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January 18, 2001
5928-00-20394

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

Dear Sir or Madam:

SUBJECT: THREE MILE ISLAND, UNIT 1 (TMI UNIT 1)
OPERATING LICENSE NO. DPR-50
DOCKET NO. 50-289
PROPOSED IRRADIATION OF FUEL RODS BEYOND CURRENT LEAD ROD BURNUP LIMIT

AmerGen Energy Company, LLC (AmerGen) plans to irradiate four M5 clad fuel rods to end-of-life rod average burnups ranging from about 63 to 69 GWd/mtU. Irradiation of these fuel rods will provide data on fuel and material performance that will support industry goals of extending the current fuel burnup limits, and will provide data to address Nuclear Regulatory Commission (NRC) questions related to fuel performance behavior at high burnups. These fuel rods are currently in their third cycle of irradiation (TMI Unit 1 Operating Cycle 13), and will have cumulative rod average burnups ranging from approximately 42 to 48 GWd/mtU. The fuel rods will replace some of the original fuel rods in a twice-burned fuel assembly, which will then be irradiated for one additional cycle in TMI Unit 1.

As detailed in Attachment 1, the use of these fuel rods will be fully evaluated as part of the TMI Unit 1 normal reload design process to ensure that all design criteria will be satisfied. Although the proposed irradiation of this limited number of fuel rods to high burnup does not require any Technical Specification changes, a specific safety evaluation will be performed for the condition consistent with the existing core reload program to ensure that no unreviewed safety question exists as defined by 10 CFR 50.59.

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A licensing basis commitment on rod burnup limits affects the implementation of this proposed program in that the four fuel rods will operate to burnup levels in excess of the lead rod burnup limit currently identified for Framatome Cogema Fuels (FCF) Mark-B fuel. These limits are specified in NRC approved Framatome Cogema Fuels Topical Reports BAW-10186P-A, "Extended Burnup Evaluation", June 1998, and BAW-10227P-A, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," February 2000. Since the high burnup fuel rods will operate to burnup levels exceeding previously approved limits, NRC approval is requested prior to the implementation of this program.

NRC has previously approved a similar request for North Anna Units 1 & 2 (NRC letter to Virginia Electric and Power Company, September 8, 1999) to exceed a 60 GWd/mtU lead rod burnup limit and irradiate a small number of fuel rods to approximately 73 GWd/mtU (Virginia Electric and Power Company letter to the NRC, April 16, 1999). Although the North Anna Units 1 & 2 request utilizes a different type of fuel and proposed a higher lead rod burnup than TMI Unit 1, the technical issues required to be evaluated are not significantly different.

The fuel assembly containing the rods that will be irradiated to high burnup is scheduled to be used in TMI Unit 1, Cycle 14, which will begin operation in October 2001. To support the core reload design schedule for this cycle, AmerGen requests NRC concurrence with this irradiation program by April 30, 2001.

If any additional information is needed, please contact David J. Distel at (610) 765-5517.

Very truly yours,

George B Rodehd III for

James A. Hutton
Director – Licensing
Mid-Atlantic Regional Operating Group

JAH/djd/vvg

Attachment

cc: H. J. Miller, Administrator, USNRC Region I
T. G. Colburn, USNRC Senior Project Manager, TMI Unit 1
J. D. Orr, USNRC Senior Resident Inspector, TMI Unit 1
File No. 00141

ATTACHMENT 1

DISCUSSION OF PROPOSED PROGRAM

INTRODUCTION

AmerGen plans to irradiate four M5^{TM} [1] fuel rods to high burnup. Irradiation of these fuel rods will provide data on fuel and materials performance that will support industry goals of extending the current fuel burnup limits, and will provide data to address Nuclear Regulatory Commission (NRC) questions related to fuel performance behavior at high burnups. The data will also help confirm the applicability of nuclear design and fuel performance models at high burnups.

The fuel rods to be used in this program were originally fabricated by Framatome Cogema Fuels (FCF) as part of a demonstration assembly that was irradiated in Three Mile Island (TMI) Unit 1 (references 1 through 3). These M5^{TM} clad fuel rods are in their third cycle of irradiation, and will have cumulative rod average burnups ranging from approximately 42 to 48 GWd/mtU at the end of the current operating cycle. The M5^{TM} fuel rods will replace some of the original fuel rods in a twice-burned Framatome fuel assembly (host assembly NJ07U9), which will then be irradiated for one additional cycle in TMI Unit 1. The end-of-cycle rod average burnups of the M5^{TM} fuel rods are expected to range from about 63 to 69 GWd/mtU, while the remainder of the fuel in the host assembly will achieve a burnup of approximately 55 GWd/mtU (assembly average burnup). Irradiation of a small number of fuel rods in this manner will generate fuel performance data at high burnups with minimal impact on core operation.

The use of these fuel rods will be fully evaluated as part of the TMI Unit 1 normal reload design process, and all design criteria are expected to be satisfied. Based on our preliminary evaluation, no unreviewed safety questions will exist as a result of irradiating this small number of M5^{TM} fuel rods to high burnup in the TMI Unit 1 core. However, as the fuel rods will operate to burnup levels in excess of the lead rod burnup limit currently identified for FCF Mark-B fuel (references 4 and 5), NRC concurrence is requested prior to implementation of the program.

FCF will be performing the fuel rod design analysis for all fuel used in the TMI Unit 1 Cycle 14 reload design, including the demonstration assembly. Appropriate conservatisms will be used in the evaluation of the high burnup fuel rods since these rods will exceed the current lead rod burnup limit. The analysis of this assembly will be evaluated separately to ensure that all fuel rod design criteria that are applicable for the current lead rod burnup limit of 62 GWd/mtU are also satisfied for the high burnup fuel rods.

BACKGROUND

In 1982 Babcock & Wilcox submitted topical report BAW-10153P (reference 6) to the NRC. BAW-10153P requested an increase in the batch average burnup from the then current limit of 33 GWd/mtU to 45 GWd/mtU. BAW-10153P was approved in 1985 with a batch average burnup limit of 45 GWd/mtU. As utilities implemented longer fuel cycles in their reactors this batch average limit became more difficult to meet. In 1992, the B&W Fuel Company (BWFC) submitted topical report BAW-10186P (reference 4) to the NRC. BAW-10186P requested fuel burnup limits of 62 GWd/mtU assembly average and 65 GWd/mtU rod average. The NRC approved BAW-10186P in 1997 with a limit of 62 GWd/mtU rod average for Mark-B fuel. There were no limits issued for batch average and assembly average burnups.

In 1997 FCF submitted topical report BAW-10227P (reference 5) to the NRC. BAW-10227P is the evaluation of the advanced cladding material M5^{TM}. Lead Test Assemblies (LTAs) containing fuel rods with M5^{TM} cladding have completed three cycles of irradiation in one U.S. reactor and are currently being irradiated in one other domestic reactor in addition to the M5^{TM}

[1] M5 is a registered trademark of Framatome Cogema Fuels.

LTAs at TMI Unit 1. The M5™ material has also been used in nine commercial reactors in Europe. Davis-Besse 1 contains the first full batch of M5™ fuel in the U.S. Power generation with this batch of fuel began in May 2000. The NRC approved BAW-10227P in February 2000. The Mark-B burnup limit in the NRC Safety Evaluation Report for BAW-10227P is 62 GWd/mtU rod average.

The burnup restrictions documented in references 4 and 5, although not explicitly stated in the TMI Unit 1 License Conditions or Technical Specifications, apply to the Framatome fuel that is irradiated at TMI. The proposed irradiation of a small number of fuel rods to extended burnups at TMI Unit 1, therefore, requires NRC approval to exceed this restriction on lead rod burnup.

Fuel rods with Framatome's advanced cladding material, M5™, were first irradiated in TMI Unit 1 in 1995 in two demonstration assemblies (Assemblies NJ07VX and NJ07VY). These demonstration fuel assemblies have Zircaloy-4 skeletons and most of the fuel rods are standard fuel rods with Zircaloy-4 cladding, but a limited number of rods in each assembly were made with the advanced cladding material. Both of these assemblies will have been irradiated for three cycles, and will have achieved an assembly average burnup of about 45 GWd/mtU. The proposed irradiation program for TMI Unit 1 uses four M5™ clad fuel rods from either Fuel Assembly NJ07VX or NJ07VY.

Exemptions to several sections of the Code of Federal Regulations (specifically, 10CFR 50.44, 10CFR 50.46, and Appendix K of 10CFR 50) are required to support the use of M5™ clad fuel. Exemption for use of M5™ cladding in the initial LTA Program was obtained in reference 3 and the exemption associated with TMI Unit 1 Cycle 14 full core design use of M5™ cladding was submitted to the NRC on December 20, 2000, by reference 7.

SAFETY SIGNIFICANCE SUMMARY

The extended burnup of four M5™ fuel rods in twice-burned host Assembly NJ07U9 will be fully addressed as part of the TMI Unit 1 Cycle 14 Reload Safety Evaluation, using Framatome Cogema Fuel's NRC-approved reload design methods and approved fuel rod design models and methods. The fuel rods are expected to satisfy all design criteria that are applicable for the current lead rod burnup limit. In addition, the impact on safety analyses will also be determined as part of the cycle-specific evaluation. The existing analyses of record are expected to remain applicable. Likewise, the M5™ test rods will not impact core operation, including setpoints. A preliminary assessment has not identified any unreviewed safety questions as defined in 10 CFR 50.59; a final determination of whether an unreviewed safety question exists will be made after the cycle-specific reload calculations are complete. NRC approval to exceed the 62 GWd/mtU lead fuel rod burnup limit imposed on FCF Mark-B fuel is requested for these TMI Unit 1 high burnup test rods.

PROPOSED EXTENDED BURNUP PROGRAM

1. Description of Fuel Assembly

The host fuel assembly (NJ07U9) for the extended burnup of four (4) M5™ lead test rods in TMI Unit 1 Cycle 14 is a twice-burned FCF Mark-B10 fuel assembly. The Mark-B10 design utilizes Zircaloy-4 for fuel rod cladding, guide tubes and intermediate spacer grids. The design also includes a removable top nozzle that enables fuel rod reconstitution. The M5™ rods were previously irradiated for three cycles in a fuel assembly of the same Mark-B10 design.

Host Assembly NJ07U9 was previously irradiated in TMI Unit 1 Cycles 11 and 12 and is currently stored in the spent fuel pool. This assembly currently has an assembly average burnup of approximately 34 GWd/mtU and is expected to achieve an assembly average burnup of approximately 55 GWd/mtU by the end of Cycle 14 operation, when it will be discharged.

During the upcoming 14R refueling outage at TMI Unit 1 following Cycle 13 shutdown in September 2001, four M5™ lead test rods will be removed from either of two assemblies (NJ07VX or NJ07VY) and reconstituted into NJ07U9. NJ07VX and NJ07VY will have been irradiated in symmetric core locations for three cycles at TMI Unit 1 and each assembly contains four M5™ lead test rods loaded on the periphery in similar assembly cell locations. Since both of these assemblies are being irradiated on the core periphery in the current TMI Unit 1 operating cycle, a significant burnup gradient will result such that the M5™ lead test rods will have rod average burnups ranging from 42 to 48 GWd/mtU at the end of Cycle 13.

Host Assembly NJ07U9 will be loaded into the center of the core in Cycle 14 where the M5™ rods are expected to achieve rod average burnups ranging from 63 to 69 GWd/mtU. In the event that problems are encountered during reconstitution of NJ07U9, an assembly with similar neutronic characteristics and burnup history is available as a replacement.

The M5™ lead test rods are dimensionally the same as the standard Zircaloy-4 rods used in the FCF Mark-B10 fuel assembly. The M5™ rods have been examined after each of their first two cycles of operation and will be examined during the upcoming refueling outage. Each examination included visual review of the rods, cladding oxide measurements, rod growth measurements and rod diameter measurements. Results to date have shown the M5™ cladding is performing as well as or better than expected.

1.1 PIE Results for M5™ Lead Test Rods

The most recent PIE campaign was conducted at TMI Unit 1 in September 1999. The purpose of the PIE examination was to evaluate the second irradiation cycle behavior of the Framatome alloy M5™ clad fuel rods. Fuel assemblies NJ07VX and NJ07VY contain a total of eight (8) alloy M5™ clad fuel rods. These rods are located on the periphery of the assemblies in symmetrical positions, one on each face. The M5™ demonstration is important because TMI Unit 1 operates with long cycles (24 month) and with a higher lithium RCS environment. Improved performance of the alloy under these conditions reinforces the other PWR experience with these alloys in the U.S. and in Europe.

The M5™ rods have not been in limiting core locations and have achieved a modest burnup to date. The first cycle assembly average burnup for NJ07VX and NJ07VY was only 13 GWd/mtU. The assemblies achieved an average burnup of 38.5 GWd/mtU by the end of the second cycle.

The second cycle PIE shows that the advanced alloy clad fuel rod performance is exceeding expectations. The oxide thickness data shows the same low values as it has in other, less aggressive, PWR environments. Six M5™ fuel rods (three in each of the test assemblies) were measured in the second cycle PIE. The average M5™ oxide thickness was approximately 12 microns. The maximum measured oxide was 21 microns and the average maximum was 15 microns. By comparison, six Zircaloy-4 rods immediately adjacent to the M5™ rods examined had an average oxide thickness of approximately 27 microns. The maximum measured oxide was 57 microns and the average maximum was 32 microns.

The alloy M5™ fuel rods also showed the expected improved performance in fuel rod growth. The recrystallized alloy exhibits the advantages of that structure in growth and creep.

After two irradiation cycles the advanced alloys are exhibiting the same improved performance with respect to optimized low-tin Zircaloy-4 that they have shown in every other PWR demonstration to date. The results are made even more notable because they were achieved in the more aggressive PWR environment of TMI Unit 1.

Regarding future PIE plans for the M5™ lead test rods, the rods will be examined after their current third cycle of operation, and the rods reconstituted into host Assembly NJ07U9 will also be examined after their fourth and final cycle of operation. Each examination will include visual review of the rods, cladding oxide measurements, rod growth measurements, and rod diameter measurements.

1.2 Impact of M5™ Lead Test Rods on Host Assembly

The M5™ lead test rods are higher in initial enrichment (4.55 wt% ^{235}U) than the fuel rods that they replace in the lead test assembly (4.00 wt% ^{235}U), but are significantly higher in burnup. The rods leaving the lattice have burnups between 31.4 and 35.4 GWd/mtU, while the replacement M5™ lead test rods have burnups between 42.0 and 48.1 GWd/mtU. The increase in burnup for each rod location varies between 10.6 and 12.7 GWd/mtU. As described in Section 4, the net result of these rod replacements is a small decrease in reactivity at test rod cell locations.

2. Mechanical Design Evaluations

FCF will perform the mechanical design assessment of host Assembly NJ07U9. The reconstituted configuration of the fuel assembly and planned operating conditions in TMI Unit 1 Cycle 14 will be considered. All current licensed fuel design criteria will be satisfied, even when accounting for the end-of-life burnups of the M5™ fuel rods from demonstration assembly NJ07VX or NJ07VY.

2.1 Fuel Rod Design for the M5™ Rods

As for any reload design, FCF will assess the fuel rod design criteria for all rods in host Assembly NJ07U9, using their approved models and methods. Calculations will be performed to demonstrate that all criteria will be satisfied for the planned operation. The TACO3 [reference 8] code will be used to demonstrate acceptable fuel thermal and fuel mechanical performance. TACO3 is presently approved for licensing Mark-B fuel rods up to 62 GWd/mtU. FCF believes that the conservatism of the TACO3 code supports its application for licensing the lead fuel rods.

The majority of the fuel rods in host Assembly NJ07U9 have Zircaloy-4 cladding and have experienced two cycles of operation. The assembly average burnup of NJ07U9 at the end of Cycle 14 is expected to be about 55 GWd/mtU. At this burnup level, no difficulties are foreseen in showing that all fuel rod design criteria will be satisfied.

The performance of the M5™ fuel rods in Assembly NJ07U9 will be assessed using NRC-approved models. Calculations will be performed as part of the normal reload design analysis to demonstrate that all fuel rod design criteria that are normally evaluated for reload fuel will be satisfied for the projected lead rod burnup levels. For the M5™ fuel rods in Assembly NJ07U9, cladding corrosion and fuel rod growth, which would normally be limiting criteria for high burnup rods, are expected to have ample margin to design criteria based on the performance of the M5™ material to date. The most limiting criteria will be rod internal pressure. Based on similar calculations already performed for extended burnup of M5™ fuel rods at another utility, no difficulties are expected in satisfying all design criteria to the projected end-of-life burnups.

It should also be noted that at least one extended burnup program similar to the TMI Unit 1 program is already in progress at another U.S. utility using Westinghouse fuel. The lead rod burnups in that program will be comparable to those in the M5™ rods in Assembly NJ07U9.

The performance of the high burnup fuel rods will continue to be assessed against the current fuel-related Technical Specifications throughout the cycle. Specifically, the fuel will be required to meet the current reactor coolant activity limits. The impact on the current safety analyses will also be evaluated, as discussed in Section 6 below.

2.2 Fuel Assembly Design

Because host Assembly NJ07U9 has only been irradiated to 34 GWd/mtU after two cycles, irradiation in TMI Unit 1 Cycle 14 will be within the operating experience of similar fuel assemblies. No unusual conditions exist that would affect the ability of the assembly to meet all mechanical design requirements, including areas such as: compatibility with all in-core, fuel handling, and storage interfaces; grid impact strength; grid cell force and fretting wear resistance requirements; and fuel assembly growth allowances.

Use of M5™ fuel rods in a Zircaloy-4 skeleton (guide tubes and grids) does not present any special concerns, because of the similarity in composition and properties of these two materials. Demonstration fuel assembly NJ07VX or NJ07VY, from which the M5™ rods will be taken, similarly contains mostly Zircaloy-4 clad fuel rods in a Zircaloy-4 skeleton, with only a limited number of fuel rods having advanced cladding materials (including M5™). Both of these assemblies are being irradiated in their third cycle and will reach an end-of-life assembly average burnup of about 55 GWd/mtU, which is equivalent to the expected end of Cycle 14 burnup for host Assembly NJ07U9. Fuel assemblies with full complements of M5™ fuel rods in Zircaloy skeletons have also been irradiated at other utilities.

3. Thermal-Hydraulic Design

Fuel assembly and core component pressure drops will not be affected by use of a small number of high burnup fuel rods in a twice-burned assembly. The thermal hydraulic analysis of host Assembly NJ07U9 will, therefore, be performed in accordance with FCF's normal reload design methodology, using NRC-approved codes and methods. The fuel assembly will be required to meet the same design criteria as other fuel assemblies in the core.

4. Neutronic Performance

Consistent with reference 9, a nuclear design evaluation will be performed for TMI Unit 1 Cycle 14 to demonstrate that the reload core will meet all applicable design criteria. Additional core physics analyses will be performed to reflect the actual composition, including the M5^{TM} fuel rods, of host Assembly NJ07U9.

The neutronic effects of the M5^{TM} lead test rod substitution described in Section 1 have been evaluated. CASMO3 (reference 10) transport calculations including microscopic depletion were performed for both the host assembly and modified host assembly with the M5^{TM} rods. The results demonstrate that the change in cladding material from Zircaloy-4 to M5^{TM} has a negligible impact on global power peaking and reactivity. When the increased initial fuel enrichment and increased burnup at each M5^{TM} lead test rod's lattice location of the host fuel assembly is modeled, a small decrease in reactivity and power production for each M5^{TM} lead test rod location is observed. On an assembly basis, the change in reactivity and power production will be significantly diluted; on a global basis the effects will be negligible.

In the reload core power distribution analysis and fuel rod performance analyses, the host assembly will be modeled in a manner that determines the power peaking for each of the four M5^{TM} lead test rods. Global parameter calculations do not need to explicitly model the M5^{TM} lead test rods because the small reactivity change in just four of the 36,816 fuel rods in the core will not affect core-wide reactivity parameters.

The fuel assembly containing these rods will be located in the center of the core, and will operate at an assembly average power near the core average assembly power throughout the cycle. The high burnup fuel rods will not be in the highest fuel rod power density locations in the core, and will not be limiting with respect to any safety analysis limit. If the effect on any design calculation is significant, it will be reflected in all phases of the design and safety analysis by either explicit calculations or additional uncertainties, as appropriate, to ensure that the assembly is treated in a conservative manner.

5. Impact on Spent Fuel Pool

In general, higher burnup fuel is expected to have an insignificant impact on evaluations for the TMI Unit 1 spent fuel pool. High burnup fuel could impact both criticality calculations and calculations of the decay heat load.

Criticality calculations for the TMI Unit 1 spent fuel pool currently take credit for the decrease in fuel reactivity with increasing burnup. Although the high burnup test rods are of a higher enrichment than the fuel rods they are replacing in host assembly NJ07U9, their burnup is sufficiently higher such that their reactivity is lower than the rods that they are replacing. The analyses of record therefore will remain conservatively bounding for the high burnup fuel rods in host Assembly NJ07U9.

With respect to possible impact on the spent fuel pool heat load, both short and long term heating effects must be considered. The major contributor to the heat load immediately after the core offload is decay heat from short-lived isotopes. These isotopes tend to reach an equilibrium condition during normal operation and the additional burnup contributes a small additional amount of decay heat. For the long decay times, the actinides are the prime contributors and also provide more decay heat. These increases are slightly offset by the increased enrichment of the replacement rods. Thus increases in decay heat could be expected in the replacement rods. However, in either the short or long term, the increase to the spent fuel heat load caused by the four replacement rods will be less than 0.01%. It is concluded that this small heat load increase caused by the four high burnup replacement rods in host Assembly NJ07U9 will not significantly affect the cooling capacity of the spent fuel pool or the heat load analysis currently described in the TMI Unit 1 UFSAR.

6. Safety Evaluations

For TMI Unit 1 Cycle 14, four thrice-burned M5™-clad fuel rods will be reinserted into the host fuel assembly that will be placed in the center core location, H-08. At the end of Cycle 14, these fuel rods are expected to have reached burnups greater than the current licensed burnup limit of 62 GWd/mtU. While this LTA will not lead the core with respect to core operating limits, an evaluation of all the safety analysis is performed to verify that the analyses of record will not be invalidated. The following sections provide a brief overview for the LOCA and non-LOCA analyses evaluations. Cycle-specific evaluations are performed for each new reload and these evaluations will explicitly consider the effects of this change on the analyses of record for TMI Unit 1.

6.1 LOCA Analysis

The LOCA calculations model fuel assembly specific steady state fuel average temperatures and internal fuel rod pressures with the linear heat rate limit peaked to a maximum value that will not result in a violation of 10CFR 50.46 limits. The fuel average temperature and pressures are calculated with an NRC-approved computer code and methods. Given that the fuel assembly will not be placed in a high power core location and provided that the fuel rod pressure criterion will not be exceeded, operation of four rods at burnups greater than 62 GWd/mtU will not invalidate the current LOCA analyses for TMI Unit 1 Cycle 14.

6.2 Non-LOCA Safety Analyses

The non-LOCA analyses were originally performed to demonstrate that the plant could safely be operated throughout the expected lifetime of a fuel assembly. For each new fuel cycle, key cycle-specific parameters are compared against the analyses of record to determine if the existing calculations remain bounding. For TMI Unit 1 Cycle 14, four fuel rods will be reinserted into another fuel assembly and these rods are expected to reach burnups greater than 62 GWd/mtU. The limiting transients at end of life (EOL) conditions are the main steam line break and the control rod ejection accidents.

The critical parameter for the main steam line break is the moderator temperature coefficient (MTC). Replacing four rods that are expected to have burnups greater than 62 GWd/mtU will have a negligible effect on the MTC, so no additional consideration is required beyond what will be performed specifically for TMI Unit 1 Cycle 14.

For the control rod ejection accident, the main issues are fuel melt, departure from nucleate boiling (DNB), and offsite dose consequences. The LTA will not be placed in a high power core location and the four high burnup rods will be operating at lower powers than the rods that they replace. As a result, it is expected that the centerline fuel melt and minimum DNBR limits will not be exceeded. Therefore, no additional consideration is required beyond what will be performed specifically for TMI Unit 1 Cycle 14.

6.3 Radiological Impact

The potential impact of the four high burnup fuel rods on the TMI Unit 1 offsite dose analyses will be addressed as part of the TMI Unit 1 Cycle 14 reload safety analysis. As Framatome Cogema Fuels will be required to show that all fuel design criteria are satisfied for these fuel rods for the proposed operating conditions, the limiting design inputs to the offsite dose safety analyses must be evaluated and are expected to remain unchanged. Each design basis accident will be evaluated relative to the impact of the four rods and the extended burnup. Assuming that the high burnup fuel rods at TMI Unit 1 increase the contribution to the core inventory, only four fuel rods operating to a high burnup (four rods represent 0.01% of the fuel rods in the core) will result in no measurable increase in the levels of these isotopes in the coolant, and no effect on normal operating plant releases.

The fuel handling accident involves a single fuel assembly. The analysis of this accident for TMI Unit 1 follows NRC Regulatory Guide 1.25, and is based on a limiting assembly operating at 1.7 times the core average power. The analysis for the fuel handling building assumes the accident occurs 72 hours after the reactor shuts down, and assumes the cladding of 56 of 208 rods (entire outer row) in the fuel assembly is damaged. The doses from this accident are primarily due to short-lived iodine and noble gas isotopes. Because of their short half lives, the quantities of these isotopes present in the fuel-to-clad gap of the fuel rods tend to reach an equilibrium between production and decay during operation, so that the isotopic inventory available for release is primarily a function of operating power and decay time after operation rather than cumulative burnup. For host Assembly NJ07U9, the assembly average power during TMI Unit 1 Cycle 14 is approximately the core average power, much lower than the assumed power for analysis of the fuel handling accident. Therefore, the activity releases that would result from damage to the rods in this assembly, including the four high burnup rods, would be considerably lower than those determined for the TMI Unit 1 analysis of record for this accident.

7. Alternatives to Use of Host Assembly NJ07U9

As noted earlier, the final determination of whether an unreviewed safety question exists will be established as part of the cycle-specific evaluations for TMI Unit 1 Cycle 14. Based on the current knowledge of the previous operation of the high burnup fuel rods in Assembly NJ07U9, the examinations performed on the rods to date, and previous vendor experience with similar analyses for other lead test assemblies, it is anticipated that the preliminary assessment that operation of these rods does not result in an unreviewed safety question will be confirmed. This confirmation will be completed as part of the normal 10 CFR 50.59 evaluation of the reload cycle.

If the high burnup fuel rods in host Assembly NJ07U9 do not satisfy the criteria for continued irradiation in Cycle 14, including the requirements of 10 CFR 50.59, the high burnup rods will not be reconstituted into assembly NJ07U9. Assembly NJ07U9 would then be irradiated in the Cycle 14 core as a standard reload fuel assembly with no fuel rods exceeding 62 GWd/mtU.

8. Preliminary Safety Assessment

The assembly to be irradiated is a reconstituted twice-burned assembly of the same mechanical design as fuel used in previous cycles at TMI Unit 1. The fuel rods in this assembly will use two different cladding materials, both of which are approved for use at TMI Unit 1. The fuel assembly and the M5™ rods that will operate to high burnup will be required to meet all design criteria for the proposed operating conditions.

Use of this assembly will not affect the set of key analysis parameters defined for the current safety analyses (reference 9). As discussed in Section 6 above, the safety analyses of record are expected to remain applicable for the operation of this assembly in TMI Unit 1 Cycle 14. Cycle-specific evaluations will verify that the assumed values for any key analysis parameters are not exceeded.

Irradiation of Fuel Assembly NJ07U9 is not expected to result in an unreviewed safety question as defined in 10 CFR 50.59:

- The probability of an accident previously evaluated in the TMI Unit 1 UFSAR will not increase, and the possibility of an accident that is different from any already evaluated in the TMI Unit 1 UFSAR will not be created. Only a very small number of fuel rods are to be irradiated to high burnup, and the fuel assembly containing these rods is fully compatible with the other fuel in the core. The remainder of the core is consistent with the design of normal reload cores for TMI Unit 1. FCF's standard reload design methodology will be used to demonstrate that all applicable design criteria and all pertinent licensing basis acceptance criteria will be met. Evaluations will be performed as part of the cycle-specific reload safety analysis to demonstrate that existing safety analyses remain applicable for the core containing the small number of high burnup fuel rods. The demonstrated adherence of the fuel and cycle-specific core design to applicable standards and acceptance criteria will preclude new challenges to components and systems that could increase the probability of occurrence of any previously evaluated accident, or could create the possibility of a new type of accident. No new failure mechanisms will be created, nor will use of these assemblies cause the core to operate in excess of design basis operating limits.

- The consequences of an accident previously evaluated in the TMI Unit 1 UFSAR are not increased. The reload core design for the cycle in which these fuel rods are irradiated will meet all applicable design criteria and ensure that all pertinent licensing basis acceptance criteria are met. Operation of a limited number of fuel rods to extended burnup in a single fuel assembly will not adversely affect the ability of existing components and systems to mitigate the consequences of any accident, or adversely affect the integrity of the fuel rod cladding as a fission product barrier. The radiological consequences of accidents previously evaluated in the TMI Unit 1 UFSAR will remain applicable for the extended burnup operation of a small number of fuel rods.

  Neither the probability of occurrence nor the consequences of a malfunction of equipment important to safety previously evaluated in the TMI Unit 1 UFSAR will increase. The use of a fuel assembly containing a small number of fuel rods that will reach high burnups will not impose new performance requirements on any system or component such that any design criteria will be exceeded, nor will the core be operated in excess of pertinent design basis operating limits no new modes or limiting single failures are created with the irradiation of these fuel rods to burnup. The existing safety analyses based on normal reload fuel are expected to remain applicable for the core in which the M5™ fuel rods are irradiated. The assembly is mechanically comparable to any other reconstituted fuel assembly, and as such no new modes or limiting single failures will be created by its irradiation.

- The possibility of a malfunction of equipment important to safety different from any already evaluated in the TMI Unit 1 UFSAR will not be created. The design for the TMI Unit 1 cycle in which the M5™-clad fuel rods will operate to high burnup will be required to meet applicable design criteria and pertinent licensing basis acceptance criteria. The vast majority of the fuel in the core will operate to burnups consistent with normal reload operation, with only a very small number of fuel rods reaching extended burnups, so the possibility of a malfunction of equipment important to safety of a different type than any previously evaluated in the TMI Unit 1 UFSAR will not be created. No new failure modes will be created for any system, component, or piece of equipment. No new single failure mechanisms will be introduced, nor will the high burnup fuel rods or the core in general operate in excess of pertinent design basis operating limits.

- The margin of safety as defined in the Bases to any TMI Unit 1 Technical Specification will not be reduced. Existing safety analyses are expected to remain applicable for the irradiation of this small number of fuel rods to extended burnup. The normal limits on core operation defined in the TMI Unit 1 Technical Specifications will remain applicable for the irradiation of these fuel rods to extended burnup. The presence of these high burnup fuel rods will be specifically evaluated during the cycle design process using FCF's standard reload design methods. Therefore, the margin of safety as defined in the Bases to the TMI Unit 1 Technical Specifications will not be reduced.

The final determination of whether an unreviewed safety question exists will be made after the cycle-specific reload calculations are complete, and will be documented as part of the normal Reload Safety Evaluation.

SUMMARY

Four M5^{TM} fuel rods that have been irradiated for three cycles will be placed in twice-burned host Assembly NJ07U9, and are scheduled to be irradiated for one additional cycle in TMI Unit 1 Cycle 14. The proposed irradiation does not require any Technical Specifications changes. However, because the end-of-life burnups of these fuel rods will exceed the 62 GWd/mtU lead fuel rod burnup limit the NRC has imposed on FCF Mark-B fuel, NRC concurrence is required for this program to proceed.

The extended burnup of the four high burnup, M5^{TM} fuel rods will be fully addressed as part of the TMI Unit 1 Cycle 14 Reload Safety Evaluation, using FCF's NRC-approved reload design methods and approved fuel rod design models and methods. Additional conservatisms will be applied to the fuel rod design analysis since the end-of-life burnup of these rods will exceed the current lead rod burnup limit. All fuel rod design criteria that are applicable for the current lead rod burnup limit are expected to be satisfied for these fuel rods.

Operation of this small number of fuel rods to high burnup in the TMI Unit 1 Cycle 14 core is not anticipated to result in the acceptable safety limits for any incident being exceeded, or in an unreviewed safety question as defined in 10CFR 50.59. This will be confirmed as part of the cycle-specific Reload Safety Evaluation.

It is concluded that, subject to successful completion of the cycle-specific calculations currently in progress, the proposed irradiation of four fuel rods to high burnup in host Assembly NJ07U9 will not affect the probability or consequences of potential reactor accidents, or otherwise affect radiological plant effluents.

Operation of these rods to a higher burnup will provide important data on fuel performance behavior at high burnups while maintaining a high standard of safety performance. If for any reason the cycle-specific calculations do not confirm the acceptability of irradiating the four fuel rods for a fourth cycle to a higher burnup, or if an unreviewed safety question is created, the high burnup rods will not be reconstituted into assembly NJ07U9. Assembly NJ07U9 would then be irradiated in the Cycle 14 core as a standard reload fuel assembly with no fuel rods exceeding 62 GWd/mtU.

REFERENCES

1. GPU Nuclear letter to the NRC, dated June 1, 1995, (C311-95-2210) Technical Specification Change Request (TSCR) No. 251, Use of Advanced Clad Assemblies.

2. NRC letter to GPU Nuclear, dated July 24, 1995, Issuance of Amendment No. 194 - TSCR No. 251.

3. NRC letter to GPU Nuclear, dated October 12, 1995, Three Mile Island Nuclear Station, Unit 1 (TMI-1) - Exemption from 10CFR 50.46, Appendix K to 10CFR Part 50, and 10CFR 50.44 For Demonstration Fuel Assemblies.

4. Framatome Cogema Fuels Topical Report, BAW-10186P-A: "Extended Burnup Evaluation," June 1997.

5. Framatome Cogema Fuels Topical Report, BAW-10227P-A: "Evaluation of Advanced Cladding and Structural Material (M5™) in PWR Reactor Fuel," February 2000

6. Babcock & Wilcox Topical Report, BAW-10153P-A: "Extended Burnup Evaluation," April 1986.

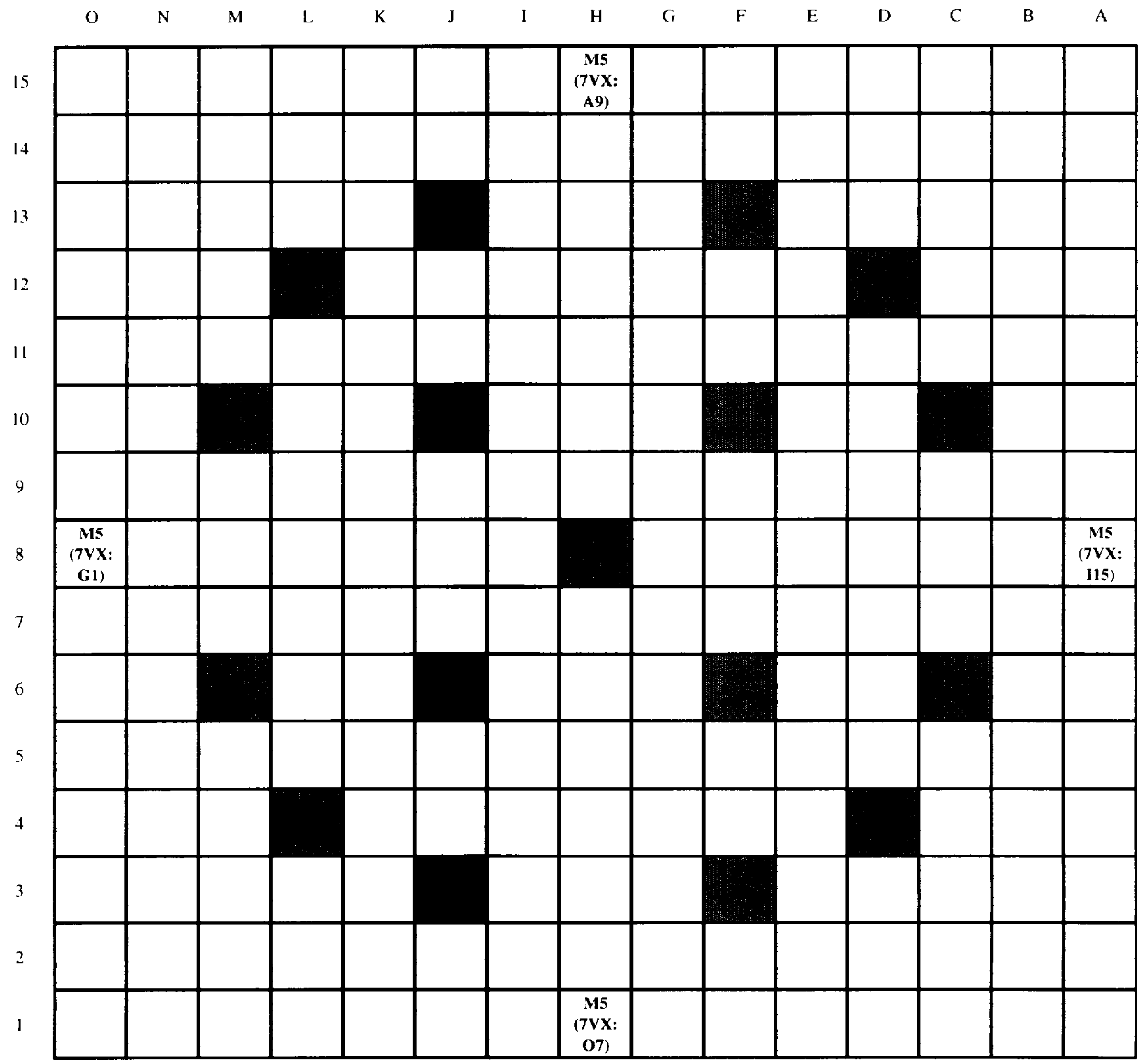
7. AmerGen letter to NRC dated, December 20, 2000 (5928-00-20249), Request for Exemption From 10CFR 50.46, 10CFR 50.44, and 10CFR 50 Appendix K, Regarding The Proposed Use of the "M5™" Advanced Alloy For fuel Rod Cladding."

8. Babcock & Wilcox Topical Report, BAW-10162P-A, "TACO3 Fuel Pin Thermal Analysis Code," October 1989.

9. Framatome Cogema Fuels Topical Report, BAW-10179P-A: "Safety Criteria and Methodology for Acceptable Cycle Reload Analyses," Rev. 3, October 1999.

10. M. Edenius, et al., CASMO-3 - A Fuel Assembly Burnup Program, STUDSVIK/NFA-89/3, Studsvik AB, Nykoping, Sweden, November 1989.

Figure 1
Preliminary Configuration of Host Asembly NJ07U9
Showing Locations of M5 Lead Test Rods
(As viewed from top)



Previous cell locations of M5 lead test rods in demonstration assembly NJ07VX are indicated.

TXU

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CPSES-200100214
Log # TXX-01010
File # 10010, 902.5

January 19, 2001

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES)
DOCKET NOS. 50-445 AND 50-446
DAM SAFETY INSPECTION RELATED TO THE CATEGORY I
SAFE SHUTDOWN IMPOUNDMENT DAM
(TAC NOS. MB0033 and MB0034)

REF: 1) NRC Letter from David H. Jaffe to C. L. Terry dated October 16, 2000

2) TXU Electric Letter, logged TXX-98222, from C. L. Terry to the NRC, dated October 15, 1998 (Response to May 1997 Safe Shutdown Impoundment Dam Inspection)

Gentlemen:

On September 5, 1999, an inspection was conducted at the CPSES Safe Shutdown Impoundment Dam. The NRC transmitted a Federal Energy Regulatory Commission (FERC) inspection report which was received by TXU Electric on October 23, 2000 (Reference 1). The NRC requested a written response to four action items identified in Reference 1 within 90 days of receipt of Reference 1. TU Electric's response to the four action items is provided in Attachment 1.

This communication contains updated / new commitments regarding CPSES Units 1 and 2 as identified in Attachment 2.

D029

TXU Electric
P.O. Box 1002
Glen Rose, TX 76043

If you have any questions, please contact Mr. Carl B. Corbin at (254) 897-0121.

Sincerely,

C. L. Terry

By: Roger D. Walker
Roger D. Walker
Regulatory Affairs Manager

CBC/cbc

Attachments

c - E. W. Merschoff, Region IV
J. I. Tapia, Region IV
D. H. Jaffe, NRR
Resident Inspectors, CPSES

Item 1 NRC/Federal Energy Regulatory Commission (FERC) Report Finding:

"As the surface rock on the outer shells of the SSID [Safe Shutdown Impoundment Dam] deteriorates, new rock will be required to repair deficient areas. Any new rock should be evaluated for durability and sized for fetch and wave run-up determined from updated design criteria."

TXU Electric Response:

The existing inspection procedure requires us to examine the rock slopes regularly for benching, rock degradation and slope stability. In the future when it becomes necessary to replace the dam riprap or surface rock, engineering will have to evaluate the new replacement rock since the original rock was quarried from quarries that are now under water. The design criteria for the outer shell surface rock (riprap) will also be re-evaluated.

Item 2 NRC/FERC Report Finding:

"Piezometers should be tested and evaluated as to the cause of the readings above reservoir levels."

TXU Electric Response:

TXU Electric has consulted with Freese and Nichols (F&N), the original architect-engineer for the SSI. F&N has reviewed the piezometer readings and has determined the readings were suspect. F&N has reviewed the design basis for SSI and verified that, even with the worst case of accuracy for these instruments, the structural integrity of the dam is intact.

Based on discussions with F&N, TXU Electric will evaluate the piezometers to determine if they can be abandonded in place. This evaluation will be completed in 2001.

Item 3 NRC/FERC Report Finding:

"Survey base monuments should be checked to ensure the accuracy of the data."

TXU Electric Response:

The SSI Dam base monuments have been checked for accuracy and were found acceptable as previously described item 1 of Attachment 1 of TXU Electric Letter, logged TXX-98222, from C. L. Terry to the NRC, dated October 15, 1998 (Response to May 1997 Safe Shutdown Impoundment Dam Inspection).

Item 4 NRC/Federal Energy Regulatory Commission (FERC) Report Finding:

"Lastly, the licensee should inspect and / or survey the slopes underwater to ensure the quality of the outer shells of the SSID."

TXU Electric Response:

To determine if there was a problem with benching below the waterline, TXU Electric requested the Texas Water Development Board Hydrologic Monitoring Section to take computer controlled, satellite-located depth readings along the underwater slope of both sides of the dam during the course of their 1997 sedimentation survey (completed after the FERC inspection in May 1997). The results of the survey indicated a uniform underwater slope. Based on these results, no further action is required at this time.

This communication contains the following commitments which are one-time actions:

CDF Number	Commitment
27163	In the future when it becomes necessary to replace the dam riprap or surface rock, engineering will evaluate the new replacement rock since the original rock was quarried from quarries that are now under water. The design criteria for the outer shell surface rock (riprap) will also be re-evaluated.
27164	Additional piezometer testing was conducted in accordance with guidelines from Freese and Nichols (F&N). This testing determined that the piezometer readings were suspect due to leaking piezometers. In 2001, the piezometers will be evaluated to determine if they can be abandoned in place.

The CDF (Commitment Data Form) number is used by TXU Electric for internal tracking of CPSES commitments.