix R, specifically, from the 1-hour rating requirement for the fire wrap in the West Cable Tunnel at JAF.

3.0 DISCUSSION

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR Part 50 when (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) when special circumstances are present. One of these special circumstances, described in 10 CFR 50.12(a)(2)(ii), is that the application of the regulation is not necessary to achieve the underlying purpose of the rule.

The NRC staff examined the licensee's rationale to support the exemption request and concluded that the existing fire protection features in and accessible for the specific fire zone referenced for JAF meet the underlying purpose of 10 CFR 50, Appendix R, Subsection III.G.2.c. The following technical evaluation provides the basis for this conclusion.

3.1 Background

On May 29, 2001, the NRC granted the licensee an exemption from the requirement of Appendix R, Section III.G.2.c, applicable to the West Cable Tunnel at JAF. Specifically, although III.G.2.c provides the use of a 1-hour rated fire barrier as a means of ensuring adequate fire protection for redundant safe shutdown trains in this fire zone, the licensee

identified that the fire barrier material intended to be rated for 1 hour, in fact demonstrated functionality for 52 minutes during testing in accordance with American Society for Testing and Materials E-119 test criteria. The NRC granted the exemption based on supporting evidence that a 30-minute rated fire barrier, in combination with existing fire protection features and the absence of significant combustibles and ignition sources in the area, provided an equivalent level of protection and satisfied the underlying purpose of the rule. More than one type of fire barrier is used in this fire area, however no specific fire barrier type was identified in the exemption itself.

In 2005, the NRC identified Hemyc fire barriers as potentially nonconforming fire barriers relied on for compliance with fire protection regulations for 1-hour or 3-hour rated protection at some licensed nuclear power plants. On April 1, 2005, the NRC staff issued Information Notice 2005-07, "Results of HEMYC Electrical Raceway Fire Barrier System Full Scale Fire Testing" (ML050890089), identifying the concern. On April 10, 2006, the NRC staff issued Generic Letter 2006-03, "Potentially Nonconforming Hemyc and MT Fire Barrier Configurations" (ML053620142), asking that licensees determine whether this type of fire barrier is relied on for compliance and, if so, how compliance is maintained given the potential for nonconformance observed during recent NRC Hemyc testing (ML051190026).

ENO identified use of Hemyc in the West Cable Tunnel and seeks an exemption similar to that granted in May 2001 (specified in the current submittal as applicable to Kaowool FP-60 fire barrier wrap), on the basis that the existing Hemyc fire barrier in this area is expected to provide at least 30 minutes of protection for the redundant safe shutdown trains located there and, in combination with existing fire protection features and the absence of significant combustibles and ignition sources in the area, provides an equivalent level of protection to satisfy the underlying purpose of the rule.

3.2 Existing Fire Protection Features

Fire Area 1C at JAF contains the West Cable Tunnel (Fire Zone [FZ] CT-1). FZ CT-1 is protected from adjoining fire zones and other plant areas by 3-hour fire barriers. It has a total area of 13,400 square feet and contains Division I (Train A) cables for systems relied on for post-fire safe shutdown. In the event of a fire in this zone, the High Pressure Coolant Injection System and Residual Heat Removal System "B" Train are relied on for hot shutdown of the plant, as well as the Alternate Shutdown Cooling System "B" Train which is relied on for cold shutdown.

These systems are supported by the "B" Train direct current (dc) power supply and associated heating, ventilating, and air conditioning equipment. Therefore, the power cable for the air handling unit which provides proper ventilation for the "B" Train dc power supply (or Battery Room "B"), is also relied on for safe shutdown and is the subject of this review.

Hemyc is used to protect approximately 40 feet of the 5-inch conduit containing this power cable, for compliance with safe shutdown requirements. Within the 40 feet of Hemyc-wrapped conduit are 3.75 feet of 5-inch flex-conduit, and an inline pull box approximately 12 inches by 18 inches by 8 inches. All structural supports are seismically-qualified and completely wrapped in Hemyc except for a portion of the base plates, which are bolted to a concrete ceiling.

The licensee describes the Hemyc material used in this application as consisting of an inner and outer covering of aluminized Siltemp^{®1}. The licensee states that aluminized Siltemp[®] can be expected to have better heat resistive properties than non-aluminized Siltemp[®] or Refrasil[®], since the reflective coating serves to reflect more radiant energy than the standard Siltemp[®] or Refrasil[®].

¹Siltemp[®] and Refrasil[®] are heat-resistant fabrics used as an outer covering for Hemyc. Both were tested by the NRC and determined to be essentially equivalent (ADAMS Accession No. ML 051190055). Refrasil[®] was used during recent NRC Hemyc tests.

The licensee identifies the in-situ combustible load for this zone as cable and fiberglass. Cable is described as making up over 90 percent of the load, with original cables ordered before Institute of Electrical and Electronics Engineers (IEEE) Standard 383-1974 was issued. However, the licensee states that the flame retardant capability of the installed cable was analyzed and determined to be similar to IEEE 383-1974 rated cable. The fiberglass in this zone is comprised of a water tank (shower waste tank), piping, and ladders. The tank is approximately 21 feet from the Hemyc wrap, and the ladders are stored over 50 feet from the Hemyc wrap. Only the cables have been identified as significant in-situ ignition sources.

Detection in FZ CT-1 is described by the licensee as an automatic area-wide early warning smoke detection system monitored in the Main Control Room. Although the detection system was designed and installed in accordance with National Fire Protection Standards 72D and 72E, 1979 and 1978 Editions, respectively, the installed system does not meet the code of record in some cases. However, the deviations from the code were evaluated by the licensee and determined not to adversely impact safety performance.

Automatic suppression for this zone is described as consisting of area-wide sprinklers and in-tray water spray. Manual suppression is also available within FZ CT-1 and in nearby areas in the form of fire extinguishers and hose stations.

3.3 Evaluation

Hemyc fire barrier is used to wrap a cable in FZ CT-1 that supplies power to the air handling unit that supports redundant safe shutdown equipment described in Section 3.2 above. Although this Hemyc was installed with the intention of providing 1 hour of rated fire protection in accordance with Appendix R, Subsection III.G.2.c, the licensee has evaluated the Hemyc configuration for this power cable and requests an exemption from the 1 hour requirement based on the expectation that the configuration will provide at least 30 minutes of protection.

Five-inch conduits were not tested in recent Hemyc tests. However, because the mass of the larger sized conduits used in this application at JAF should be more resistant to thermal absorption than that of the 4-inch conduits tested, and because this expectation was confirmed during NRC testing where the smaller sized conduits consistently failed in less time than the larger sized conduits, the NRC staff expects the results of the 4-inch conduit tests to be representative of a 5-inch configuration with some conservatism. The NRC testing was described in NRC Information Notice 2005-07 and further documented in the Sandia National Laboratories test reports (ML051190026).

In the NRC tests (described in Section 3.1 above), the 4-inch conduit was tested with and without cable placed inside. With cable inside, indication of thermal failure for the 4-inch conduit was reached at 43 minutes. Therefore, for the rigid 5-inch configuration at JAF, the NRC staff finds that the test results for the 4-inch conduit and the additional time margin for thermal failure to occur due to the larger mass of the 5-inch conduit provides reasonable assurance that the Hemyc would provide 30 minutes of protection.

The 5-inch cable configuration at JAF also includes a section of flex-conduit and an in-line pull box. Flex-conduit was not included in the recent Hemyc tests. However, the licensee provided additional information regarding this application of flex-conduit. The size and geometry of the flex-conduit is described as identical to that of the rigid conduit. However, the weight per unit length of the flex-conduit (4.7 pounds per foot (lbs/ft)) was determined to be best represented by the empty 2.5-inch conduit tested (5.1 lbs/ft). Because the initiation of thermal failure for the 2.5-inch empty conduit was indicated at 41 minutes during the NRC tests, the NRC staff finds that the flex-conduit configuration at JAF would be expected to provide slightly less than 41 minutes of protection. Because initiation of thermal failure for the 1-inch filled conduit tested (2.52 lbs/ft) was indicated at 34 minutes during the NRC tests, the NRC staff finds that the flex-conduit configuration at JAF would be expected to provide 30 minutes of

protection, with an estimated margin of approximately 10 minutes (approximately 33 percent margin).

The in-line pull box included in the Hemyc configuration is approximately 12-inches by 18-inches by 8-inches, and is positioned in-line with the 5-inch rigid conduit. A larger junction box of the same shape as the JAF pull box was included in the recent Hemyc tests, tested both with and without bands. Therefore, the NRC test results for the junction box should provide a reasonable representation of the expected performance of the JAF pull box configuration.

In the NRC tests the Hemyc material was wrapped around the junction box (18-inches by 24-inches by 8-inches) using two Hemyc mats, each covering 3 sides of the box and stitched together. In the test with bands, the banding kept both mats in place even though the stitching failed. The junction box was banded with 2 to 3 bands around each of the six sides. When tested with the bands, initiation of thermal failure within the junction box was indicated at 31 minutes following the onset of the fire. In the test without the bands, initiation of thermal failure within the junction box was indicated at 15 minutes following the onset of the fire.

At JAF, the Hemyc material is wrapped around the pull box using one Hemyc mat covering four sides, with a seam stitched along the length of one side. The remaining two ends are protected by Hemyc end pieces stitched in place. Banding is used to keep the four sides secured in place; however, the banding does not secure the end pieces. The licensee describes the end pieces as partially secured in place with the Hemyc that is wrapped around the in-line conduit. However, the NRC staff is concerned that without banding of the end pieces similar to banding of all sides during NRC tests, failed stitching would result in thermal failure at the unbanded end pieces similarly to that demonstrated during NRC testing of the unbanded junction box.

In the licensee's May 17, 2006, response (ADAMS Accession No. ML061530108) to the NRC staff's request for additional information (ADAMS Accession No. ML060860014) regarding

the expected performance of the pull box during a severe fire, the licensee stated that the degree of thermal shrink observed during NRC testing using Refrasil® was more substantial than that observed during subsequent industry testing using Siltemp®, which is the material used in the JAF Hemyc configuration. However, this reasoning is not consistent with the NRC staff's interpretation of the results of the tests. The NRC staff observed both the NRC and industry tests and analyzed the data from both tests. The NRC staff observed that the improvements made to the industry test configuration (including increased collar widths, double wrapped elbows, and larger overlap area at the joints) may have resulted in smaller gaps at the joints; however, the resulting thermal failures were consistent (and sometimes more severe) than those observed during the NRC tests. In addition, these improvements have not been incorporated into the JAF pull box configuration. Therefore, the NRC staff finds no basis to conclude improved performance at the pull box end piece stitching.

Based on the results of the NRC tests, it appears that the four banded sides of the pull box would remain protected for approximately 31 minutes. However, the protection provided by the two ends of the pull box is uncertain. Banding is not used to secure the end pieces of the JAF pull box as it was during the NRC test of the junction box. The adjoining Hemyc from the in-line conduit may provide some reinforcement, but that potential additional protection is uncertain. Also, the apparent pinched stitching could provide additional Hemyc material that may improve performance, but again with uncertain quantification of the potential additional protection. Therefore, based on the results of the NRC tests and the absence of banding at the two ends of the JAF pull box, it appears that the conduit within the pull box would remain protected for 15 to 31 minutes from the onset of a fire. With additional margin added to the NRC test results to provide reasonable assurance of protection of the cables inside, the NRC staff finds that 30 minutes of protection cannot be reasonably expected at the pull box.

Regarding the licensee's expectation that aluminized Siltemp® will improve the heat resistive properties of the JAF Hemyc configuration, it is not clear to the NRC staff that this expectation has been quantified or analyzed. In response to the NRC staff's request for additional information asking for supporting evidence of this expectation, the licensee referred to the manufacturer's data. Although this reference confirmed the statement that, "(a)luminized Siltemp® provides thermal reflectivity," it also provided a table of Siltemp® products, including aluminized Siltemp® as an entry with a footnote that states, "Coatings will lose properties as temperature increases." In addition, the licensee stated that "(b)ased on the better thermal reflectivity of the aluminized Siltemp®, less heat transfer will occur into the Hemyc wrap because it is reflected away." However, the licensee has provided no quantification for any potential reduction in radiant heat transfer. In addition, the stratification of hot gases would likely result in the formation of a black body in the vicinity of the Hemyc configuration (near the ceiling) which would impede radiant heat transfer. Based on the information provided, the NRC staff is unable to confirm that the contribution of thermal reflectivity, if any, would be effective enough to result in a measurable improvement in Hemyc performance. Therefore, the NRC staff finds no basis for the expectation of any marked difference in radiant energy reflection between aluminized and standard Siltemp® or Refrasil®.

All structural supports used in this application are seismically-qualified and completely wrapped in Hemyc except for a portion of the base plates, which are bolted to a concrete ceiling. In response to the NRC staff's request for additional information, the licensee provided details on the configuration of the structural support. Although the area of the exposed portions of the base plates requested was not provided, the NRC staff is of the opinion that the concrete ceiling should act as a heat sink for a fire in this area, minimizing the heat transfer through the supports. Based on the fully-wrapped structural support system, the NRC staff finds the heat

transfer through the exposed based plates or supports would be insufficient to adversely impact the functionality of the associated protected cable.

Combustibles and Ignition Sources

The only significant in-situ combustible and ignition source for this zone is cable. Although these cables were installed before IEEE Standard 383-1974 was issued, they have been analyzed to determine the flame retardant capability and shown to be equivalent to IEEE 383-1974 rated cable. The NRC staff has reviewed the licensee's evaluation of the flame retardant characteristics of the cable installed and finds acceptable the licensee's determination that a fire in this area will propagate slowly.

Administrative procedures control transient combustibles, ignition sources, and hot work in this zone. Procedures are being revised to incorporate restrictions on hot work in the proximity of the Hemyc wrap under review, similar to that done for the Kaowool FP-60 fire barrier wrap.

Detection

An automatic area-wide smoke detection system is installed in this fire area. If actuated, the detector will initiate an alarm in the Main Control Room. Because the installed detection system does not meet the code of record in some cases, the deviations from the code were evaluated by the NRC staff and found to potentially affect the availability of the detection system. Therefore, the NRC staff reviewed the licensee's program to ensure availability of the detection systems in the event detection is unavailable in FZ CT-1. The NRC staff found that adequate administrative controls are in effect to apply compensatory measures if the system is not available and adequate controls maintain the effectiveness of the detection system. Therefore, the NRC staff concludes that the detection system code deviations do not adversely impact safety performance in this zone.

Suppression

Automatic suppression for this zone is supplied by area-wide sprinklers and an in-tray water spray system. Manual suppression is also available through hose stations and fire extinguishers located within the fire zone and in nearby areas. In the event that automatic or manual suppression systems are out of service, compensatory measures have been established to protect safe shutdown equipment in FZ CT-1.

Risk Analysis

The licensee reviewed the JAF fire probabilistic risk analysis database for the air handling unit and the power cable supplying it, and found that neither are risk significant. If the power cable was damaged by a fire, and therefore ventilation was lost to the B battery room, the licensee stated it would take 2 hours for the B battery room to heat up to the point it would exceed the manufacturer's qualification of the battery. This allows time to fight the fire and take corrective actions. Assuming the loss of all the equipment in FZ CT-1, the licensee estimated the total core damage frequency for a fire in FZ CT-1 as $7.21E-7$ /year, based on the JAF Individual Plant Examination for External Events.

Defense-in-Depth

Part 50 of 10 CFR, Appendix R, section II, states that a licensee's fire protection program extend the concept of defense-in-depth to fire protection with the following objectives:

- To prevent fires from starting,
- To detect rapidly, control, and extinguish promptly those fires that do occur, and
- To provide protection for structures, systems and components important to safety so that a fire that is not promptly extinguished by the fire suppression activities will not prevent the safe shutdown of the plant.

Regulatory Guide 1.174 also identifies factors to be considered when evaluating defense-in-depth for a risk-informed change.

The NRC staff has evaluated the elements of defense-in-depth used for fire protection at JAF, applicable to the fire zone under review. Although the NRC staff finds inadequate basis to support the licensee's expectation that the existing Hemyc configuration in FZ CT-1 will provide 30 minutes of protection for the power cable to the air handling unit relied on for post-fire safe shutdown in the event of a worst-case fire in FZ CT-1, the NRC staff is reasonably assured that the absence of significant combustible loading and ignition sources in the area of the Hemyc configuration and low risk significance associated with the safe shutdown equipment protected, preclude the need for withstanding a fire of the magnitude tested in recent NRC tests. In particular, although the Hemyc configuration applied to the JAF pull box may not be optimal, the risk significance is low. In addition, the existing fire protection capabilities for full area detection, full area suppression, and in-tray suppression, provide reasonable assurance for prevention of an unmitigated fire. Therefore, based on the NRC staff's analysis, defense-in-depth is maintained.

Special Circumstances

One of the special circumstances, described in 10 CFR 50.12(a)(2)(ii), is that the application of the regulation is not necessary to achieve the underlying purpose of the rule. The underlying purpose of Subsection III.G.2.c of 10 CFR 50, Appendix R, is to ensure that one of the redundant trains necessary to achieve and maintain hot shutdown conditions remains free of fire damage in the event of a fire, and allows the use of a 1-hour fire barrier with fire detectors and an automatic fire suppression system as one means for complying with this fire protection requirement. For FZ CT-1, based on the presence of area-wide smoke detection; the presence of automatic area and in-tray fire suppression and manual fire suppression; fire barrier protection at the boundaries of the fire zone; the existing Hemyc configuration in the fire zone; implementation of transient combustibles controls including proposed revisions for hot work in the vicinity of the Hemyc configuration; and the absence of significant combustible loading and ignition sources, the NRC staff finds that a 1-hour rating for the fire barrier protection in this zone is not necessary to ensure the availability of a redundant train necessary to achieve and maintain safe shutdown of the plant in the event of a fire in FZ CT-1. Based upon consideration of the information in the licensee's Fire Hazards Analysis; administrative controls for transient combustibles and ignition sources; responses to NRC staff requests for additional information; previously-granted exemptions for this fire zone; and the considerations noted above, the NRC staff concludes that this exemption meets the underlying purpose of the rule. Therefore, operating in the proposed manner meets the underlying purpose of Subsection III.G.2.c to 10 CFR 50, Appendix R, and special circumstances required by 10 CFR 50.12 for the granting of an exemption from 10 CFR 50 exist.

Authorized by Law

This exemption would allow use of a fire barrier expected to provide less than 1 hour of fire protection. As stated above, 10 CFR 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR Part 50. The NRC staff has determined that granting of the licensee's proposed exemption is permissible under the Atomic Energy Act of 1954, as amended, or the Commission's regulations. Therefore, the exemption is authorized by law.

No Undue Risk to Public Health and Safety

The underlying purpose of Subsection III.G.2.c of 10 CFR 50, Appendix R, is to ensure that one of the redundant trains necessary to achieve and maintain hot shutdown conditions remains free of fire damage in the event of a fire. Based on the existing fire barriers, fire detectors, automatic and manual fire suppression equipment, administrative controls, the fire hazard analysis, the Hemyc configuration, and the absence of significant combustible loads and ignition sources, special circumstances are present such that application of this rule is not necessary. No new accident precursors are created by allowing use of a fire barrier expected to provide less than 1 hour of fire protection and the probability of postulated accidents is not increased. Similarly, the consequences of postulated accidents are not increased. Therefore, there is no undue risk (since risk is probability multiplied by consequences) to public health and safety.

Consistent with Common Defense and Security

The proposed exemption would allow use of a fire barrier expected to provide less than 1 hour of fire protection based on the existing fire barriers, fire detectors, automatic and manual fire suppression equipment, administrative controls, the fire hazard analysis, the Hemyc configuration, and the absence of significant combustible loads and ignition sources. This change to the plant requirements for the specific configuration in this fire zone has no relation

to security issues. Therefore, the common defense and security is not impacted by this exemption.

4.0 CONCLUSION

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a), the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Specifically, special circumstances are present in that the application of the regulation is not necessary to achieve the underlying purpose of the rule. Therefore, the Commission hereby grants ENO an exemption from the requirement of a 1-hour rated fire barrier (fire wrap) in Section III.G.2.c of 10 CFR Part 50, Appendix R, for the West Cable Tunnel at JAF provided that the proposed revisions to the procedures for hot work in the vicinity of the Hemyc configuration are implemented. The granting of this exemption is based on the implementation of revised administrative controls for hot work in the vicinity of the Hemyc configuration in FZ CT-1 (addressed in Section 3.3 above), the existing or upgraded fire barrier protection features in FZ CT-1, the maintenance of existing automatic detection and suppression features in FZ CT-1, and the availability of manual fire fighting and associated fire fighting equipment.

Pursuant to 10 CFR 51.32, the Commission has determined that the granting of this exemption will not have a significant effect on the quality of the human environment (71 FR 54100).

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 27th day of September 2006.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Catherine Haney, Director
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation