May 8, 2001

Mr. Mark E. Warner
Vice President - TMI Unit 1
AmerGen Energy Company, LLC
P.O. Box 480
Middletown, PA 17057

SUBJECT: THREE MILE ISLAND NUCLEAR STATION UNIT 1 (TMI-1), EXEMPTION FROM THE REQUIREMENTS OF 10 CFR PART 50, SECTIONS 50.44, 50.46, AND APPENDIX K FOR FRAMATOME COGEMA FUELS (FCF) M5 ADVANCED ALLOY FOR FUEL ROD CLADDING (TAC NO. MB0787)

Dear Mr. Warner:

The Commission has approved the enclosed exemption from specific requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Sections 50.44, 50.46, and Appendix K of Part 50, for TMI-1. This exemption is in response to your letter of December 20, 2000, as supplemented by letter dated March 14, 2001, relating to the proposed expanded use of FCF M5 cladding for fuel rods and fuel spacer grids at TMI-1.

A copy of the exemption and the supporting safety evaluation are enclosed. The exemption has been forwarded to the Office of the Federal Register for publication.

Sincerely,

/RA/

Timothy G. Colburn, Senior Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-289

Enclosure: Exemption

cc w/encl: See next page

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

AMERGEN ENERGY COMPANY, LLC

THREE MILE ISLAND NUCLEAR STATION, UNIT 1

DOCKET NO. 50-289

EXEMPTION

1.0 BACKGROUND

AmerGen Energy Company, LLC (the licensee or AmerGen) is the holder of Facility Operating License No. DPR-50 which authorizes operation of the Three Mile Island Nuclear Station, Unit 1(TMI-1). The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (NRC, the Commission) now or hereafter in effect.

The facility consists of a pressurized-water reactor located in Dauphin County in Pennsylvania.

2.0 PURPOSE

Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.44, "Standards for combustible gas control system in light-water-cooled power reactors," requires, among other items, that each boiling or pressurized light-water nuclear power reactor fueled with oxide pellets within cylindrical zircaloy or ZIRLO cladding must, as provided in paragraphs (b) through (d) of that section, include means for control of hydrogen gas that may be generated, following a postulated loss-of-coolant accident (LOCA) by - (1) Metal-water reaction

involving the fuel cladding and the reactor coolant, (2) Radiolytic decomposition of the reactor coolant, and (3) Corrosion of metals.

Section 50.46, “Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors,” requires, among other items, that each boiling or pressurized light-water nuclear power reactor fueled with uranium oxide pellets within cylindrical zircaloy or ZIRLO cladding must be provided with an emergency core cooling system (ECCS) that must be designed so that its calculated cooling performance following postulated LOCAs conform to the criteria set forth in paragraph (b) of that section. ECCS cooling performance must be calculated in accordance with an acceptable evaluation model and must be calculated for a number of postulated LOCAs of different sizes, locations, and other properties sufficient to provide assurance that the most severe postulated LOCAs are calculated.

Appendix K of Part 50, “ECCS Evaluation Models,” requires, among other items, that the rate of energy release, hydrogen generation, and cladding oxidation from the metal/water reaction shall be calculated using the Baker-Just equation (Baker, L., Just, L.C., “Studies of Metal Water Reactions at High Temperatures, III. Experimental and Theoretical Studies of the Zirconium-Water Reaction,” ANL-6548, page 7, May 1962) and implicitly assumes that either zircaloy or ZIRLO shall be used as the fuel rod cladding material.

Sections 50.44, and 50.46, and Appendix K of 10 CFR Part 50, make no provisions for use of fuel rods clad with other than zircaloy or ZIRLO. The licensee has requested the use of Framatome Cogema Fuels (FCF) “M5" advanced alloy for fuel rod cladding for the TMI-1 Cycle 14 operation. In order to accommodate the high fuel rod burnups that are required for today’s modern fuel management schemes and core designs, FCF developed the M5 advanced fuel rod cladding and fuel assembly structural material. The M5 alloy is a proprietary zirconium-based alloy comprised of primarily zirconium (~99 percent) and niobium (~1 percent). The elimination of tin has resulted in superior corrosion resistence and reduced irradiation induced

growth relative to both standard Zircaloy and low-tin Zircaloy. The addition of niobium increases ductility. Since the chemical composition of the M5 alloy differs from the specifications of Zircaloy or ZIRLO, a plant-specific exemption is required to allow the use of the M5 alloy as a fuel rod cladding material at TMI-1. The M5 would also be used for fuel assembly spacer grids, fuel rod end plugs and fuel assembly guide and instrument tubes.

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. Special circumstances are present whenever application of the regulations in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule.

The underlying purpose of Section 50.46 is to ensure that facilities have adequate acceptance criteria for ECCS. FCF demonstrated in its topical report, BAW-10227P-A, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," dated September 30, 1997, and approved on 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. The analysis described in BAW-10227P-A also concludes that the ECCS acceptance criteria applied to reactors fueled with zircaloy fuel are also applicable to reactors fueled with M5 fuel rod cladding.

The underlying purposes of Section 50.44 and 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. In BAW-10227P-A, FCF demonstrated that the Baker-Just model is conservative in all post-LOCA scenarios with respect to the use of M5 advanced alloy as fuel rod cladding material. The licensee has stated that the amount of hydrogen generated in an M5-clad core will remain within the TMI-1 design basis. The NRC staff has reviewed the FCF's advanced cladding and structural material, M5, for pressurized water reactor fuel mechanical designs as described in BAW-10227P-A. In its February 4, 2000, safety evaluation, the NRC staff concluded that, to the extent specified and with limitations noted in the NRC staff's evaluation, the assumptions related to M5 material properties and mechanical design methodology are acceptable for referencing in fuel reload licensing applications. The NRC staff has determined that since the licensee and FCF have ongoing processes which assure that LOCA analysis input values for peak cladding temperature-sensitive parameters bound the as-operated plant values for those parameters at TMI-1 and also have ongoing processes to determine mixed-core penalties as needed, the methodologies and analyses described in BAW-10227P-A apply to TMI-1 and the plant can be safely operated within the bounds of those analyses with mixed- and full-core loadings of M5 clad fuel and other M5 core structures. The NRC staff further concluded that since fuel assemblies which utilize the two different alloys (M5 and zircaloy) and which will be co-resident in the core have only slight geometry differences, there will be virtually no thermal-hydraulic effect, and a mixed core penalty in LOCA evaluations would not have to be assessed to compensate for the material differences. Therefore, based on the information described above, the NRC staff has determined that the underlying purposes of Section 50.44, and 50.46, and Appendix K of 10 CFR Part 50 have been achieved through the use of M5 advanced alloy as fuel rod cladding material and core structure material, and that the special circumstances

required by 10 CFR 50.12(a)(2)(ii) for granting exemptions from 50.44, and 50.46, and Appendix K of 10 CFR Part 50 exist.

4.0 CONCLUSION

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a)(ii), the exemption is authorized by law, will not endanger life or property or common defense and security, and is, otherwise, in the public interest. Also, special circumstances are present. Therefore, the Commission hereby grants AmerGen Energy Company, LLC, an exemption from the requirements of 10 CFR 50.44, 10 CFR 50.46, and Appendix K to 10 CFR Part 50, for Three Mile Island Nuclear Station, Unit 1, as to the use of M5 cladding and core structures in lieu of Zircaloy or ZIRLO as currently specified or implied in those regulations.

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 (66 FR 23279).

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 8th day of May 2001.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

John A. Zwolinski, Director
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Three Mile Island Nuclear Station, Unit No. 1

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