Florida Power
A Progress Energy Company

Crystal River Unit 3
Docket No. 50-302
Operating License No. DPR-72

Ref: 10 CFR 50.90
10 CFR 50.12

October 23, 2002
3F1002-05

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

Subject: Crystal River Unit 3 - License Amendment Request #276, Revision 0, "Use of M5 Advanced Alloy Fuel Cladding"

Dear Sir:

Pursuant to Title 10 of the Code of Federal Regulations, Section 50.90 (10 CFR 50.90), Florida Power Corporation (FPC) submits a request to amend the Crystal River Unit 3 (CR-3) Operating License, Appendix A, Improved Technical Specifications (ITS). The proposed changes involve ITS 4.2.1, Fuel Assemblies and 4.2.2, Control Rods. Current ITS 4.2.1 permits the use of only Zircaloy-4 cladding. The proposed change will permit the use of Framatome ANP (FRA-ANP) M5 advanced alloy for fuel rod cladding and fuel assembly structural components.

The proposed change also removes the maximum fuel enrichment, nominal active fuel length, weight of uranium for fuel rods and details of Control Rod content from ITS. These changes are consistent with NUREG 1430, Standard Technical Specifications for Babcock and Wilcox Reactors, Revision 2. Additionally, to add consistency with NUREG 1430 wording, ITS 4.2.1 text is being changed to allow the use of a limited number of lead test assemblies to be placed in non-limiting core regions. CR-3 does not intend to load lead test assemblies in the upcoming fuel cycle (Cycle 14).

This letter also requests exemptions pursuant to 10 CFR 50.12 from each of the following three regulations: 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," 10 CFR 50.44, "Standards for combustible gas control systems in light-water cooled power reactors," and 10 CFR 50 Appendix K, "ECCS Evaluation Models." These 10 CFR 50 sections presume the use of Zircaloy or ZIRLO fuel cladding. The M5 cladding is a proprietary zirconium-based alloy that is chemically different from zircaloy or ZIRLO. Therefore, a plant specific exemption from each of the regulations mentioned above is required in order to use the M5 cladding. Information supporting the exemption requests is contained in Attachment B. FPC has concluded that the special circumstances defined by 10 CFR 50.12 exist to warrant the exemptions and that granting the exemption requests will not present undue risk to the public health and safety and is consistent with the common defense and security.

The M5 cladding has been approved for use at other nuclear facilities. In particular, fuel with M5 cladding is in use at Three Mile Island and Davis Besse, which are Babcock and Wilcox (B&W) plants similar to CR-3.

A001

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CR-3 is planning to utilize M5 cladding for the next refueling scheduled for October 2003. CR-3 respectfully requests that this amendment and the required exemptions be issued by August 1, 2003.

The CR-3 Plant Nuclear Safety Committee has reviewed this request and recommended it for approval.

This letter makes no new regulatory commitments.

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

Sincerely,

Dale E. Young

Dale E. Young
Vice President
Crystal River Nuclear Plant

DEY/pei

Attachments:

A. Description and Assessment of Proposed Changes

B. Basis and Justification for Exemption Requests

C. Proposed Revised Improved Technical Specification Pages – Strikeout Version

D. Proposed Revised Improved Technical Specification Pages – Revision Line Version

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

STATE OF FLORIDA

COUNTY OF CITRUS

Dale E. Young states that he is the Vice President, Crystal River Nuclear Plant for Progress Energy; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission the information attached hereto; and that all such statements made and matters set forth therein are true and correct to the best of his knowledge, information, and belief.

Dale E. Young

Dale E. Young
Vice President
Crystal River Nuclear Plant

The foregoing document was acknowledged before me this 23d day of October, 2002, by Dale E. Young.

Lisa A Morris

Signature of Notary Public
State of Florida

...A. MORRIS
Notary Public, State of Florida
My Comm. Exp. Oct. 25, 2003
Comm. No. CC 879691

LISA A MORRIS

(Print, type, or stamp Commissioned Name of Notary Public)

LISA A. MORRIS
Notary Public, State of Florida
My Comm. Exp. Oct. 25, 2003
Comm. No. CC 879691

Personally Known X -OR- Produced Identification ______

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

ATTACHMENT A

LICENSE AMENDMENT REQUEST #276, REVISION 0
Use of M5 Advanced Alloy Fuel Cladding

Description and Assessment of Proposed Changes

Description and Assessment of Proposed Changes

1.0 INTRODUCTION

This letter submits a License Amendment Request (LAR) to revise Crystal River Unit 3 (CR-3) Improved Technical Specifications (ITS) 4.2.1, Fuel Assemblies and 4.2.2, Control Rods. CR-3 is planning to use an enhanced Framatome ANP (FRA-ANP) fuel design for the replacement fuel assemblies in Cycle 14. The enhanced fuel design utilizes M5 advanced alloy fuel cladding, which is chemically different from either Zircaloy or ZIRLO that are specified in ITS 4.2.1. In addition, the active fuel length and weight of uranium for fuel rods for the enhanced fuel design will exceed the current values listed in ITS 4.2.1. No changes to the control rod design are planned for Cycle 14.

2.0 DESCRIPTION

The proposed ITS change will replace the existing specifications 4.2.1 and 4.2.2 with the wording from NUREG-1430, Revision 2, with the following main difference: the fuel cladding type will include "M5" in addition to Zircaloy-4. The proposed wording is as follows:

4.2.1 Fuel Assemblies

The reactor shall contain 177 fuel assemblies. Each assembly shall consist of a matrix of Zircaloy-4 or M5 fuel rods with an initial composition of natural or slightly enriched uranium dioxide (UO_2) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions.

4.2.2 Control Rods

The reactor core shall contain 60 safety and regulating CONTROL ROD assemblies and 8 Axial Power Shaping Rods (APSR) assemblies. The material shall be silver indium cadmium or Inconel as approved by the NRC.

3.0 BACKGROUND

CR-3 initial Technical Specifications for Fuel Assemblies and Control Rods contained design information including the maximum enrichment, nominal active fuel length, maximum total weight of uranium, and specifics about the content of Control Rods. When CR-3 converted to ITS, the standard for ITS, NUREG 1430, had not yet been fully developed. Therefore, some of the CR-3 ITS retained aspects of the previous Technical Specifications. When NUREG 1430, Revision 0, was published, Fuel Assembly and Control Rod design information, such as that included in CR-3 ITS 4.2.1 and 4.2.2, was removed. Design parameters such as these were considered to be more appropriately located in other design documentation, core reload analyses and the Final Safety Analysis Report (FSAR).

4.0 TECHNICAL ANALYSIS

The technical basis for use of the M5 material for fuel cladding and structural material is topical report BAW-10227P-A, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," February 2000. This topical report was approved by the NRC by a letter dated February 4, 2000. The M5 cladding is an FRA-ANP proprietary material comprised primarily of zirconium (approximately 99%) and niobium (approximately 1%). This composition provides for improvements in fuel cladding corrosion and hydrogen pickup, fuel assembly and fuel rod growth, and fuel rod cladding creep relative to the Zircaloy-4 cladding currently in use at CR-3. The M5 alloy has been tested in both reactor and non-reactor environments to ascertain its mechanical and structural properties, as described in BAW-10227P-A.

Results of test irradiations of M5 fuel rod cladding in commercial power reactors, in both the U.S. and Europe, have demonstrated that the maximum fuel cladding corrosion rate is 40 to 50% of Zircaloy-4 and the hydrogen pickup rate is a quarter of that experienced with Zircaloy-4 cladding of the type currently used at CR-3. Therefore, use of M5 cladding will provide significantly greater margin to the 100 micron corrosion limit than Zircaloy-4. The improvements in corrosion and hydrogen uptake are also applicable to fuel assembly structural components, such as guide tubes and spacer grids.

These same tests have also shown that the M5 alloy exhibits significantly less irradiation induced growth in fuel rods and fuel assembly guide tubes when compared to Zircaloy-4. This property will provide additional margin to the fuel assembly and fuel rod growth limits for fuel assemblies with high burnups such as those that will be produced in twenty-four month fuel cycles. Reduced fuel assembly growth will also help reduce irradiation-induced fuel assembly bow and distortion, which can be detrimental to fuel handling. Fuel cladding creep collapse is also greatly reduced for the M5 alloy relative to Zircaloy-4, which can benefit fuel rod internal pressure performance. In evaluating the properties of the M5 alloy, FRA-ANP determined that the use of the M5 alloy would have either no significant impact or would produce a benefit for the following parameters and analyses:

- Fuel assembly handling and shipping loads.
- Fuel rod internal pressure.
- Fuel rod cladding transient strain.
- Fuel centerline melting temperature.
- Fuel rod cladding fatigue.
- Fuel rod cladding creep collapse.
- Fuel rod axial growth.
- Fuel rod bow.

Thus, FRA-ANP has determined that the M5 advanced alloy will perform acceptably at all normal operating conditions.

FRA-ANP also evaluated the performance of the M5 alloy for both Loss-of-Coolant Accident (LOCA) and non-LOCA accident scenarios that bound the accidents in the CR-3 FSAR. Non-LOCA events in which the cladding material could affect departure from nucleate boiling (DNB) were evaluated. For such accidents, a change from Zircaloy-4 to M5 fuel rod cladding produces no adverse consequences in DNB performance. This is to be expected, since both M5 and Zircaloy-4 have very similar heat transfer properties. In some cases, due to the reduced clad creep rate of M5, a DNB benefit can be produced since the reduced clad creep rate results in greater heat transfer surface area and, therefore, lower heat flux. For non-LOCA accident evaluations that do not involve DNB criteria, there is an effect of the M5 alloy if the transient involves the calculation of a detailed cladding temperature history with an excursion into the alpha/beta phase temperature range (approximately 700°C). For these transients, a small impact on temperature response is expected. This impact will be assessed in the Cycle 14 reload analysis in accordance with ITS 5.6.2.18, Core Operating Limits Report (COLR), and BAW-10179P-A. The results of these calculations are not expected to differ substantially from Zircaloy-4 based calculations and no limiting criteria are expected to be challenged.

FRA-ANP determined that the five LOCA acceptance criteria from 10 CFR 50.46 are applicable to fuel rods clad with the M5 alloy. Generic LOCA analyses for both B&W and Westinghouse plants and fuel have been performed using the specific material properties which accounted for the following:

- Lower alpha-beta phase transition temperature for M5 relative to Zircaloy-4.
- Slower clad creep collapse for M5 relative to Zircaloy-4.
- Slightly lower beginning of life yield strength for M5 relative to Zircaloy-4 (after 3 GigaWatt Days per metric ton of uranium (GWd/mtU), approximately 3 months of irradiation, the yield strength of M5 is equivalent to that of unirradiated Zircaloy-4).
- M5-specific clad swelling and rupture models determined through experimental measurements.

These generic LOCA analyses using M5-specific material properties have demonstrated: that all five of the LOCA acceptance criteria mandated by 10 CFR 50.46 can be readily met in cores using M5 cladding; that the use of M5 cladding will not require any reductions in LOCA linear heat rate limits; and that there are no adverse LOCA-related issues that would prevent the acceptable use of M5 cladding. The cycle-specific reload report associated with Cycle 14 will include a plant-specific LOCA reanalysis prior to the use of the M5 alloy fuel assemblies at CR-3. This LOCA analysis will be done in accordance with ITS 5.6.2.18, "Core Operating Limits Report (COLR)" and BAW-10179P-A.

Also, FRA-ANP determined that, for those accidents which result in radionuclide release (e.g., LOCA, control rod ejection accident, fuel handling accident), the use of M5 cladding and structural components will have no adverse impact on radiological doses. Again, this is due to the similar material properties and DNB performance of M5 and Zircaloy-4 during these accident scenarios.

In addition to the use of M5 material, the FRA-ANP enhanced fuel design will also utilize greater active fuel length and greater total maximum uranium content than current Mark-B10 fuel. Consequently, the values for these parameters in ITS 4.2.1 would need to be revised to accommodate the Cycle 14 replacement fuel assemblies. NUREG 1430, Standard ITS for B&W reactors, Section 4.2.1 does not include these design details. Therefore, in order to permit the proposed fuel design change and better comply with standard ITS, the values for these and other fuel and Control Rod design parameters are being deleted. The core reload analysis will continue to be done using BAW-10179P-A, "Safety Criteria and Methodology for Acceptable Cycle Reload Analyses," (the approved revision at the time the reload analyses are performed). Therefore, relocation of these design parameters is primarily administrative in nature. Utilization of the wording of the Standard ITS will decrease the potential need to revise specifications 4.2.1 and 4.2.2 in the future due to additional design changes.

5.0 REGULATORY ANALYSIS

5.1 No Significant Hazards Consideration Determination

Florida Power Corporation (FPC) has evaluated the proposed License Amendment Request (LAR), which consists of the identified Technical Specification changes and exemption requests, against the criteria of 10 CFR 50.92(c). The Technical Specification changes are categorized as follows:

1. Modification of Section 4.2.1, DESIGN FEATURES, Fuel Assemblies, and to include the M5 advanced alloy for fuel rod cladding and fuel assembly structural material,

2. Removal of design information such as maximum fuel enrichment, nominal active fuel length, maximum individual rod weight, and details of Control Rod content. Adopting the wording from the Standard ITS.

3. Addition to ITS 4.2.1 of the following sentence: "A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions." Crystal River Unit 3 does not intend to load lead test assemblies in the upcoming fuel cycle (Cycle 14). This sentence is being added for consistency with NUREG 1430, Revision 2.

FPC has concluded that this proposed LAR does not involve a significant hazards consideration. The following is a discussion of how each of the criteria is satisfied.

(1) Involve a significant increase in the probability or consequences of an accident previously evaluated.

<u>M5 advanced alloy:</u> Topical reports BAW-10227P-A, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," February 2000 and

BAW-10179P-A, Revision 4, "Safety Criteria and Methodology for Acceptable Cycle Reload Analyses," March 2001 provide the licensing basis for the Framatome ANP (FRA-ANP) advanced cladding and structural material, designated M5. The M5 material can be used for fuel rod cladding, as well as for fuel assembly spacer grids, fuel rod end plugs, and fuel assembly guide and instrument tubes. By letter dated August 2, 2001 (Reference 4), the NRC approved BAW-10179P-A, Revision 4, for referencing in license applications. BAW-10179P-A, Revision 4 incorporates BAW-10227P-A. The M5 material was shown in these documents to have equivalent or superior properties to the current Zircaloy-4 material. The cladding itself is not an accident initiator and does not affect accident probability. The M5 cladding has been shown to meet all 10 CFR 50.46 design criteria and, therefore, will not increase the consequences of an accident.

Removal of design parameters of maximum fuel enrichment, active fuel length, rod weight and Control Rod content: This change moves design features from Improved Technical Specifications (ITS) to the Final Safety Analysis Report (FSAR) and other design documents and analyses. The Framatome ANP enhanced fuel design will involve increased rod weight and active fuel length. The approved Framatome ANP topical report, BAW-10179P-A, "Safety Criteria and Methodology for Acceptable Cycle Reload Analyses," will continue to be used to ensure that the required safety limits for the fuel are satisfied. Therefore, the relocation of design information does not involve a significant increase in the probability or consequences of an accident previously evaluated.

Addition of a limited number of lead test assemblies: This change is administrative in nature and is proposed for consistency with the ITS standard. Crystal River Unit 3 does not intend to load lead test assemblies in the upcoming fuel cycle. When lead test assemblies are to be loaded, the approved Framatome ANP topical report BAW-10179P-A will be used to ensure that all applicable limits of the safety analysis are met and that the lead test assemblies are placed in nonlimiting core locations. Applicable mixed core penalties and core operating limits will be developed and applied. Therefore, use of lead test assemblies will not involve a significant increase in the probability or consequences of an accident previously evaluated.

(2) Create the possibility of a new or different kind of accident from any accident previously evaluated.

M5 advanced alloy: Topical report BAW-10227P-A demonstrated that the material properties of the M5 alloy are not significantly different from those of Zircaloy-4. Therefore, M5 fuel rod cladding and fuel assembly structural components will perform similarly to those fabricated from Zircaloy-4, thus precluding the possibility of the fuel becoming an accident initiator and causing a new or different type of accident.

Removal of design parameters of maximum fuel enrichment, active fuel length, rod weight and Control Rod content: This change moves design features from ITS to the FSAR and other design documents and analyses or adds consistency with the standard ITS. The location of this information does not create the possibility of a new or different kind of accident from any accident previously evaluated. The approved FRA-ANP topical report, BAW-10179P-A will continue to be used to ensure that the required safety limits are satisfied. Therefore, these changes do not involve the possibility of a new or different kind of accident from any accident previously evaluated.

Addition of a limited number of lead test assemblies: This change is administrative in nature and it is proposed for consistency with the ITS standard. Crystal River Unit 3 does not intend to load lead test assemblies in the upcoming fuel cycle. When lead test assemblies are to be loaded, they will be designed and manufactured to ensure compatibility with the co-resident fuel assemblies, core internal structures, and fuel handling and storage equipment. The approved Framatome ANP topical report BAW-10179P-A will be used to ensure that the lead test assemblies meet all applicable limits of the safety analysis and that the lead test assemblies are placed in non-limiting core locations. Applicable mixed core penalties and core operating limits will be developed and applied. Therefore, use of lead test assemblies will not involve the possibility of a new or different kind of accident from any previously evaluated.

(3) *Involve a significant reduction in a margin of safety.*

M5 advanced alloy: The proposed changes will not involve a significant reduction in the margin of safety because it has been demonstrated that the material properties of the M5 alloy are not significantly different from those of Zircaloy-4. The M5 alloy is expected to perform similarly or better to Zircaloy-4 for all normal operating and accident scenarios, including both non-LOCA and LOCA scenarios. For LOCA scenarios, where the slight differences in M5 material properties relative to Zircaloy-4 could have some impact on the overall accident scenario, plant-specific LOCA analyses will be performed prior to the use of fuel assemblies with fuel rods or fuel assembly components containing M5. These LOCA analyses, required by ITS 5.6.2.18, "Core Operating Limits Report (COLR)," will demonstrate that all applicable margins of safety will be maintained by the use of the M5 alloy.

Removal of design parameters of maximum fuel enrichment, active fuel length, rod weight and Control Rod content: Approved methodologies will be used in the cycle-specific safety analysis to evaluate the use of the M5 advanced alloy, and account for various assembly differences (various rod weights and active fuel lengths). The location of the design information does not affect the margin of safety.

Addition of a limited number of lead test assemblies: This change is administrative in nature and is proposed for consistency with the ITS standard. Crystal River Unit 3 does not intend to load lead test assemblies in the upcoming fuel cycle. When lead test assemblies are to be loaded, the approved Framatome ANP topical report BAW-10179P-A will be used to ensure that all applicable limits of the safety analysis are met and that the lead test assemblies are placed in nonlimiting core locations. Applicable mixed core penalties and core operating limits will be developed and applied. There will be no significant reduction in the margin of safety when a limited number of lead test assemblies are utilized.

5.2 Regulatory Safety Analysis

The underlying purpose of 10 CFR 50.46 is to ensure that facilities have adequate acceptance criteria for ECCS. FRA-ANP demonstrates in its topical report BAW-10227P-A, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," (Reference 1) approved by the NRC by letter dated February 4, 2000 (Reference 2), that the effectiveness of the ECCS will not be affected by a change from zircaloy fuel rod cladding to M5 fuel rod cladding. BAW-10179P-A (Reference 3) includes application of the BAW-10227P-A document and was approved by the NRC by letter dated August 2, 2001 (Reference 4). Therefore, since the underlying purpose of 10 CFR 50.46 is achieved through the use of the M5 advanced alloy as a fuel rod cladding material, the use of M5 cladding is acceptable.

The underlying purposes of 10 CFR 50.44 and 10 CFR 50 Appendix K Paragraph I.A.5 are to ensure that cladding oxidation and hydrogen generation are appropriately limited during a LOCA and conservatively accounted for in the ECCS evaluation model. Specifically, Appendix K requires that the Baker-Just equation be used in the ECCS evaluation model to determine the rate of energy release, cladding oxidation, and hydrogen generation. FRA-ANP demonstrated, in Appendix D of BAW-10227P-A, that the Baker-Just model is conservative in all post-LOCA scenarios with respect to the use of the M5 advanced alloy as a fuel rod cladding material, and that the amount of hydrogen generated in an M5-clad core during a LOCA will remain within the design basis. Therefore, since the underlying purposes of 10 CFR 50.44 and 10 CFR 50 Appendix K Paragraph I.A.5 are achieved through the use of the M5 advanced alloy as fuel rod cladding material, the use of M5 cladding is acceptable.

6.0 ENVIRONMENTAL EVALUATION

10 CFR 51.22(c)(9) provides criteria for and identification of licensing and regulatory actions eligible for categorical exclusion from performing an environmental assessment. A proposed amendment to an operating license for a facility requires no environmental assessment if operation of the facility in accordance with the proposed amendment would not: (1) involve a significant hazards consideration, (2) result in a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (3) result in a significant increase in individual or cumulative occupational radiation exposure.

Florida Power Corporation (FPC) has reviewed this license amendment request and has determined that it meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(c), no environmental impact statement or environmental assessment needs to be prepared in connection with the issuance of the proposed license amendment. The basis for this determination is as follows:

1. The proposed license amendment does not involve a significant hazards consideration as described previously in the no significant hazards evaluation for this License Amendment Request (LAR).

2. The proposed change in cladding material will result in fuel with increased corrosion resistance and reduced irradiation induced growth. These properties will improve fuel performance and will not change the types or increase the amounts of any effluents. The relocation of design criteria from the ITS to the FSAR is an administrative change and will have no impact on plant effluents. The addition of a limited number of test assemblies is an administrative change proposed for consistency with the ITS standard.

Offsite release concentrations and doses will continue to be maintained within the limits of 10 CFR 20 and 10 CFR 50, Appendix I in accordance with the requirements of the CR-3 Offsite Dose Calculation Manual (ODCM). The ODCM contains offsite dose calculation methodologies, the radioactive effluent controls program, and radiological environmental monitoring activities. The ODCM contains the methodologies and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents, the methodologies and parameters used in the calculation of gaseous and liquid effluent monitoring alarm and trip setpoints, and the controls for maintaining the doses to members of the public from radioactive effluents as low as reasonably achievable in accordance with 10 CFR 50.36a. The proposed changes will not result in changes in the operation or design of the gaseous, liquid or solid waste systems, and will not create any new or different radiological release pathways.

Therefore, the proposed license amendment will not result in a significant change in the types or increase in the amounts of any effluents that may be released off-site.

3. The proposed changes will not cause radiological exposure in excess of the dose criteria for restricted and unrestricted access specified in 10 CFR 20. Radiation levels in the plant will not be changed due to the new fuel clad material or relocation of design criteria. Individual worker exposures will be maintained within acceptable limits by the CR-3 as-low-as-reasonably-achievable (ALARA) program. Therefore, the proposed license amendment will not result in a significant increase to the individual or cumulative occupational radiation exposure.

Non-Radiological Evaluation

With regard to non-radiological impacts, the proposed license amendment involves no significant increase in the amounts or changes in the types of any non-radiological effluents that may be released offsite.

7.0 REFERENCES

1. FRA-ANP Topical Report BAW-10227P-A, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," February 2000.

2. NRC letter to Framatome Cogema Fuels, dated February 4, 2000, Revised Safety Evaluation (SE) for Topical Report BAW-10227P: "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel." (TAC M99903)

3. FRA-ANP Topical Report BAW-10179P-A, "Safety Criteria and Methodology for Acceptable Cycle Reload Analyses," (the approved revision at the time the reload analyses are performed).

4. NRC letter to BWOG Core Performance Committee, dated August 2, 2001, Safety Evaluation for Topical Report BAW-10179P-A, "Safety Criteria and Methodology for Acceptable Cycle Reload Analyses," Revision 4, March 2001. (TAC MB 1692)

8.0 PRECEDENTS

The use of the M5 advanced alloy material was previously approved for two other Babcock and Wilcox 177 fuel assembly reactors. The amendments were issued as follows:

Davis Besse Nuclear Power Station, Unit 1, Amendment No. 239, dated March 15, 2000.

Three Mile Island, Unit 1, Amendment No. 233, dated May 10, 2001.

The removal of design information from ITS Sections 4.2.1.and 4.2.2 is consistent with NUREG 1430, Standard Technical Specifications Babcock and Wilcox Plants, Revision 2.

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

ATTACHMENT B

LICENSE AMENDMENT REQUEST #276, REVISION 0
Use of M5 Advanced Alloy Fuel Cladding

Basis and Justification for Exemption Requests

Exemptions from 10 CFR 50.46, 10 CFR 50.44 and 10 CFR PART 50, Appendix K, P I.A.5 Regarding the Proposed Use of the "M5" Advanced Alloy

In accordance with 10 CFR 50.12, "Specific Exemptions," three exemptions for Crystal River Unit 3 (CR-3) are requested from the requirements specified in 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Nuclear Power Reactors," Section 50.44, "Standards for Combustible Gas Control System in Light-Water-Cooled Power Reactors," and 10 CFR 50 Appendix K, "ECCS Evaluation Models," paragraph I.A.5, regarding the use of zircaloy or ZIRLO as a fuel rod cladding material. These exemption requests pertain to the proposed use of the M5 advanced zirconium alloy for CR-3 fuel rod cladding and fuel assembly material.

Background

10 CFR 50.46 and 10 CFR 50.44 provide various requirements for light water reactor system performance during and following a postulated loss of coolant accident (LOCA) for reactors containing oxide fuel pellets in either zircaloy or ZIRLO. 10 CFR 50 Appendix K, Paragraph I.A.5, requires that the Baker-Just equation be used in emergency core cooling system (ECCS) evaluation models for determining the rate of energy release, hydrogen generation, and cladding oxidation for fuel rod cladding. All three of these regulations, either implicitly or explicitly, assume that either zircaloy or ZIRLO shall be used as the fuel rod cladding material.

In order to accommodate the high fuel rod burnups that are required in contemporary fuel management schemes and core designs, FRA-ANP developed the M5 advanced fuel rod cladding and fuel assembly structural material. M5 is an alloy comprised primarily of zirconium (approximately 99 percent) and niobium (approximately 1 percent) that has demonstrated superior corrosion resistance and reduced irradiation induced growth relative to both standard and low-tin zircaloy.

The M5 alloy is to be used at CR-3 for fuel rod cladding, spacer grids and fuel assembly guide and instrument tubes. Use of the M5 alloy at CR-3 will accommodate longer fuel residence times, higher fuel burnups, and reduced reload feed batch sizes, with corresponding improvements in fuel cycle economics. In addition, use of the M5 material will increase performance margins with regard to fuel rod corrosion, fuel rod growth and fuel assembly growth. Reduced feed batch sizes will also help to reduce the spent fuel storage burden at CR-3.

The chemical composition of the M5 advanced alloy differs from the specifications for either zircaloy or ZIRLO. Therefore, absent the requested exemptions, use of the M5 advanced alloy falls outside of the strict interpretation of the wording of 10 CFR 50.46, 10 CFR 50.44 and 10 CFR 50 Appendix K Paragraph I.A.5. Approval of this exemption request will allow the use of the M5 advanced alloy as a fuel rod cladding and fuel assembly material at CR-3.

Basis for Exemption Requests

10 CFR 50.12 permits the Nuclear Regulatory Commission (NRC) to grant exemptions which are authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security, provided that special circumstances are present. Special circumstances are present whenever application of the regulation in the particular circumstance is not necessary to achieve the underlying purpose of the rule (50.12(a)(2)(ii)). Florida Power Corporation (FPC) believes, for the reasons described below, that the use of the M5 advanced alloy as a fuel rod cladding material achieves the underlying purposes of 10 CFR 50.46, 10 CFR 50.44, and 10 CFR 50 Appendix K Paragraph I.A.5.

The underlying purposes of 10 CFR 50.46 is to ensure that facilities have adequate acceptance criteria for ECCS. FRA-ANP demonstrates in its topical report BAW-10227P-A, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," approved by the NRC by letter dated February 4, 2000, that the effectiveness of the ECCS will not be affected by a change from zircaloy fuel rod cladding to M5 fuel rod cladding. Therefore, since the underlying purpose of 10 CFR 50.46 is achieved through the use of the M5 advanced alloy as a fuel rod cladding material, the special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption to 10 CFR 50.46 do exist.

The underlying purposes of 10 CFR 50.44 and 10 CFR 50 Appendix K Paragraph I.A.5 are to ensure that cladding oxidation and hydrogen generation are appropriately limited during a LOCA and conservatively accounted for in the ECCS evaluation model. Specifically, Appendix K requires that the Baker-Just equation be used in the ECCS evaluation model to determine the rate of energy release, cladding oxidation, and hydrogen generation. FRA-ANP demonstrates, in Appendix D of BAW-10227P-A, that the Baker-Just model is conservative in all post-LOCA scenarios with respect to the use of the M5 advanced alloy as a fuel rod cladding material, and that the amount of hydrogen generated in an M5-clad core during a LOCA will remain within the design basis. Therefore, since the underlying purposes of 10 CFR 50.44 and 10 CFR 50 Appendix K Paragraph I.A.5 are achieved through the use of the M5 advance alloy as fuel rod cladding material, the special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of exemptions to 10 CFR 50.44 and 10 CFR 50 Appendix K Paragraph I.A.5 do exist.

Conclusions

Based on the above, the underlying purposes of 10 CFR 50.46, 10 CFR 50.44, and 10 CFR 50 Appendix K Paragraph I.A.5, which are to provide adequate acceptance criteria for ECCS and to ensure that the cladding oxidation and hydrogen generation are appropriately limited and accounted for during LOCA evaluation, are accomplished through the use of the M5 advanced alloy as a fuel rod cladding material.

The granting of the exemption requests would have no impact on radiological effluents, non-radiological effluents or radiation exposure.

Because these underlying purposes have been preserved, it is concluded that the proposed exemptions do not present an undue risk to the public health and safety and are consistent with the common defense and security.

Plant-specific exemptions to allow the use of the M5 alloy as a cladding material have been reviewed and accepted by the NRC for Davis Besse and TMI-1.

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

ATTACHMENT C

LICENSE AMENDMENT REQUEST #276, REVISION 0
Use of M5 Advanced Alloy Fuel Cladding

Proposed Revised Improved Technical Specification Pages
Strikeout Version

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Shadowed text	Indicates added text

4.0 DESIGN FEATURES

4.1 Site

The 4,738 acre site is characterized by a 4,400 foot minimum exclusion radius centered on the Reactor Building; isolation from nearby population centers; sound foundation for structures; an abundant supply of cooling water; an ample supply of emergency power; and favorable conditions of hydrology, geology, seismology, and meteorology.

4.2 Reactor Core

4.2.1 Fuel Assemblies

The reactor shall contain 177 fuel assemblies. Each fuel assembly shall consist of a matrix of Zircaloy-4 **or M5** clad fuel rods with an initial composition of natural or slightly enriched uranium dioxide (UO_2) as fuel material., with a maximum enrichment of 5.0 weight percent U-235. Limited substitutions of **zirconium alloy or** stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. Each fuel rod shall have a nominal active fuel length of 144 inches and shall contain a maximum total weight of 2253 grams uranium. **A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions.**

4.2.2 Control Rods

The reactor core shall contain 60 safety and regulating **CONTROL ROD assemblies** (including extended life CONTROL RODS) and 8 AXIAL POWER SHAPING (APSR) rods **assemblies.** Except for the extended life CONTROL RODS, the CONTROL RODS shall contain a nominal 134 inches of absorber material. The extended life CONTROL RODS shall contain a nominal 139 inches of absorber material. The nominal values of absorber material shall be 80 percent silver, 15 percent indium, and 5 percent cadmium. Except for extended life CONTROL RODS, all CONTROL RODS shall be clad with stainless steel tubing. The extended life CONTROL RODS shall be clad with Inconel. The APSRs shall contain a nominal 63 inches of absorber material at their lower ends. The absorber material for the APSRs shall be 100% **silver indium cadmium** or Inconel **as approved by the NRC.**

(continued)

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

ATTACHMENT D

LICENSE AMENDMENT REQUEST #276, REVISION 0
Use of M5 Advanced Alloy Fuel Cladding

Proposed Revised Improved Technical Specification Pages – Revision Line Version

4.0 DESIGN FEATURES

4.1 Site

The 4,738 acre site is characterized by a 4,400 foot minimum exclusion radius centered on the Reactor Building; isolation from nearby population centers; sound foundation for structures; an abundant supply of cooling water; an ample supply of emergency power; and favorable conditions of hydrology, geology, seismology, and meteorology.

4.2 Reactor Core

4.2.1 Fuel Assemblies

The reactor shall contain 177 fuel assemblies. Each assembly shall consist of a matrix of Zircaloy-4 or M5 fuel rods with an initial composition of natural or slightly enriched uranium dioxide (UO_2) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions.

4.2.2 Control Rods

The reactor core shall contain 60 safety and regulating CONTROL ROD assemblies and 8 AXIAL POWER SHAPING (APSR) assemblies. The material shall be silver indium cadmium or Inconel as approved by the NRC.

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