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

SUBJECT: 10 CFR 50.46 Annual Report

Three Mile Island, Unit 1 (TMI Unit 1)
Operating License No. DPR-50
Docket No.50-289

References:
1. FTI Topical Report BAW-10104P-A, Rev. 5, "B&W's ECCS Evaluation Model," November 1988.
2. FTI Topical Report BAW-10154-A, Rev. 0, "B&W's Small-Break LOCA ECCS Evaluation Model," July 1985.
3. FTI Topical Report BAW-10192P-A, Rev. 0,"BWNT LOCA – BWNT Loss-of-Coolant Accident Evaluation Model for Once-Through Steam Generator Plants," June 1998.

10 CFR 50.46 (a)(3)(ii) states that each holder of an operating license shall report to the Nuclear Regulatory Commission (NRC) at least annually each change or error in an accepted emergency core cooling system (ECCS) evaluation model (EM) or in the application of such a model that affects the peak cladding temperature (PCT) calculation.

For the reporting period from January 1, 2001 through December 31, 2001, Framatome ANP has confirmed that no significant errors were reported in the CRAFT2-based B&W ECCS EM (Reference 1 for LBLOCA and Reference 2 for SBLOCA). Two errors were reported in the RELAP5/MOD2-B&W-based BWNT LOCA EM (Reference 3). Error corrections and additional generic changes to the RELAP5/MOD2-B&W code and the BWNT LOCA EM were implemented as described in Enclosure 1. Enclosure 2 provides a summary of the EM changes applicable to TMI Unit 1 as identified and evaluated by Framatome ANP, and reported in accordance with 10 CFR 50.46(a)(3)(ii).

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No new regulatory commitments are established in this submittal.

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

Very truly yours,

Michael P. Gallagher
Director - Licensing & Regulatory Affairs
Mid Atlantic Regional Operating Group

Enclosures: 1) EM Changes and Significant Error Notification
2) Summary of EM Changes Applicable to TMI Unit 1

cc: H. J. Miller, USNRC Administrator, Region I
T. G. Colburn, USNRC Senior Project Manager, TMI Unit 1
J. D. Orr, USNRC Senior Resident Inspector, TMI Unit 1
File No. 00068

ENCLOSURE 1

EM CHANGES AND SIGNIFICANT ERROR NOTIFICATION

1.1 CRAFT 2 Evaluation Model

No errors or changes were reported in the CRAFT2-based B&W ECCS EM, BAW-10104P-A, Rev. 5 for LBLOCA (Reference 1.1) and BAW-10154-A, Rev. 0 for SBLOCA (Reference 1.2), during 2001.

1.2 RELAPS/MOD2-B&W Evaluation Model

Two errors were reported in the RELAP5/MOD2-B&W-based BWNT LOCA EM, BAW-10192P-A Rev. 0, (Reference 1.3), during 2001. The first item (Section 1.2.1) is associated with Preliminary Safety Concern (PSC) 2-00. It was identified in the 2000 annual 10 CFR 50.46 letter for TMI Unit 1 (Reference 1.11) because work was in progress. The work was completed and a Framatome ANP report sent to the NRC in 2001, therefore, the item is reported in the 2001 letter as an error correction. The second item (Section 1.2.2) is reported because of an NRC request for submittal of additional information on the range of application for the BEACH code (BAW-10166 PA).

One change was made to the RELAP5/MOD2-B&W-based BWNT LOCA EM, BAW-10192P-A Rev. 0, (Reference 1.3), during 2001. This change (Section 1.2.4) deals with an extension of the BEACH range of application.

Two other generic issues are presented. The first deals with an additional check of the local oxide thickness (Section 1.2.3). The second issue (Section 1.2.5) deals with the generic evaluation of the long-term cooling ability of the TRAPPER™ fine-mesh debris filter, currently incorporated on the Mark-B10K and Mark-B12 fuel assembly designs.

1.2.1 RCP Two-Phase Degradation Model for SBLOCA Error Correction

The NRC-approved SBLOCA EM (Volume II of Reference 1.3) prescribes that the two-phase RELAP5 head difference and degradation multipliers, derived from the Semiscale pump tests, be used with the reactor coolant pump (RCP) performance curves. Examination of the Semiscale pump degradation curves, which are based upon tests run at relatively low pressures, indicates that the RELAP5 model can overpredict the amount of head degradation during the first several minutes of a SBLOCA transient with continued RCP operation (as analyzed in resolution of PSC 2-00). Comparison of the RELAP5 curves to representative data, specifically the CE 1/5-scale steam-water tests (which were run at higher pressures) confirms that the RELAP5 model overpredicts pump head degradation during two-phase flow early in the event. Less pump degradation results in additional RCS liquid loss, which leads to more extensive core

uncovering and higher PCTs. Therefore, the approved RELAP5 model cannot be judged to be conservative for application to continued RCP operation during a SBLOCA. When a bounding pump performance curve (the lower bound "M3-modified" curve used in the approved large break LOCA model) is modeled, the predicted consequences are more severe. Therefore, the SBLOCA EM must be corrected to specify that the selection of a RCP two-phase degradation model in future SBLOCA analyses must be justified by sensitivity studies. This approach, which is similar to that used for LBLOCA applications, performs or makes reference to applicable studies that determine which RCP degradation model is conservative for application to plant-specific SBLOCA analyses.

RCP degradation model sensitivity studies were performed to resolve PSC 2-00 with RCP trip at two minutes after loss of subcooling margin. It was concluded from these analyses that the consequences for the CFT line break are most influenced by this change in degradation. CFT line break sensitivity studies confirmed that the M3-modified curve produces the most conservative results. The PCT change associated with the correction to the SBLOCA RCP degradation model for the B&W-designed lowered loop plants is highly plant specific as determined by the ECCS configurations and flow capacities. For some plants there was no change in overall SBLOCA PCT, however, for others the PCT change was in excess of 1500 F with an overall PCT that exceed 2200 F if the pumps were not tripped until two minutes. For those cases that exceed 2200 F with a two-minute RCP trip, reanalysis with a RCP trip at one-minute following LSCM resulted in no core uncovering. The utilities affected by the RCP trip time for analyses performed at 100% full power were notified on September 11, 2000 (Reference 1.7). The NRC was initially notified on September 26, 2000 (Reference 1.8). During the resolution of the PSC, the LOCA analyses that support off-nominal plant operation at 75% power with one HPI pump out of service were also found to have unacceptable PCT consequences with respect to PSC 2-00. Acceptable results were achieved at a reduced power of 50% with credit for a two-minute RCP trip. The final report summarizing the analyses and sensitivity studies for all operating B&W plants was sent to the NRC on April 2, 2001 (Reference 1.9).

This issue is considered an EM Error Correction. The PCT change associated with the error correction for TMI Unit 1 is discussed in Enclosure 2.

1.2.2 BEACH Topical Report Error Correction

Revisions to the BEACH topical report (Reference 1.4) were submitted to the NRC in December of 2001. The revision (Reference 1.5) seeks to extend ranges on the SER restrictions currently in place on the use of BEACH to validate all current LBLOCA applications.

Appendix H was added to the BEACH topical to extend the limitation of the cladding temperature at the onset of reflood. The BEACH SER restriction on Revision 2 limited the initial cladding temperature to between 950 and 1640 F. All of the demonstration cases presented in the BWNT LOCA EM (Reference 1.3) and subsequently approved by the NRC had initial cladding temperatures that exceeded this range. Nonetheless, Framatome ANP completed an additional benchmark to assure that the BEACH code

application could be extended to higher initial cladding temperatures. This benchmark (FLECHT-SEASET Test 34420) provides additional confirmation that the mechanistic modeling of BEACH is adequate and acceptable for reflood heat transfer prediction for plant LOCA application initial temperatures up to 2045 F. This material was provided to the utilities for 10 CFR 50.46 reporting for calendar year 1999. After the NRC was informed that the BWNT LOCA EM demonstration cases were outside of this initial temperature range, they stated that this was an error and they requested that a formal revision to the BEACH code topical report be prepared and submitted for review and approval. The extension of the SER restriction on the initial cladding temperatures effectively corrects all application analyses that may have had temperatures outside of the initially approved range. The PCT change for increasing the acceptable range of initial cladding temperatures in BEACH analyses is 0 F because no alteration of the code results or formulation was required.

This issue is considered an EM Error Correction. The PCT change associated with the error correction is (0 F).

1.2.3 Supplemental Peak Local Oxidation Calculation

A supplemental method was established to further demonstrate compliance with 10 CFR 50.46 criterion that specifies that the cladding peak local oxidation not exceed 17 percent of the total clad thickness before oxidation. The local oxidation is a combination of the initial oxidation and the oxidation that occurs during the transient as a result of the metal-water reaction. The method addresses the concern that the NRC may require the local cladding oxidation to be calculated with realistic initial oxidation values rather than the lower-bound values used in the NRC-approved BWNT LOCA EM.

Based on the approved BWNT LOCA EM, the initial cladding oxidation thickness is determined from a lower bound corrosion model developed in the 1970s as a function of burnup. Use of thinner initial oxide layers results in increased metal-water reaction rates that maximize the overall PCT. Therefore, underprediction of the oxide layer is conservative for the PCT evaluation and the whole core hydrogen generation. Underprediction, however, may not be conservative for the comparison against the 10 CFR 50.46 criterion for maximum local oxidation, because both the initial and transient oxidation are included in the total.

Over the past several years, the recognition of the degree of operation oxidation possible with the increased fuel pin burnup ranges has prompted an industry and NRC review of EM practices in demonstrating compliance with the 17 percent oxidation criterion. The NRC has issued an information notice (IN 98-29 August 3, 1998) stating their expectation that the initial oxide thickness be included with the transient oxidation in the comparison to this criterion. This information notice does not, however, address the determination of the initial oxide layers, particularly relative to NRC-approved procedures contained with the EMs. This issue is still being discussed among the NRC, NEI, and the industry. Pending resolution, Framatome ANP has developed a

supplemental method (Reference 1.12) for the BWNT LOCA EM to check the burnup dependency of the total local oxidation, initial (function of burnup) plus transient. The check is based on the realistic corrosion correlations given in Figure 3-4 of BAW-10227P-A (Reference 1.6) to assure that the 17 percent criterion would be met if such an approach were adopted.

This issue is considered a LOCA-related analysis that was performed but does not relate directly to PCT predictions. This supplemental analysis is for information only.

1.2.4 BEACH Topical Report EM Change

Revisions to the BEACH topical report (Reference 1.4) were submitted to the NRC in December of 2001. The revision (Reference 1.5) seeks to extend ranges on the SER restrictions currently in place on the use of BEACH.

Appendix I was added to the BEACH topical to decrease the limitation on the minimum flooding rate. The BEACH SER restriction on Revision 2 restricts the lower bound of the BEACH flooding rate to 0.5 in/s or above. The extension of the range of applicability from 0.5 in/s to 0.3 in/s is justified through benchmark comparisons to experimental data. Although this flooding rate decrease is not needed for the B&W-designed plants, it may be needed for the RSG LOCA EM BAW-10168 P-A Revision 3 (Reference 1.10), that also uses the BEACH computer code. The PCT change for decreasing the minimum flooding rate allowed in BEACH is 0 F because it was not used in licensing calculations for the B&W plants.

This issue is considered a change in the ECCS EM to modify or improve the model. This EM change was submitted to the NRC for approval, however, this has not been applied to any B&W plant application. This PCT change associated with the BEACH Topical Report EM change is (0 F).

1.2.5 Fine Mesh Debris Filter Evaluation

The TRAPPER™ fine-mesh debris filter is currently incorporated into the Mark-B10K and Mark-B12 fuel assembly designs. The purpose of the filter is to catch debris on the upstream face. A generic evaluation (Reference 1.13) was completed that concluded that the fine-mesh debris filter will not impede long-term cooling ability when the ECCS may be infiltrated with debris during the sump recirculation phase. It was determined that the filter beneficially restricts the debris from entering the core heated region. This evaluation is applicable to all fuel assemblies that utilize a similar fine-mesh debris filter. This information is being provided for information only and a PCT change evaluation is not necessary.

This issue is considered a LOCA-related analysis that was performed but does not relate directly to PCT predictions. A PCT change is not applicable to this item.

References

1.1 FTI Topical Report BAW-10104P-A, Rev. 5, "B&W's ECCS Evaluation Model", November 1988.
1.2 FTI Topical Report BAW-10154-A, Rev. 0, "B&W's Small-Break LOCA ECCS Evaluation Model", July 1985.
1.3 FTI Topical Report BAW-10192P-A, Rev. 0, "BWNT LOCA – BWNT Loss-of-Coolant Accident Evaluation Model for Once-Through Steam Generator Plants", June 1998.
1.4 FTI Topical Report BAW-10166PA-04, "BEACH – Best Estimate Analysis Core Heat Transfer; A Computer Program for Reflood Heat Transfer During LOCA," February 1996.
1.5 FTI Topical Report BAW-10166P-05, "BEACH – Best Estimate Analysis Core Heat Transfer; A Computer Program for Reflood Heat Transfer During LOCA," December 2001.
1.6 FCF Topical Report BAW-10227P-A, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," February 2000.
1.7 Letter to BWOG Analysis Committee, "PSC 2-00 Status and Summary," FTI-00-2268, September 11, 2000.
1.8 Letter to USNRC, "Report of Preliminary Safety Concern Related to Core Flood Line Break with 2-Minute Operator Action Time," FTI-00-2433, September 26, 2000.
1.9 Letter to USNRC, " Transmittal of Final Report on the Evaluation of PSC 2-00 Relating to Core Flood Line Break with 2-Minute Operator Action Time," FANP-01-988, April 2, 2001.
1.10 FTI Topical Report BAW-10168P-A, Rev. 3, "RSG LOCA – BWNT Loss-of-Coolant Accident Evaluation Model for Recirculating Steam Generator Plants", January 2, 1997.
1.11 AmerGen letter to the NRC (5928-01-20123) dated June 11, 2001.
1.12 FRA-ANP Proprietary Document 32-5015422-00, "Allowed Transient Oxidation Fraction".
1.13 FRA-ANP Proprietary Document 51-5014664-00, "Mk-B Fine Mesh Debris Filter Evaluation for SA & LOCA," September 24, 2001.

ENCLOSURE 2

SUMMARY OF EM CHANGES APPLICABLE TO TMI UNIT 1

Each of the 2001 licensing analyses or evaluations applicable to TMI Unit 1 is described below, with the inclusion of the Framatome ANP recommended reporting category and applicable PCT change. Each activity and the effect on the limiting ECCS analysis is summarized in Table 1. Limiting ECCS analyses are tracked for the Mark-B9 and the Mark-B12 fuel rod designs. The modified Mark-B9 fuel rod design and gadolinia are considered with the limiting Mark-B9 ECCS analysis. The Mark-B12 gadolinia rods are considered with the limiting Mark-B12 ECCS analysis.

2.1 BEACH Topical Report Error Correction

No analyses were required to support the BEACH Topical Report error correction of the initial cladding temperature at the onset of reflood (Generic Item 1.2.2). The error correction simply increases the range of initial cladding temperatures allowed at the onset of reflooding and supports the EM analyses that have already been performed. Therefore, the PCT change associated with the BEACH Topical Report error correction is (0 F).

This issue is considered an EM Error Correction. The PCT change associated with the error correction is (0 F).

2.2 BEACH Topical Report Change

No analyses were required to support the BEACH Topical Report EM Change for reducing the minimum applicable reflooding rate (Generic Item 1.2.4). This change does not affect the TMI-1 LOCA analyses, as they met the original minimum flooding rate criteria. Therefore, the PCT change associated with the BEACH Topical Report change is (0 F).

This issue is considered a change in the ECCS EM to modify or improve the model. This EM change was submitted to the NRC for approval, however, this has not been applied to any TMI-1 plant application. The PCT change associated with the EM change is (0 F).

2.3 PSC 2-00

Preliminary Safety Concern 2-00 (Reference 2.1) evaluated the EM assumption that SBLOCA analyses with Loss-Of-Offsite Power (LOOP, which results in immediate RCP trip) predict more severe consequences than analyses that model the availability of the RCPs until the operators manually trip them according to procedures. Analysis of large SBLOCAs (0.44 ft^2 CFT line break, 0.3-, 0.5- and 0.75-ft^2 CLPD) for some B&W plants with the incorporation of Generic Item 1.2.1 (RCP Two-Phase Degradation Model for SBLOCA error correction) have shown that more severe consequences may be obtained when modeling RCP trip at 2 minutes after the loss of subcooling margin (LSCM).

The analysis (Reference 2.1) of the 0.44-ft^2 CFT line break with 2 minute RCP trip at 2772 and 2568 MWt (including a LHR reduction from 17.0 to 16.8 kW/ft) predicted unacceptable consequences (PCT >2200 F). This occurred because the ECCS reaching the core was not able to offset the decreased RCS liquid inventory predicted with the RCPs in operation with the minimum two-phase head degradation curve (M3-modified). Analysis of the CFT line break at 2568 MWt with a RCP trip at one minute following LSCM predicted acceptable consequences that do not challenge the limiting SBLOCA PCT predicted with LOOP. Credit of the SBLOCA results based on a one minute RCP trip are supported by rigorous operator training that places high priority on the recognition of LSCM and the subsequent "immediate" tripping of the RCPs.

An explicit analysis at 2772 MWt with a one minute RCP trip has not been completed at this time. Therefore, even though the remainder of the SBLOCA spectrum was performed at 2772 MWt, the SBLOCA spectrum is currently limited to 2568 MWt with a maximum LOCA LHR limit of 16.8 kW/ft at the 9.536-ft elevation.

For the resolution of PSC 2-00, credit of RCP trip within one minute following LSCM and the 2568 MWt rated power level is necessary. With this credit, the PCT change associated with PSC 2-00 is (0 F).

This issue is considered an application Error Correction in that recent studies indicate that both RCP trip on LOOP and manual RCP trip following LSCM (1 minute for CFT line break and 2 minutes for larger SBLOCA break sizes) should be considered. This issue is also considered an EM Error Correction which corrected to the M3-modified two-phase RCP degradation model. The PCT change is estimated to be (0 F) because the limiting SBLOCA break size was not explicitly analyzed with RCP at 1 or 2 minutes following LSCM. The TMI Unit 1 licensing basis has been revised to reflect a one-minute RCP trip on LSCM.

2.4 Mark-B12 UO_2 LBLOCA

New LBLOCA analyses for support of the Mark-B12 fuel assembly design were completed in 2001. The Mark-B12 design utilizes M5™ cladding material and has a larger diameter fuel pellet, thinner cladding thickness, and smaller plenum volume than the Mark-B9 design that has previously been utilized at TMI-1. Additionally, the Mark-B12 design incorporates the TRAPPER™ fine mesh debris filter. The LBLOCA spectrum studies were performed and are summarized in Reference 2.2.

The LOCA analyses were performed with the NRC-approved BWNT LOCA EM (Reference 1.3) at an uprated power level of 2772 MWt for burnups between 0 and 40 GWd/mtU. At 62 GWd/mtU, the analyses were performed at 2568 MWt to take advantage of more realistic power history envelopes. Peak linear heat rate limits between 16.8 kW/ft and 17.0 kW/ft were analyzed for five core elevations and two times in life (0, 40). At 62 GWd/mtU, a LHR of 12.4 kW/ft was analyzed at a single representative core elevation. The limiting PCT of 1989 F was analyzed at 16.8 kW/ft and 0 GWd/mtU for the Mark-B12 UO_2 fuel pin.

This is considered a new application since this analysis is the first application to the Mark-B12 fuel design.

2.5 Mark-B12 Gadolinia LBLOCA

In association with the Mark-B12 assembly design, LBLOCA analyses were performed to evaluate the gadolinia fuel pins (Reference 2.2). Analyses were performed at the 2.506-ft elevation at three times in life to determine the reduction in LHR (compared to the corresponding UO_2 LHR) that will compensate for the reduced thermal conductivity of the gadolinia fuel and maintain the PCT less than the acceptance criteria.

Analyses were performed for three gadolinia enrichments, 2, 4 and 8 weight percent, based on the Mark-B12 fuel assembly design. The LHRs analyzed for the gadolinia pins were 5, 9 and 15 percent less, respectively, than the corresponding Mark-B12 UO_2 LHR limits. Based on the analyzed gadolinia cases and estimates of PCTs for all other elevations typically evaluated for the UO_2 pins, the UO_2 fuel pin produces the limiting ECCS case.

This is considered a new application since this analysis is the first application to the Mark-B12 gadolinia fuel design.

2.6 Mark-B12 and Mark-B9 Mixed-Core Study

A feature of the Mark-B12 fuel assembly design is the implementation of the TRAPPER™ fine mesh debris filter. The debris filter is not included on the current Mark-B9 fuel design. There exists the potential for flow diversion at the core inlet between the Mark-B9 and Mark-B12 assemblies related to the increased resistance of the debris filter. A mixed-core analysis was performed that modeled the higher resistance of the fine mesh debris filter in the hot channel and concluded that it did not cause any substantial flow diversion effects. Therefore, no penalty was determined to be necessary for a mixed-core of Mark-B9 assemblies and Mark-B12 assemblies.

This is considered a new application since this analysis is the first application of the mixed-core study for Mark-B9 and Mark-B12.

2.7 Mark-B12 SBLOCA

The BWNT LOCA EM states that SBLOCA analyses will either be performed specifically for each fuel design, or a current analysis may be shown to be bounding of similar fuel designs (page LA-92 of Reference 1.3). Since SBLOCA transients are generally not sensitive to fuel design changes, a sensitivity study based on the limiting break size is typically performed to validate the extension of one set of SBLOCA analyses to a new fuel design.

Therefore, to validate the application of the previous Mark-B9 SBLOCA spectrum to the Mark-B12 fuel, a fuel type sensitivity study was performed (Reference 2.2). The reanalysis of the limiting SBLOCA with the Mark-B12 fuel resulted in a PCT decrease of 9 F. The evaluation also considered other break sizes in the SBLOCA spectrum and deemed that similar results would be obtained if they were reanalyzed. Additionally, sensitivity studies previously performed based on the Mark-B9 fuel design were found to remain applicable to the Mark-B12 design. The study verified that the Mark-B9 and Mark-B12 fuel designs are similar with respect to the SBLOCA spectrum, and that the Mark-B9 SBLOCA spectrum is bounding of the Mark-B12 fuel type.

This is considered a new application since this analysis is the first application of the Mark-B9 spectrum to the Mark-B12 fuel assembly design.

2.8 SBLOCA with Increased EFW Temperature

The SBLOCA analyses were performed with an EFW temperature of 120 F. However, the line from the tank to the pumps is used during normal plant operation, and the liquid in this line could be as high as 135 F. It is estimated that it could take up to 10 minutes for the liquid in the line to clear before an EFW temperature of 120 F could be credited. The entire SBLOCA spectrum was evaluated considering an EFW temperature of 135 F for the first 10 minutes, with a step change to 120 F at 10 minutes. Based on the evaluation, the 0.04-, 0.05- and 0.06-ft^2 CLPD breaks were analyzed. The results of the analysis showed a 42 F increase in the PCT for the 0.05 ft^2 break, and a decrease in the PCT for the other two breaks. The results of this study (Reference 2.2) are applicable to the Mark-B9 and Mark-B12 fuel types.

This is considered a new application since a change in the EFW temperature to a more conservative value than that specified in the EM is a plant configuration change.

2.9 Cold Fuel Pin Geometry Input Error Correction

During the Mark-B9 SBLOCA analyses performed to support PSC 2-00 (Section 2.3) and the increased EFW temperature (Section 2.8), it was discovered that the cold fuel pin geometry in the base analysis (References 2.2 and 2.5) was specified incorrectly as that of the Mark-B10 fuel rod design. The hot fuel pin geometry was specified correctly from the Mark-B9 fuel initialization run. RELAP5 compares the hot and cold geometries to determine the fuel to clad gap conductance multiplier and a fuel geometry over-specification factor that are applied throughout the transient analysis. These factors compensate for the differences between the RELAP5 and steady-state fuel code (TACO3) fuel pin conduction models.

As discussed in Section 2.7, a single SBLOCA spectrum is typically validated for several fuel designs. In order to provide validation for the Mark-B9 fuel assembly design, a study was performed in Reference 2.6 that modeled the cold fuel pin geometry for the Mark-B9 fuel rod. The result of that analysis was a 17 F reduction in PCT. It was determined that the original Mark-B9 SBLOCA analyses remained bounding for the Mark-B9 fuel design. Therefore, the reduction in PCT was not credited or summarized in Reference 2.2. The cold fuel pin geometry was corrected for analysis of the PSC 2-00 large SBLOCA cases (Reference 2.1). However, the PCT reduction for the error correction has not been credited in the limiting SBLOCA ECCS PCT (Reference 2.2). In the event of future PCT changes related to EM changes or error correction, the PCT change of –17 F should be considered in determining the absolute value of the PCT changes.

This is considered an application Error Correction. The correction of the Mark-B9 SBLOCA cold fuel pin geometry resulted in a decrease in the limiting SBLOCA PCT. This PCT decrease has not currently been applied to the PCT values summarized in References 2.2 and 2.5, but should be considered with respect to future EM changes or error corrections.

2.10 Power Level Study

Most of the Mark-B9 and Mark-B12 LHR limits have been analyzed at an uprated power level of 2772 MWt to accommodate a potential increase in the licensed power level of 2568 MWt. A LBLOCA core power level study was completed for the Mark-B12 design (Reference 2.2) to verify that no LHR limit penalty needed to be applied to the uprated limits for application to 2568 MWt. The potential for a penalty exists when there are significant differences in the core inlet and exit temperature at the uprated level compared to the licensed power level. The temperature difference may promote a beneficial delay in CHF for higher power levels. The study concluded that there was no penalty associated with performing the LOCA limits at the uprated power level of 2772 MWt. The PCT change associated with performing the LOCA analyses at an uprated power level is (0 F).

This is considered a LOCA-related analysis that was performed but does not relate directly to PCT predictions. The study verified that LOCA results determined at the uprated power level are conservative for application at the current rated power level.

2.11 Mark-B9 M5-Clad Lead Test Pins

The Mark-B10(LTA) assembly (Batch 13L) consists of Mark-B9 fuel pins reconstituted with four thrice-burned M5-clad rods. NRC-approval for the extended burnup of these M5-clad pins has been received (Reference 2.7). The M5 test pins have been shuffled within Cycles 11, 12 and 13 and have been reconstituted into a twice-burned Mark-B10 assembly (with Mark-B9 fuel rods) for return to Cycle 14. Therefore, the maximum burnup of the M5 test pins is expected to be less than ~69 GWd/mtU, which is beyond the previously analyzed LOCA LHR range for the Mark-B9 fuel rods. At high burnups, the LOCA LHRs are typically limited based on reaching a maximum pin pressure limit based on the TACO3 steady-state fuel code (Reference 2.4), and are not limited by the PCT. Therefore, an M5 specific fuel rod initialization was performed to evaluate the maximum LHR limit that could be achieved at 70 GWd/mtU to obtain the pin pressure limit. The analysis credited a power history envelope representative of the test pins (rather than a generically bounding envelope) and obtained a LHR of 13.3 kW/ft. This LHR was reduced to 12.8 kW/ft so that it was equivalent to the Mark-B9 LHR limit at 62 GWd/mtU. It was estimated that the PCT predicted at 70 GWd/mtU would remain significantly below the limiting PCT, and that these four pins would not impact the surrounding Mark-B9 pins (Reference 2.3). Therefore, the PCT change associated with incorporation of the M5 test pins with burnups up to 70 GWd/mtU is estimated to be (0 F).

This is considered a LOCA-related analysis that was performed but does not relate directly to PCT predictions. This lead test pin is a special application of the EM which is approved via the SER for docket number 50-289 (Reference 2.7). The PCT change associated with high burnup test pins is (0 F).

References

2.1 FRA-ANP Document 51-5009856-00, "Summary of PSC 2-00 Analyses," April 13, 2001.
2.2 FRA-ANP Document 86-5011294-00, "TMI-1 Mk-B12 LOCA Summary Report," March 22, 2001.
2.3 FRA-ANP Proprietary Document 51-5012026-00, "TMI-1 Cycle 14 LOCA LHR Limits," April 26, 2001.
2.4 FRA-ANP Topical Report BAW-10162P-A, Rev. 0, "TACO3, Fuel Rod Thermal Analysis Code," November 1989.
2.5 FRA-ANP Document 86-5002073-02, "Summary Report for BWOG 20% TP LOCA," July 28, 1999.
2.6 FRA-ANP Proprietary Document 32-5009466-00, "SBLOCA Mk-B12/EFW Temperature Analysis," April 2, 2001.
2.7 FRA-ANP Document 38-1288551-00, "TMI-1 Application and SER for M5 Fuel Rod Irradiation Beyond Current Burnup Limit", October 5, 2001.

Table 1: 2001 LOCA Licensing Activity for TMI Unit 1

	Plant Name:	Three Mile Island – Unit 1	***LOCA Spectrum***		
	Utility Name:	AmerGen	*Mark-B9 LBLOCA*	*Mark-B12 LBLOCA*	*Mark-B9 / Mark-B12 SBLOCA*
Previous Licensing Basis			2083 F	N/A	1412 F
2001 Licensing Activity					
Item #	***Reporting Category***	***Description***	***PCT or (PCT Change)***		
2.1	EM Error Correction	BEACH Topical Report Correction Extension of the SER restriction on the initial cladding temperatures	(0 F)	(0 F)	N/A
2.3	EM Error Correction and Application Error Correction	Correction of RCP Degradation Model for SBLOCA PSC 2-00, SBLOCA considering LOOP and 1 Minute RCP Trip	N/A	N/A	(0 F) Analyzed
2.4	New Application	Mark-B12 UO_2 LBLOCA	N/A	1989 F Analyzed	N/A
2.5	New Application	Mark-B12 2, 4 and 8 w/o Gadolinia LBLOCA	N/A	(0 F) Analyzed	N/A
2.6	New Application	Mark-B12 and Mark-B9 Mixed-Core Study	(0 F)	(0 F)	N/A
2.7	New Application	Mark-B12 SBLOCA Validate application of Mark-B9 SBLOCA Spectrum to Mark-B12 design.	N/A	N/A	(0 F) Analyzed
2.8	New Application	SBLOCA with Increased EFW Temperature	N/A	N/A	(+42 F) Analyzed

	Plant Name:	Three Mile Island – Unit 1	***LOCA Spectrum***		
	Utility Name:	AmerGen	*Mark-B9 LBLOCA*	*Mark-B12 LBLOCA*	*Mark-B9 / Mark-B12 SBLOCA*
2.9	Application Error Correction	SBLOCA Cold Fuel Geometry Input Error Correction	N/A	N/A	(0 F) estimated (reduction not credited)
2.10	Other	Power Level Study	(0 F)	(0 F)	N/A
2.11	Other	Mark-B9 M5-Clad Lead Test Pins (burnup up to ~69 GWd/mtU)	(0 F)	N/A	N/A
Revised Licensing Basis			**2083 F**	**1989 F**	**1454 F**