

**OFFICE OF THE INSPECTOR GENERAL  
EVENT INQUIRY**



**NRC STAFF'S ACTIONS RELATED TO REGULATION AT MAINE YANKEE**

**CASE NO. 96-04S**

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## CHRONOLOGY OF SIGNIFICANT LICENSING EVENTS

<u>DATE</u>	<u>EVENT</u>
September 15, 1972	Operating license issued to Maine Yankee Power Station at 2440 MWt
August 1, 1977	MYAPCo submitted application for thermal power increase to 2630 MWt
May 10, 1978	NRC approved License Amendment No. 38 to increase thermal power to 2560 MWt, pending review by the NRC's ACRS
June 20, 1978	NRC approved License Amendment No. 39 to increase thermal power to 2630 MWt
October 31, 1980	NRC issued NUREG-0737, "Clarification of TMI Action Plan Requirements"
January 14, 1983	MYAPCo submitted YAEC Topical Report 1300P, "RELAP5YA: A Computer Program for Light Water Reactor System Thermal-Hydraulic Analysis"
March 14, 1983	NRC issued Order confirming MYAPCo commitments to implementation of TMI Items set forth in NUREG-0737
December 28, 1988	MYAPCo submitted application for thermal power increase to 2700 MWt
January 30, 1989	NRC issued Safety Evaluation Report approving RELAP5YA and closed out TMI Item II.K.3.30
May 8, 1989	NRC letter sent to MYAPCo closing out TMI Item II.K.3.31, which was implementation of SBLOCA analysis
July 10, 1989	NRC approved thermal power increase to 2700 MWt
June 1990 - February 1992	Cycle 12 operation
April 1992 - July 1993	Cycle 13 operation
February 6, 1995- January 11, 1996	Maine Yankee Power Station shutdown to repair steam generators
January 3, 1996	NRC issued Confirmatory Order suspending authority for and limiting power operation and containment pressure and demand for information
January 11, 1996	Maine Yankee Power Station resumed operation at 2440 MWt

## EXECUTIVE SUMMARY

The Office of the Inspector General (OIG) initiated this inquiry based on an anonymous letter to the Union of Concerned Scientists (UCS) and later forwarded to the U.S. Nuclear Regulatory Commission (NRC), on December 4, 1995. The anonymous letter alleged that Yankee Atomic Electric Company (YAEC), acting as agent for Maine Yankee Atomic Power Company (MYAPCo), knowingly performed inadequate small break loss-of-coolant accident (SBLOCA) analyses of the emergency core cooling system (ECCS) to support two license amendments to increase the rated thermal power at which Maine Yankee Atomic Power Station could operate. Specifically, it was alleged that YAEC management knew that the ECCS for Maine Yankee, if evaluated in accordance with 10 CFR Section 50.46 using the RELAP5YA code, did not meet the licensing requirements for either the 2630 MWt or the 2700 MWt power uprates that had previously been granted, and that deliberate misrepresentations were made to the NRC in order to obtain the 2700 MWt power uprate. It was further alleged that MYAPCo was cognizant of these inadequate analyses, yet misrepresented them to the NRC in seeking the license amendments.

Further, the anonymous letter alleged that MYAPCo applied for a thermal power increase to 2700 MWt during a time when the NRC was least vigilant. Additionally, it was alleged that YAEC and MYAPCo perceived the NRC Project Manager, at the time, as lenient and wanted to submit the power increase application before the Project Manager left his position.

It was also alleged that MYAPCo applied for power uprates on the basis of a fraudulent containment analysis. Specifically, the facility containment was designed for a pressure of 55 psig, but allegedly, YAEC deliberately excluded an energy source (steam generators) from the calculations to conceal the possibility that containment pressure could increase beyond the design pressure during a loss-of-coolant accident (LOCA).

The OIG inquiry addressed the NRC staff's actions relating to the regulation of Maine Yankee Power Station's SBLOCA analyses of the ECCS. During this inquiry, OIG reviewed the activities of MYAPCo and YAEC to enable OIG to assess the NRC's performance. Possible NRC violations by the licensee identified by OIG were provided to the NRC Office of Investigations (OI). The NRC OI has a separate investigation of licensee misconduct and misrepresentations.

The OIG inquiry disclosed that although the staff reviewed the RELAP5YA computer code method, there was weakness in the review process. OIG determined that the NRC staff reviewed the RELAP5YA code for Maine Yankee independently of the code plant specific application. OIG learned that normally computer code methods and applications were reviewed together by the NRC staff.

The inquiry determined that until the allegations arose, the NRC staff was unaware of MYAPCo's non-compliance with certain Safety Evaluation Report (SER) conditions set forth in the approval. The SER established 12 conditions in which the licensee was required to follow when using the RELAP5YA computer code. OIG found that the staff did not follow-up on the licensee's compliance with the conditions in the SER after it was issued in January 1989.

The inquiry determined that the May 1989 NRC letter that closed out TMI Item II.K.3.31 contained several irregularities. OIG found no indication of a technical review by the staff of the licensee's response to TMI Items

II.K.3.30 and .31. OIG learned that there was insufficient management involvement regarding the May 1989 letter. Further, OIG learned that the NRC Project Managers, technical staff managers and senior officials had several opportunities to resolve the erroneous closure of TMI Item II.K.3.31, but failed to do so.

The inquiry learned that the NRR staff did not have and presently does not have a formal licensing commitment tracking system. The NRR staff relied on the licensee's tracking system to follow-up on commitments to the NRC. OIG determined that the lack of a formal licensing commitment tracking system was a major factor in NRR being unaware of the licensee's non-compliance with NRC regulations.

The OIG inquiry found that there was not a uniformed policy on Project Managers documenting and retaining their documentation of conversations with licensees. OIG found that the Project Managers had to rely on the licensee's documentation of events because they either did not document an event or did not retain such documentation. Consequently, the staff was unable to reconstruct or verify their actions with respect to certain past events under review by OIG.

The OIG inquiry revealed several examples where the staff relied on the licensee to follow the NRC requirements and regulations; however, the licensee did not adhere to NRC requirements and regulations.

In addition, this OIG report discusses the allegations against MYAPCo and YAEC with respect to possible violations of NRC regulations and requirements. The OIG learned that the licensee did not report modifications and changes to the RELAP5YA computer code and problems experienced with the code as required under 10 CFR Section 50.46. OIG learned that the licensee did not use the RELAP5YA computer code in accordance with its SER and the requirements of TMI Action Item II.K.3.31.

## BASIS

The Office of the Inspector General (OIG) initiated this inquiry based on an anonymous letter to the Union of Concerned Scientists (USC) and later forwarded to the U.S. Nuclear Regulatory Commission (NRC), on December 4, 1995. The anonymous letter alleged that Yankee Atomic Electric Company (YAEC), acting as agent for Maine Yankee Atomic Power Company (MYAPCo), knowingly performed inadequate small break loss-of-coolant accident (SBLOCA) analyses of the emergency core cooling system (ECCS) to support two license amendments to increase the rated thermal power, at which Maine Yankee Atomic Power Station may operate. It is further alleged that MYAPCo was cognizant of these inadequate analyses, yet misrepresented them to the NRC in seeking the license amendments.

Further, the anonymous letter alleged that MYAPCo applied for a thermal power increase to 2700 MWt between Thanksgiving and Christmas 1988, when the NRC was least vigilant. Additionally, it was alleged that YAEC and MYAPCo perceived the NRC Project Manager, at the time, as lenient and wanted to submit the power increase application before the Project Manager left his position.

It is also alleged that the MYAPCo had applied for power uprates on the basis of a fraudulent containment analysis. Specifically, the facility containment was designed for a pressure of 55 psig, but allegedly, YAEC deliberately excluded an energy source (steam generators) from the calculations to conceal the possibility that containment pressure could increase beyond the design pressure during a loss-of-coolant accident (LOCA).

As a result of these allegations, the NRC conducted a technical review and evaluation of the circumstances and records surrounding MYAPCo applications to increase the station's maximum rated thermal power. This review and evaluation was conducted at YAEC Headquarters in Bolton, Massachusetts, on December 11-14, 1995, by a five member NRC team. On December 18, 1995, a meeting was held at the NRC Headquarters to discuss with MYAPCo the findings of the review and evaluation team and to seek any additional information the licensee or its agent, YAEC, could provide to the NRC.

The NRC issued a Confirmatory Order Suspending Authority for and Limiting Power Operation and Containment Pressure (Effective Immediately), and Demand for Information (DFI) as a result of the review and evaluation team's findings. This Order and DFI specified the requirements for reactor start-up and operation at 2440 MWt, as well as any increase in thermal power to the previously approved maximum level of 2700 MWt.

On January 5, 1996, the Director of the Office of Nuclear Reactor Regulation (NRR) referred to the OIG allegations of improper conduct by the NRC staff that were included in allegations against YAEC and MYAPCo.

## SCOPE

The Office of the Inspector General (OIG) inquiry was twofold in its review of the allegations against Maine Yankee Atomic Power Company (MYAPCo) and Yankee Atomic Electric Company (YAEC). Firstly, OIG conducted interviews of MYAPCo and YAEC staff, on a limited basis, and reviewed documents provided by YAEC to develop information with respect to licensee submittals to the U.S. Nuclear Regulatory Commission (NRC). With respect to the licensee's activities, OIG coordinated its efforts with the NRC Office of Nuclear Reactor Regulation (NRR) and the NRC Office of Investigations (OI). Secondly, the OIG addressed the NRC staff's actions relating to the regulation of Maine Yankee Power Station's SBLOCA analyses of the ECCS. The issue of the NRC staff's activities in connection to the allegations was OIG's primary purpose.

The OIG efforts included, but were not limited to, the following:

1. Interviews of the past and present NRC Project Managers; the Director of the Division of Reactor Projects and managers; past and present Branch Chiefs of the Reactor Systems Branch (RSB) in NRR; and the technical staff of the RSB.
2. Interviews of MYAPCo's Vice President of Nuclear Engineering and Licensing (NE&L); past and present Managers of NE&L; reactor engineering staff; and YAEC's LOCA Group Manager and Senior Engineer in the Projects Department for Maine Yankee.
3. A review of the NRC Project Manager's file; the RSB technical file; the Technical Evaluation Report (TER) on RELAP5YA by Idaho National Engineering Laboratory (INEL); the NRC Safety Evaluation Report (SER) on RELAP5YA; Topical Report YAEC-1300P, "RELAP5YA: A Computer Program for Light Water Reactor System Thermal-Hydraulic Analysis"; TMI Action Plan Implementation Status Report and Database; documents provided by YAEC on small break loss-of-coolant accident (SBLOCA) analysis covering the period 1976 to 1995; and documents provided by MYAPCo and YAEC staff and their consultants, Morgan, Lewis and Bockius.

## **HISTORICAL BACKGROUND**

Maine Yankee Atomic Power Company (MYAPCo) is the holder of Facility Operating License No. DPR-36, issued by the Atomic Energy Commission, predecessor to the NRC, pursuant to 10 CFR Part 50 on September 15, 1972. The licensee operates Maine Yankee Power Station (Maine Yankee), located in Lincoln County, Maine. Maine Yankee is a pressurized-water reactor (PWR).

Maine Yankee was initially authorized to operate at a power level of 2440 MWt, based in-part on a Combustion Engineering (CE) analysis of the emergency core cooling system (ECCS). By application dated August 1, 1977, MYAPCo requested a single step increase in the maximum operating thermal power to 2630 MWt, again based on a CE ECCS analysis. On May 10, 1978, the NRC issued Amendment No. 38 to the license, which increased the licensed power level to 2630 MWt, but restricted operation to 2560 MWt until the NRC Advisory Committee on Reactor Safeguards (ACRS) reviewed and recommended approval of the power increase from 2560 to 2630 MWt. On June 20, 1978, the NRC issued Amendment No. 39, which authorized the MYAPCo to operate its facility at 2630 MWt. On December 28, 1988, the licensee submitted a request to amend its license to increase the plant's maximum operating thermal power to 2700 MWt. The Commission granted this amendment request on July 10, 1989.

Licensees are required, in accordance with Appendix K to 10 CFR Part 50 and 10 CFR Section 50.46, to perform specific accident analyses, including small break loss-of-coolant accident (SBLOCA) analyses, for operation at their licensed maximum power level. NUREG-0737, "Clarification of TMI Action Plan Requirements," issued following the accident at Three Mile Island Plant (TMI) provided guidance to NRC licensees for performing SBLOCA analyses. In particular, Item II.K.3.30, "Revised SBLOCA Methods to Show Compliance With 10 CFR Part 50, Appendix K," and Item II.K.3.31, "Plant-Specific Calculations to Show Compliance with 10 CFR Section 50.46," requested that licensees submit to the NRC for approval both the revised methods and plant specific SBLOCA analysis. In response to Item II.K.3.30, MYAPCo submitted licensing Topical Report YAEC-1300P, "RELAP5YA: A Computer Program for Light Water Reactor System Thermal-Hydraulic Analysis," dated January 14, 1983.

By letter dated January 30, 1989, the NRC found that RELAP5YA was acceptable, under certain conditions, as a licensing method for use in meeting the requirements of 10 CFR Part 50 Appendix K and NUREG-0737 Item II.K.3.30 for SBLOCA analysis for Maine Yankee. Specifically, the NRC's Safety Evaluation Report (SER), dated January 30, 1989, for RELAP5YA listed 12 conditions in connection with approval, including specifications for future plant specific licensing submittals, justifying options taken and sensitivity studies performed.

In April 1989, the NRC undertook a detailed review of the implementation status of TMI action plan items at all licensed plants. The NRC review concluded that, as of May 19, 1989, only 254 items remained to be implemented by licensees. These few remaining items were considered to be of lower priority than certain other actions also being implemented to improve safety at nuclear power plants.

On May 8, 1989, the NRC issued a letter acknowledging that MYAPCo's computer model and program developed concerning SBLOCA analysis was operational and would be used to develop Maine Yankee's Cycle 12 fuel reload. Based upon a telephone conversation between the licensee and the NRC Project Manager for Maine Yankee, TMI

Item II.K.3.31 was closed.

On December 4, 1995, the NRC received an allegation against YAEC acting as agent for MYAPCo. In brief, it was alleged that YAEC knowingly performed inadequate analyses of the emergency core cooling systems (ECCS) and the reactor containment to support the two license amendments to increase the rated thermal power at which Maine Yankee Power Station could operate. It was alleged that MYAPCo deliberately misrepresented the analyses to the NRC in seeking the license amendments. Further, it was alleged that MYAPCo applied for thermal power increase to 2700 MWt during a time when the NRC was least vigilant. Additionally, it was alleged that YAEC and MYAPCo perceived the NRC Project Manager, at the time, as lenient and wanted to submit the power increase application before the Project Manager left his position.

On January 11, 1996, Maine Yankee resumed operation after being shutdown for almost a full year (plant shutdown since February 1995). Operation of the plant at the initially licensed power level of 2440 MWt was granted by the NRC.

## DETAILS

### **MYAPCo and YAEC Relationship**

Maine Yankee Atomic Power Company (MYAPCo) has employed Yankee Atomic Electric Company (YAEC), an engineering firm, as consultants for a number of technical issues. One of those issues was the development of the small break loss-of-coolant accident (SBLOCA) methodologies which were based in the computer code RELAP5YA. YAEC was also to provide the detailed submittal packages for MYAPCo to review and submit to the U.S. Nuclear Regulatory Commission (NRC) as well as develop the SBLOCA methodologies.

### **Development of RELAP5YA**

The Loss-of-Coolant Accident (LOCA) Methods Development Program was initiated at YAEC in 1979 to establish improved LOCA methods to support the Maine Yankee, Yankee Rowe, Vermont Yankee and Seabrook Power Stations. RELAP5/MOD1 was chosen as the code to be used as a basis for developing the RELAP5YA methodology because it possessed the most promising features. The YAEC approach was consistent with the requirements established in 1980 that resulted from assessments of the Three Mile Island Plant (TMI) accident. These requirements were contained in TMI Action Items II.K.3.30 and .31. These TMI items required that methods used to demonstrate compliance with 10 CFR 50 Appendix K be revised to account for comparisons with experimental data related to SBLOCA and that plant specific calculations be performed using NRC approved models.

YAEC developed a method for performing SBLOCA analyses for MYAPCo in response to TMI Action Item II.K.3.30. This method consisted primarily of the RELAP5YA computer code for thermal-hydraulic analysis. The RELAP5YA code, contained in YAEC Topical Report-1300P, was submitted for NRC review in 1983. NRC requested responses to 197 questions on general application of the code in May 1984 and asked several additional questions on SBLOCA application in September 1986. A series of submittals responding to these questions were transmitted to the NRC between March 1984 and December 1986. A final submittal on the SBLOCA application model improvements with appropriate comparisons to experimental test results was made by YAEC in 1988.

Sometime during the SBLOCA review period between 1983 and 1988, YAEC began experiencing problems with RELAP5YA. Upon application of the code, YAEC experienced several instances of non-physical behavior (i.e., occurrences not consistent with experimental data and known physical phenomena) leading to cladding temperature fluctuations (oscillations). The Manager for YAEC's LOCA Group determined that the problems were in the RELAP5YA code. The LOCA Manager advised OIG that a variety of modifications and improvements were made to the code to address the problems and subsequently, the problems with oscillations were no longer evident. OIG found that MYAPCo and YAEC did not report these problems to the NRC because they believed the problems occurred during the developmental stage of the code, thus they were not reportable to the NRC.

### **Approval of RELAP5YA & Closeout of TMI Action Item II.K.3.30**

By letter dated January 30, 1989, the NRC found that RELAP5YA was acceptable, under certain conditions, as a

licensing method for use in meeting 10 CFR Part 50 Appendix K and NUREG-0737 Item II.K.3.30 for SBLOCA analysis for Maine Yankee. A SER was transmitted with the January 30, 1989, letter to MYAPCo. The NRC's SER for RELAP5YA listed 12 conditions, including specifications for future plant specific licensing submittals, justifying options taken and sensitivity studies performed. OIG learned that certain conditions of the SER were not adhered to by MYAPCo. Of specific interest to OIG were conditions 4, 7, 8, 9, and 12 of the SER, which identified justification for model nodalization used when a two-phase mixture level dropped below the top of the core; justification of all selected options and input data used in plant specific licensing submittals; documentation of plant specific sensitivity studies including, but not limited to, time step and break sizes; justification of steam generator nodalization; and the need to perform a break size study to include the worst SBLOCA cases for plant specific licensing application. Specifically, MYAPCo did not comply with the above five conditions related to information being provided to the NRC regarding plant specific licensing applications.

Upon the January 1989 approval of RELAP5YA for Maine Yankee, YAEC began a full scope licensing SBLOCA analysis application for the plant. While doing the analysis it became apparent to YAEC that the problem with predicting excessive emergency core cooling system (ECCS) bypass had not been totally resolved. The code predicted non-physical behavior again as it did during the development stage of 1983 to 1988. YAEC's LOCA Group Manager said to OIG that the code experienced oscillations with the peak cladding temperature (PCT) exceeding 2200°. OIG learned that NRC regulations stipulate that the PCT should not exceed the calculated maximum fuel element cladding temperature of 2200°. Because of the difficulties encountered in the application of the method to Maine Yankee, YAEC did not complete this analysis until 1993. OIG learned that MYAPCo did not report these difficulties to the NRC.

10 CFR Section 50.46(3)(ii) states, in part, "For each change to or error discovered in an acceptable evaluation model or in the application of such a model that affects the temperature calculation, the applicant or licensee shall report the nature of the change or error and its estimated effect on the limiting ECCS analysis to the Commission at least annually as specified in §50.4." As required under this section, MYAPCo should have reported the problems with RELAP5YA, especially when the code experienced PCTs greater than 2200°. Additionally, OIG learned that MYAPCo and YAEC did not report these changes to the NRC because they interpreted the phrases "the limiting transient" and the "limiting ECCS analysis" in 10 CFR Section 50.46 to pertain to the large break loss-of-coolant accident (LBLOCA), not SBLOCA. MYAPCo and YAEC staff explained to OIG that the LBLOCA has been historically more limiting than SBLOCA. Thus, MYAPCo and YAEC concluded that changes to RELAP5YA for SBLOCAs did not have to be reported to the NRC.

### **Closeout of TMI Action Item II.K.3.31**

NUREG-0737 required that within a year of TMI Item II.K.3.30 being closed, TMI Item II.K.3.31, plant specific analysis must be implemented at the plant and submitted to the NRC. YAEC LOCA Group Manager planned to make plant specific submittals by the end of 1989, that would have provided the results of RELAP5YA analyses for Maine Yankee and Yankee Rowe. OIG found records that disclosed that progress on diagnosing and solving the oscillatory problems was slow due to the slow computer run time. MYAPCo and YAEC advised OIG that an alternative approach was proposed for closing TMI Item II.K.3.31. This approach involved determining the limiting break size using best estimate (BE) models and assumptions and bounding assumptions to determine the PCT for that break. The YAEC LOCA Manager acknowledged to OIG that the alternative approach was not

consistent with the SER for RELAP5YA. The Manager told OIG that the NRC review and approval of the approach would be necessary.

YAEC issued a letter to the NRC in January 1989 proposing to use either the BE approach or another method based on experience to determine the limiting break at Yankee Rowe, and the approved RELAP5YA as an evaluation model (EM) to analyze the limiting break. The NRC Project Manager for Yankee Rowe accepted this approach for closing TMI Item II.K.3.31. In February 1989, the NRC Project Manager for Yankee Rowe issued a letter closing TMI II.K.3.31 for Yankee Rowe.

Based upon the NRC's acceptance of the BE/EM approach to close TMI Item II.K.3.31 for Yankee Rowe, MYAPCo and YAEC prepared a letter to the NRC proposing to use the BE/EM approach for Maine Yankee. OIG found that the letter to the NRC was prepared in draft, but was never sent to the NRC. Instead, the NRC Project Manager for Maine Yankee issued a letter to MYAPCo closing TMI Item II.K.3.31 as of May 8, 1989.

The May 8, 1989, letter stated:

By telecon May 5, 1989, Mr. S. Nichols of Maine Yankee informed me that your computer model and program you developed concerning Small Break LOCA analysis, per NUREG-0737 II.K.3.30 and II.K.3.31 is operational and will be used to develop your next fuel reload (Cycle 12).

Since this constitutes implementation, this closes item II.K.3.31. Item II.K.3.30 was closed by letter dated January 30, 1989. Thus, this completes NRC review of your Small Break LOCA analysis. Your computer program, its verification and implementation may, in the future, be the subject of an inspection by NRC.

MYAPCo and YAEC staff stated to OIG that they were surprised by the May 8, 1989 letter because it did not resemble NRC's February letter for Yankee Rowe, which was used to close out TMI Item II.K.3.31. However, MYAPCo and YAEC said to OIG that they believed the May letter was intentionally vague and intended to allow them the flexibility in implementing TMI Item II.K.3.31. Further, MYAPCo and YAEC interpreted the May letter to state that the RELAP5YA analysis results should be retained at the plant for possible NRC inspection. MYAPCo and YAEC staff told OIG that they believed the May letter superseded the January 1989 SER conditions for making specific submittals. Thus, MYAPCo and YAEC did not submit to the NRC the plant specific analysis results.

### **Licensee's Commitment To Use RELAP5YA**

The NRC's May 1989 letter closed out TMI Action Item II.K.3.31 for Maine Yankee based upon the licensee's commitment to use RELAP5YA for Cycle 12. MYAPCo and YAEC staff acknowledged that a commitment was made to use RELAP5YA in the plant specific analyses to develop Cycle 12 fuel reload; however, the analysis report would be retained at the plant. OIG learned that MYAPCo did not use RELAP5YA to develop Maine Yankee's Cycle 12 fuel reload as indicated in the May letter. MYAPCo and YAEC acknowledged to OIG that the RELAP5YA application to the plant experienced some difficulties, such as PCTs higher than 2200°, during the 1989 to 1993 period. As a result, the plant specific analysis was not completed for Cycle 12.

OIG found records that indicated that in October 1989, MYAPCo informed the NRC Project Manager for Maine Yankee, via telephone, that RELAP5YA would not be used to develop Cycle 12 fuel reload. The licensee explained that they had previously committed (May 1989) to implementing the SBLOCA analysis for the core reload scheduled in April/May 1990, but would not be able to meet the scheduled commitment. MYAPCo stated during the telephone conversation with the Project Manager that a submittal documenting the reason(s) for failure to implement the analysis and their plans for future implementation would be provided to the NRC. However, MYAPCo did not provide the NRC with such a submittal justifying their failure to implement RELAP5YA. The implementation of RELAP5YA to Maine Yankee did not occur until 1993, midway through Cycle 13. The analysis of plant specific application was transmitted to the NRC in the Cycle 14 Core Performance Analysis Report (CPAR). MYAPCo and YAEC believed that this analysis was consistent with the conditions in the SER. However, MYAPCo and YAEC acknowledged to OIG that the analysis, which was the first licensing application of the RELAP5YA methodology to Maine Yankee, was not submitted to the NRC for review.

## **DETAILS OF NRC STAFF ACTIVITIES**

### **Background**

According to NUREG-0325, "NRC Functional Organizational Charts," dated July 1, 1989, the Office of Nuclear Reactor Regulation (NRR) has responsibility for implementing regulations, and developing and implementing policies, programs and procedures for all aspects of licensing and inspection of nuclear reactors in the commercial sector. The two primary NRR offices involved in this matter are Project Directorate I-3 (PDI-3) and the Reactor Systems Branch (RSB). PDI-3 performs the overall safety and environmental project management and monitors daily operations of certain power reactors in Region I. The PDI-3 serves as Headquarters contact with licensees and applicants; and coordinates the preparation of Safety Evaluation Reports (SER) and Environmental Impact Statements and routine inspections. RSB is responsible for issues pertaining to core physics, fuel behavior, and core thermal-hydraulic performance. RSB reviews and evaluates nuclear and thermal-hydraulic aspects of the reactor core under steady-state, transient, and accident conditions.

### **Issuance of SER and Closeout of TMI Action Item II.K.3.30**

In 1980, NUREG-0737, "Clarification of TMI Action Plan Requirements," was issued to all NRC licensees following the Three Mile Island Plant accident. NUREG-0737 provided guidance on the requirements for several safety significant issues raised by the accident at Three Mile Island Plant (TMI). In particular, TMI Item II.K.3.30, "Revised SBLOCA Methods to Show Compliance With 10 CFR Part 50, Appendix K," and TMI Item II.K.3.31, "Plant-Specific Calculations to Show Compliance With 10 CFR Section 50.46," that required licensees submit to the NRC for approval both the revised methods and SBLOCA analysis.

In response to TMI Item II.K.3.30, MYAPCo submitted to the NRC Topical Report YAEC-1300P, "RELAP5YA: A Computer Program for Light Water Reactor System Thermal-Hydraulic Analysis," for review and approval as a licensing method for SBLOCA analysis. OIG found that the code was reviewed by the Reactor System Branch (RSB), NRR, which was assisted by a technical contractor, Idaho National Engineering Laboratory (INEL). The review by INEL was limited to certain aspects.

The NRC and INEL review consisted of an evaluation of the RELAP5YA computer program as well as modifications made by YAEC to the RELAP5/MOD1, the computer program from which the licensing version of RELAP5YA originated. The review was made using the information provided by YAEC in the RELAP5YA code manuals and in the licensee's responses to questions submitted by the NRC to YAEC. NRR maintained that RELAP5YA met the requirements of 10 CFR Section 50.46, Appendix K, and NUREG-0737, TMI Item II.K.3.30. Thus, NRR issued MYAPCo a Safety Evaluation Report (SER), dated January 30, 1989, accepting the RELAP5YA computer program's use in PWR SBLOCA licensing analyses on the basis that the suggested conditions and requirements were followed.

OIG found that MYAPCo did not adhere to the previously stated five conditions of the SER (see page 10). The NRR staff acknowledged to OIG that they did not know MYAPCo was not in compliance with the January 1989 SER until the present allegations were raised in December 1995. The Branch Chief of RSB advised OIG that normally the staff reviewed codes and plant applications together, but did not do so with RELAP5YA. OIG

learned that the staff was not required to review the RELAP5YA code and plant application together, although that had been their established practice. OIG learned that the issuance of an SER and the licensee's subsequent adherence to that SER has always been required by regulation. The NRR staff told OIG that MYAPCo's non-compliance was an aberration, an isolated occurrence. A Branch Chief of NRR advised OIG that when RSB wrote an SER with conditions there was the expectation that the licensee would comply with those conditions. OIG determined that the NRR staff relied on the licensee to follow the SER and its conditions.

### **Closeout of TMI Action Item II.K.3.31**

On May 8, 1989, the NRC Project Manager for Maine Yankee issued a letter to MYAPCo closing out TMI Item II.K.3.31. The former Project Manager who prepared and signed the letter advised OIG that MYAPCo informed him via telephone that RELAP5YA was operational and would be implemented during their Cycle 12 fuel reload. The former Project Manager said he closed out TMI Item II.K.3.31 based upon the information and commitment provided by the licensee and in accordance with NUREG-0737, which required TMI Item II.K.3.31, plant specific analysis be implemented and submitted to the NRC within a year of TMI Item II.K.3.30 being closed.

The former Project Manager advised OIG that proper procedure was followed in closing out TMI Item II.K.3.31. The procedure mandated that project managers consult with the technical staff on anything technical in nature pertaining to their licensees. However, the OIG investigation did not disclose any documentation or testimony confirming the former Project Manager's actions. To the contrary, none of the NRR technical staff interviewed recalled consulting with the former Project Manager on the closeout of TMI Item II.K.3.31.

OIG learned that there was no technical review of the May 8, 1989, letter that closed TMI Item II.K.3.31. Upon review of the May 1989 letter and interviews of the NRR staff, OIG also found the following:

1. The letter did not follow the established practice of communicating with the technical staff for technical resolution. A review of the letter disclosed that neither the Branch Chief of RSB nor the technical staff concurred with the letter or was placed on the distribution list. The NRR staff advised OIG that the apparent lack of technical review and lack of concurrence by the technical staff was a significant indication of the letter's inappropriateness;
2. OIG found that the letter did not follow the established concurrence format of the former Project Manager's office, Project Directorate I-3 (PDI-3). The former Project Director and other Project Managers of PDI-3 advised OIG that procedures dictated that significant correspondence to the licensee should have the concurrence of a senior management official. The former Project Manager concurred for himself and for his supervisor, the Project Director. OIG determined that the Project Director was on official travel during the week of May 8, 1989, and designated a staff member to act in his absence. The former Project Director advised OIG that the former Project Manager who concurred for him most likely was not designated as the acting Project Director;
3. The former Project Manager did not recall discussing the letter with the Project Director or any NRC management official. OIG determined that neither the Project Director nor the RSB Branch Chief was informed of the letter prior to its issuance to the licensee. The Director of the Division of Reactor Projects

advised OIG that the former Project Manager did not have the authority on his own to make judgmental decisions or conclusions to the licensee; and

4. The NRR staff interviewed by OIG, characterized the May 8, 1989, letter as vague and subject to misinterpretation, based on a current review of the letter. An NRR senior management official advised OIG that the letter was not clear and fully informative, and did not clearly articulate the NRC's expectations of the licensee. OIG found that the licensee, in fact, had a different interpretation than the NRR staff of the May 8, 1989, letter. The licensee advised OIG that the letter relieved them of the TMI Item II.K.3.31, plant specific analysis submittal to the NRC. The licensee believed that the May 8, 1989, letter superseded the SER requirements for plant specific submittals.

Based on the several anomalies to the May 8, 1989, letter and testimonial affirmations, OIG also determined that some NRR staff, especially those on the distribution list, had the opportunity to question the contents of the letter. OIG interviewed the NRR staff listed for distribution, who believed that the letter was inappropriate or certain aspects of the letter indicated improprieties. However, OIG found that none of the NRR staff listed for distribution questioned the May 1989 letter until OIG raised the issue during this investigation. The former Project Director of PDI-3 advised OIG that either the NRC was not being meticulous enough at the time or an individual spoke for the NRC, but whatever the reason no one noticed the letter. Some of the NRR staff interviewed stated that although the letter went unnoticed within the NRC, the licensee should have informed the Project Manager of any incorrect or inappropriate statements in the letter.

### **Tracking Licensing Issues**

OIG reviewed the records submitted by MYAPCo and YAEC and the following NRR records: the Project Manager for Maine Yankee's file, which contained most of the correspondence between the NRC and licensee, and other documents that pertained to Maine Yankee licensing issues; the Reactor Systems Branch's (RSB) Maine Yankee file, which contained documents pertaining to some technical issues conducted by the RSB staff; and the TMI Action Plan Implementation Status Report and Database, which was a detailed report of the status of the TMI items implemented at NRC licensed reactors, as of May 19, 1989. Upon its review, OIG found several documents that indicated that TMI Item II.K.3.31 was not appropriately closed for Maine Yankee. In addition, OIG found that the NRR staff had several opportunities to resolve the erroneous closure of TMI Item II.K.3.31.

In April 1989, NRR performed a special review of the TMI Action Plan implementation status at all the licensed reactors in response to a congressional request. As part of the effort, a TMI database was created to document the status of licensee implementation as of May 19, 1989. OIG learned that the NRR Project Managers, technical staff managers and senior officials reviewed the TMI items status and gave their knowledge regarding licensee implementation for each TMI item at each plant. The NRR staff members, who compiled the database and subsequent report to Congress, advised OIG that the database was subjected to several levels of review for accuracy and completeness. These NRR staff members explained to OIG that the controls were established so if a project manager said TMI Item II.K.3.31 was closed there was the opportunity for the technical staff to disagree if they had different information. However, this inquiry disclosed that the mistaken closure of TMI Item II.K.3.31 for Maine Yankee was not discovered by the NRR staff during this review process. One senior NRR staff member stated to OIG that the closing of TMI Item II.K.3.31 for Maine Yankee was wrong, and that somebody in the process should have discovered the mistake.

Upon review of MYAPCo records, OIG found documented conversations between the then NRC Project Manager and MYAPCo Licensing staff. These discussions occurred between September and December 1989, after the NRC's May 1989 close out TMI Item II.K.3.31. OIG determined that MYAPCo made certain licensing commitments, such as the use of RELAP5YA to develop their Cycle 12 fuel reload, during their discussions with the Project Manager. However, OIG learned that MYAPCo did not use RELAP5YA for its Cycle 12 fuel reload and furthermore, did not use the code until 1994 during Cycle 14.

OIG found that although the Project Manager discussed (September to December 1989) the implementation of TMI Item II.K.3.31 with MYAPCo, he never requested a plant submittal. The Project Manager advised OIG that he expected the licensee to support the commitments discussed with future documentation and/or submittals to the NRC. OIG found that the former Project Manager neither documented his conversations with MYAPCo nor verified that the licensee fulfilled their commitments. The Project Manager said to OIG that the licensee was expected to fulfill and track their commitments to the NRC. OIG learned that the NRR Project Managers did not have a formal system established to track licensing commitments by licensees to the NRC. Further, OIG determined that the lack of a formal licensing commitment tracking system was a major factor in the NRC being unaware of MYAPCo's non-compliance with TMI Item II.K.3.31.

The former Project Manager acknowledged to OIG that it was his responsibility to make sure that the NRC had the analysis so that TMI Item II.K.3.31 could be properly closed. The Project Manager advised OIG that he should have probed deeper into why Maine Yankee had not implemented the RELAP5YA code. Further, the Project Manager recognized that he should have pursued the history of RELAP5YA, such as the SER approving the use of the code, and the requirements to close out TMI Items II.K.3.30 and .31. The Project Manager concluded that the closure of TMI Item II.K.3.31 was perhaps a mistake that he could have caught as well as others within NRR.

OIG's review of the NRR Project Manager's file disclosed that the former Project Managers did not document their conversations with the licensee and/or did not retain their documentation. OIG learned that the former Project Managers both maintained constant contact with the licensee via weekly telephone conversations. However, one former Project Manager stated to OIG that he had a policy of not taking notes and if he did take notes, he would later destroy them. This Project Manager advised OIG that his notes could be subject to subpoena. The other former Project Manager stated to OIG that any documentation of past conversations would not have been retained by him.

## **OIG Observations**

1. The OIG inquiry disclosed that although the NRR staff reviewed the RELAP5YA computer code method, there was weakness in the review process. OIG found that NRR reviewed the RELAP5YA code for Maine Yankee independent of the code plant specific application. Normally the codes and plant specific applications were reviewed together, but not so with the RELAP5YA code for Maine Yankee.
2. OIG determined that the NRR staff was unaware of MYAPCo's non-compliance with five of the SER conditions until December 1995. OIG found that the NRR staff did not follow-up on the SER with MYAPCo after the SER was issued in January 1989.

3. OIG found that the close out of TMI Item II.K.3.31 by the NRC staff was inappropriate. With respect to NRC's May 8, 1989, letter that closed out TMI Item II.K.3.31, OIG determined the following: the former Project Manager, the author of letter, did not follow the established practice of procedure of obtaining NRR technical staff review; the former Project Manager did not follow the established concurrence format of the PDI-3; the former Project Manager apparently made a unilateral decision regarding the closure of TMI Item II.K.3.31; and the former Project Manager was vague and made the close out letter subject to misinterpretation.
4. The OIG inquiry determined that there was a lack of NRR management oversight regarding the May 1989 letter. OIG found that the NRR staff listed for distribution of the May letter had the opportunity to question the letter. OIG disclosed that none of the NRR staff listed for distribution questioned the letter or the close out of TMI Item II.K.3.31.
5. OIG determined that the close out of TMI Item II.K.3.31 was overlooked by the staff. OIG learned that a review of the TMI Items status was conducted by NRR during 1989. The inquiry found that the NRR Project Managers, technical staff managers and senior officials had several opportunities to identify and resolve the erroneous closure of TMI Item II.K.3.31.
6. OIG learned that the NRR Project Managers had several conversations with the licensee in which the licensee made commitments with respect to the small break loss-of-coolant accident (SBLOCA) analysis. OIG found that the NRR Project Managers did not follow-up on the licensee's commitments.
7. OIG also found that NRR staff did not have and presently does not have a formal licensing commitment tracking system. OIG determined that the lack of a formal licensing commitment tracking system was a contributing factor to the NRC being unaware of MYAPCo's non-compliance with the SER and TMI Item II.K.3.31.
8. OIG found that NRR did not have a policy on Project Managers documenting and retaining their documentation of conversations with licensees. One former Project Manager stated to OIG that he had a policy of not taking notes and if he did take notes, he would later destroy them. Another former Project Manager stated to OIG that any documentation of past conversations with the licensee would not have been retained by him. OIG found that the Project Managers' lack of documentation has placed the agency in a position of having to rely on the licensee's documentation when inquiring into past events.
9. The OIG inquiry determined that the theme of NRR's reliance on the licensee resounded throughout this investigation. OIG revealed several examples where the NRR staff relied on MYAPCo to follow the NRC requirements and regulations, however, MYAPCo did not adhere to NRC requirements and regulations.

During this inquiry OIG developed information regarding the allegations against MYAPCo and YAEC. The OIG inquiry did not attempt to investigate the activities of MYAPCo and YAEC. Such an investigation will be conducted by the NRC Office of Investigations. However, based on interviews of MYAPCo and YAEC, and reviews of SBLOCA analysis documents provided by YAEC, OIG uncovered significant indications of possible licensee violations of NRC requirements and regulations.

The OIG developed evidence that neither MYAPCo nor YAEC reported the modifications and changes to the RELAP5YA computer code and oscillatory problems experienced with the code during the 1989 to 1993 period. As required under 10 CFR Section 50.46, MYAPCo should have reported the modifications and changes, and problems with the code to the NRC, especially when the code experienced PCTs greater than 2200°. Further, OIG determined that MYAPCo and YAEC had been experiencing difficulties with the application of RELAP5YA which partially contributed to the code not being implemented for Cycle 12. As stated in the NRC May 8, 1989, letter, MYAPCo committed to using RELAP5YA to develop its Cycle 12 fuel reload, however, RELAP5YA was not fully implemented until Cycle 14. OIG found that MYAPCo may not have satisfied the requirements of NUREG-0737, TMI Item II.K.3.31. NUREG-0737 required that within a year of TMI Item II.K.3.30 being closed (January 30, 1989), TMI Item II.K.3.31, plant specific analysis must be implemented at the plant and submitted to the NRC.

In addition, OIG developed evidence to indicate that MYAPCo did not submit the RELAP5YA plant specific analysis to the NRC to support compliance with TMI Item II.K.3.31. MYAPCo and YAEC stated to OIG that the NRC's May 1989 letter closing out TMI Item II.K.3.31 required MYAPCo to retain the analysis at the site for possible inspection by the NRC. OIG found that submittals were required as conditions specified in the SER for RELAP5YA as well as the submittal required in TMI Item II.K.3.31. MYAPCo and YAEC believed that the NRC's May 1989 letter superseded the provisions in the SER requiring a submittal. In the NRC staff's opinion, the May 1989 letter could not supersede the SER and its conditions.

## LIST OF ACRONYMS

ACRS	Advisory Committee on Reactor Safety
BE	Best Estimate method
CE	Combustion Engineering
CFR	Code of Federal Regulations
CPAR	Core Performance Analysis Report
DFI	Demand For Information
ECCS	Emergency Core Cooling System
EM	Evaluation Model method
INEL	Idaho National Engineering Laboratory
LBLOCA	Large Break Loss-of-Coolant Accident
LOCA	Loss-of-Coolant Accident
MYAPCo	Maine Yankee Atomic Power Company
MWt	Mega-Watt Thermal power
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
OI	Office of Investigations
OIG	Office of the Inspector General
PCT	Peak Cladding Temperature
PDI-3	Project Directorate I-3
PSIG	Per Square Inch Gauge
PWR	Pressurized-Water Reactor

RSB	Reactor Systems Branch
SBLOCA	Small Break Loss-of-Coolant Accident
SER	Safety Evaluation Report
TER	Technical Evaluation Report
TMI	Three Mile Island Plant
YAEC	Yankee Atomic Electric Company

## GLOSSARY OF TECHNICAL TERMS

Emergency Core Cooling System - a safety system that prevents the fuel in a nuclear reactor from melting should a sudden loss of normal coolant occur.

Fuel Cycle - the sequence of steps involved in supplying, using reprocessing, and disposing of the fuel used in nuclear reactors.

Light Water Reactor - the most widely used reactor type in the world in which ordinary water is the moderator and coolant.

Limiting Transient - the limiting transient for the loss of coolant accidents analyzed with an evaluation model is the accident sequence, which combines break size, location, and single failure assumption, such that the worst consequences or highest peak cladding temperature result.

Loss-of-Coolant Accident - a reactor accident that results in a loss of the primary coolant, usually water, from the core.

Megawatt (t) - a standard measure of electrical capacity: one megawatt equals one million watts or a thousand kilowatts. The (t) stands for thermal heat.

Peak Cladding Temperature - is the highest temperature in the fuel cladding within the reactor core experienced during a loss-of-coolant accident.

Pressurized Water Reactor - a light water reactor in which the water used as a moderator is kept under pressure, preventing it from boiling at normal temperatures.

RELAP5YA - is a computer program developed by Yankee Atomic Electric Company for analyses of thermal-hydraulic responses of the light-water reactor system of transient events and accidents, such as a loss of coolant accident.

Safety Evaluation Report - an NRC staff report that summarizes results of the NRC review regarding the anticipated effects of proposed facilities on public health and safety. It is prepared when the NRC is satisfied that the acceptance criteria have been met of the applicant's preliminary report.

Small Break Loss-of-Coolant Accident - a small break loss-of-coolant (LOCA) is a class of LOCA with smaller break sizes, normally less than one square foot, where there is no clearly distinguishable phases of blowdown, refill, and reflood like that experienced in a large break LOCA.

TMI Accident - a reference to Three Mile Island or TMI usually means the accident that occurred on March 28, 1979, at Metropolitan Edison Company's Unit Two located on an island in the middle of the Susquehanna River near Harrisburg, Pennsylvania. TMI was the most serious nuclear accident to occur in the history of the U.S. civilian nuclear reactor program and it had an impact on virtually every NRC action since it occurred.