

UNION OF CONCERNED SCIENTISTS

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Chairman Shirley Ann Jackson
United States Nuclear Regulatory Commission
Washington, DC 20555-0001

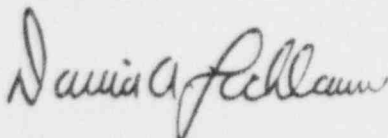
Dear Chairman Jackson:

The Union of Concerned Scientists reviewed the October 1996 report on the Independent Safety Assessment of Maine Yankee Atomic Power Company and have technical comments (enclosed). We respectfully direct the NRC's attention to the following points:

- 1) Three of the ISAT's findings, involving emergency diesel generator loading, offsite power sources, and component cooling water capability, challenge safe operation of Maine Yankee even at its presently authorized power level. It is imperative that these technical issues be promptly resolved.
- 2) The ISAT determined that the root causes for the problems were attributable to economic pressure to contain costs and the lack of a questioning attitude by the utility staff. The ISAT reported a backlog of several thousand unresolved items. There may be unresolved items with safety significance in this backlog, but the ISAT report indicates that Maine Yankee may lack the resources to properly manage this backlog.
- 3) The ISAT determined that several design bases issues prevented the team from justifying safe operation of the plant above the originally licensed power level of 2,440 Mwt, yet the team did not address the safety implications from Maine Yankee routinely operating above this power level since June of 1978. These issues represent the very real potential that Maine Yankee would have been unable to mitigate an accident without incurring significant adverse public safety consequences.

The fact that Maine Yankee operated for 17½ years at power levels with eroded margins demonstrates that this utility failed to fulfill the legal obligations that accompanied its license and that the NRC's regulatory oversight failed to provide adequate protection of public health and safety. Substantive corrective measures by both the utility and the NRC are essential if the people of Maine are to be adequately protected in the future.

Sincerely,



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Technical Comments on Maine Yankee's Independent Safety Assessment

BACKGROUND

In December 1995, the Union of Concerned Scientists (UCS) submitted allegations it had received from an anonymous source to state officials in Maine who forwarded the allegations to the Nuclear Regulatory Commission (NRC). The allegations were that Yankee Atomic Electric Company knowingly performed inadequate analyses to support increasing the thermal power level at which the Maine Yankee Atomic Power Station (MYAPS) is licensed by the NRC to operate. After conducting a technical review of the allegations, the NRC's Office of Nuclear Reactor Regulation issued a confirmatory order on January 3, 1996, limiting operation at MYAPS to the originally licensed power level of 2,440 Mwt.¹

The Nuclear Regulatory Commission (then called the Atomic Energy Commission) issued a license on September 15, 1972, for MYAPS to operate at a maximum thermal power output of 2,440 Mwt (~810 Mwe). The licensed power level of MYAPS was increased to 2,630 Mwt (~875 Mwe) on June 20, 1978, when the NRC approved Maine Yankee's license amendment request. The NRC approved Maine Yankee's request for a thermal power increase to 2,700 Mwt (~890 Mwe) on June 10, 1989.²

In the spring of 1996, the NRC's Office of the Inspector General (OIG) conducted an investigation into the allegations of wrongdoing involving the Maine Yankee power uprate submittal. The OIG determined that the NRC was unaware of MYAPS's non-compliance with certain conditions established in the NRC's approval of the power uprate license amendment request in 1989. The OIG reported that the NRC staff did not have a formal tracking system for commitments made by their licensees or imposed upon licensees by the staff, but rather relied on the licensees to satisfy regulatory obligations.³

Following the OIG findings, NRC Chairman Shirley Ann Jackson directed the NRC staff to conduct an independent evaluation of the Maine Yankee Atomic Power Station to determine whether the facility conformed with its design and licensing bases. An Independent Safety Assessment (ISA) Team of 25 members, including three representatives of the State of Maine, performed the evaluation. The ISA team members had no previous, substantive involvement in Maine Yankee's licensing activities.⁴

¹ Edward L. Jordan, United States Nuclear Regulatory Commission, "Independent Safety Assessment of Maine Yankee Atomic Power Company," October 1996.

² Memo from Leo J. Norton, NRC Acting Inspector General, to NRC Chairman Jackson, NRC Commissioner Rogers, and NRC Commissioner Dicus, "Event Inquiry - Maine Yankee Power Station (Case No. 96-04S)," May 8, 1996.

³ Memo from Leo J. Norton, NRC Acting Inspector General, to NRC Chairman Jackson, NRC Commissioner Rogers, and NRC Commissioner Dicus, "Event Inquiry - Maine Yankee Power Station (Case No. 96-04S)," May 8, 1996.

⁴ Letter from NRC Chairman Shirley Ann Jackson, to Mr. Charles D. Frizzle, President - Maine Yankee Atomic Power Company, October 7, 1996.

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The ISA team concluded that Maine Yankee was in general conformance with its licensing bases although the team's findings contained the conspicuous caveat that significant items of non-conformance were identified. The ISA team determined that *"Despite uncorrected and previously undiscovered design problems, the design-basis and compensatory measures adequately supported plant operation at a power level of 2440 Mwt. However, the team could not conclude, and the licensee did not demonstrate, that at a power of 2700 Mwt the design-basis assured adequate NPSH for the containment spray pumps and the heat removal capability of the component cooling water system in the event of a loss-of-coolant accident."*⁵

The Union of Concerned Scientists performed a technical review of the ISA Report on Maine Yankee and noted:

- 1) Three of the ISA Team's findings, involving emergency diesel generator loading, offsite power sources, and component cooling water capability, challenge safe operation of Maine Yankee even at its presently authorized power level.
- 2) The ISA team determined that several design bases issues prevented the team from justifying safe operation of the plant above 2,440 Mwt, yet the team did not address the safety implications from Maine Yankee routinely operating above this power level since June of 1978. The breadth and number of these issues represent the very real potential that the facility would have been unable to mitigate a design bases accident without incurring significant adverse public safety consequences. UCS strongly recommends that a significant civil penalty be imposed in this case to send a clear message that violations of federal regulations that place public health and safety in jeopardy will not be tolerated.
- 3) The fact that Maine Yankee operated for 17½ years at power levels with *"eroded margins"*⁶ demonstrates that this utility failed to fulfill the legal and ethical obligations that accompanied its license and that the NRC's regulatory oversight provided inadequate protection of public health and safety.

⁵ Edward L. Jordan, United States Nuclear Regulatory Commission, "Independent Safety Assessment of Maine Yankee Atomic Power Company," October 1996.

⁶ Transcript of Public Meeting, "Briefing On Integrated Safety Assessment Team Inspection (ISAT) At Maine Yankee," October 18, 1996.

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DISCUSSION

The NRC's Independent Safety Assessment (ISA) Team was a large, multi-disciplined team that investigated a wide range of plant activities (i.e., engineering, maintenance, operations) in considerable depth. The ISA team evaluated previously known design bases issues and discovered several previously unidentified issues that it documented in a report released in October of 1996.⁷

The ISA team documented numerous problems that justified restricting Maine Yankee to its originally licensed power level. Some of these problems are summarized below:

High Pressure Safety Injection (HPSI) System

Three separate, unrelated problems challenged the ability of the HPSI system to fulfill its safety function of providing cooling water to the reactor core following a design bases accident. Due to 5 feet of missing wire, HPSI pump P-14A would not have automatically started after a loss of coolant accident (LOCA) with offsite power available. This pump was assumed in plant safety analyses to start automatically start. The duration that this wiring error existed is not known because the HPSI pump start circuitry had been incompletely tested for years.

The ISA team also determined the containment spray system's capability to provide a reliable supply of water to the HPSI pumps following a LOCA had not been adequately demonstrated for plant operation at power levels above 2,440 Mwt due to the potential for pump cavitation. For additional information on this finding, see the section below on the containment spray system.

In addition, the ISA team determined that the HPSI pumps needed to operate beyond their design conditions to fulfill their safety function after a LOCA. The Maine Yankee staff had accepted this undesirable situation on the basis of testing that indicated cavitation and very little margin. The ISA team indicated that Maine Yankee planned a future test of the HPSI pumps to fully demonstrate the available margin.

Maine Yankee personnel determined that the wiring error preventing automatic HPSI pump initiation by itself increased Maine Yankee's core damage frequency by approximately six percent. The increased core damage frequency from the other two HPSI problems was not specified in the ISA report, but probably would have been greater than six percent.

Containment Spray (CS) System

The ISA team questioned the containment spray system's capability to provide a reliable supply of water to the HPSI system during the recirculation phase of a LOCA from power levels above 2,440 Mwt. The team was expressly concerned about CS pump cavitation. Cavitation occurs when entrained air or vapor bubbles pass through an operating pump. A

⁷ United States Nuclear Regulatory Commission, "Independent Safety Assessment Of Maine Yankee Atomic Power Company," October 1996.

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cavitating pump experiences higher vibration levels that can ultimately disable it. The team's evaluation of Maine Yankee's CS pump performance calculations reported that a water temperature change of only a few degrees would mean the difference between acceptable and unacceptable results. According to the ISA team, these calculations have an unknown degree of uncertainty for this application and therefore cannot be relied upon to demonstrate pump operability above 2,440 Mwt.

Following the ISA, Maine Yankee conducted additional analysis of the CS system to support plant operation at power levels up to 2,440 Mwt. After reviewing this supplemental information, the ISA team concluded that the CS pumps would be operable at power levels up to 2,440 Mwt. Maine Yankee routinely operated at power levels greater than 2,440 Mwt and up to 2,700 Mwt for 17½ years between June 1978 and January 1996. Nothing in the ISA report states or implies that the CS pumps would have fulfilled their safety function during that period.

Component Cooling Water (CCW) Systems

The ISA team reported that calculations for the component cooling water (CCW) systems showed essentially no margin at the presently authorized power level of 2,440 Mwt. The CCW system performs the essential function of removing decay heat and heat generated by emergency equipment following a design bases accident. The ISA team was unable to conclude, and Maine Yankee personnel could not demonstrate, this system would perform adequately under design bases accident conditions originating from power levels above 2,440 Mwt. Maine Yankee routinely operated at power levels greater than 2,440 Mwt and up to 2,700 Mwt for 17½ years between June 1978 and January 1996. The report indicated that this system may not have fulfilled its safety function during that period.

Equipment Qualification (EQ)

The ISA team determined that Maine Yankee did not conform with the federally mandated requirements for equipment qualification because certain safety related electrical components were not qualified for the expected environment following a design basis event. In July 1996, Maine Yankee personnel identified 30 components installed below the maximum submergence level inside the reactor containment. Simply put, these electrical components would be under water following a design bases accident. Maine Yankee's EQ submittal dated October 31, 1980, and the NRC's associated safety evaluation report dated June 1, 1981, identified seven plant components that were below the submergence level that needed to be removed or replaced in order to meet the EQ requirements. Several of components identified as deficient in July 1996 were the same components that were identified by both Maine Yankee and the NRC over 15 years earlier as being deficient. The unqualified components could have prevented safety functions from being fulfilled following a design bases accident whether Maine Yankee was operating above or below 2,440 Mwt.

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Instrumentation

The ISA team reported that the instrumentation used by the control room operators to control and monitor emergency feedwater flow may not have been available under design basis conditions. Inadequate emergency feedwater flow was a contributing factor in the Three Mile Island accident in March 1979.

Spray Building Ventilation System

The ISA team determined that there was a reasonable potential for the pneumatic dampers for the spray building ventilation system's exhaust fans to close under accident conditions, rendering this ventilation system inoperable. This ventilation system provides essential cooling for emergency equipment in the building. Maine Yankee personnel responded to this finding by blocking the dampers in the open position to ensure sufficient ventilation.

Maine Yankee personnel informed the ISA team that the vulnerability of these dampers had been raised in an internal memorandum dated February 20, 1991. This memorandum contained a specific recommendation to block open the dampers because, *"If the controller fails, it could cause the inlet vanes for both fans to close, causing a reduction in the output of the system."*^{*}

The damper problem, whose adverse consequences were clearly understood by Maine Yankee personnel for at least five years, would have prevented the spray building ventilation system from fulfilling its safety function.

In addition to the aforementioned problems that prevent Maine Yankee from safely operating above 2,440 Mwt, the ISA team identified problems that challenge safe operation even at its presently authorized power level. These problems are summarized as follows:

Emergency Diesel Generator (EDG) Loading

The ISA team identified several omissions and non-conservatism in Maine Yankee's calculation for emergency diesel generator (EDG) loading. The purpose of the loading calculation is to confirm that the generating capacity of the EDG exceeds the total power requirements of the electrical equipment it supplies. In response to the ISA team's findings, the preliminary revision to the loading calculation showed the worst-case loading on EDG-1B increased to just 0.28% below the EDG rating limit.

The ISA team also reported that when the ambient air temperature exceeded 90°F following a design bases accident, cooling limitations on the emergency diesel generator would require a derating of its electrical output. Since the revised loading calculation provides merely 0.28% margin for derating the EDG's electrical output, it is not apparent that the EDG can supply all required loads under design bases conditions even at the presently authorized power level.

^{*} United States Nuclear Regulatory Commission, "Independent Safety Assessment Of Maine Yankee Atomic Power Company," October 1996.

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Offsite Power Sources

The ISA team concluded that the configuration of the 115 kV offsite power sources for Maine Yankee conflicted with the design and licensing bases presented in the FSAR which stated that either of the 115 kV lines was independently capable of supplying the plant auxiliary power system. This requirement is intended to supply plant equipment with highly reliable power through redundant, independent sources. Safety studies have shown that loss of offsite power is a significant contributor to plants' overall core damage risk. The ISA team did not agree with Maine Yankee's contention that the 345 kV system back-feed operation, even if completed within six hours, was an acceptable basis for compliance with the licensing basis as stated in the FSAR.

The ISA team concluded the offsite power source discrepancy had low safety significance based on the historical stability of the electric power grid, the existence of two independent reserve power transformers, and the limited conditions under which one 115 kV line would be unavailable. The ISA team relied on its informal risk assessment to discount the safety significance of Maine Yankee's failure to comply with this design and licensing bases requirement. The ISA team's conclusion on this issue conflicts with NRC policy regarding risk assessment which states "*...existing rules and regulations shall be complied with unless these rules and regulations are revised.*"⁹

Nothing in the ISA report states or implies that the risk perspective of this offsite power source deficiency was formally analyzed. Although UCS has not yet reviewed Maine Yankee's Individual Plant Examination (IPE), based on familiarity with other IPEs we expect that the Maine Yankee IPE probably assumes that either of the two 115 kV lines can supply the plant auxiliary power system. The IPE should reflect the installed configuration and determine the risk appropriately.

Component Cooling Water (CCW) System

The ISA team reported that if the valves on the bypass lines around the CCW heat exchangers did not close during a design bases event, the heat transfer capability of the heat exchangers would be significantly degraded. The CCW system performs the essential function of removing decay heat and heat generated by emergency equipment following design bases accidents. With the bypass valves not fully closed, some water would be routed around the heat exchangers instead of passing through the heat exchangers. If CCW system performance is significantly degraded, the operation of the emergency equipment it cools could be adversely affected.

In 1995, Maine Yankee personnel discovered that one of the CCW heat exchanger bypass valves remained partially open following attempts to close it. In addition, the ISA team found no calibration procedures existed for the bypass valves, the controllers for the bypass valves

⁹ Nuclear Regulatory Commission, Final Policy Statement, "Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities," August 10, 1995.

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were not of the "fail safe" design, no procedures were located that tested the ability of these valves to perform their safety related function, and the maintenance history of these valves identified 11 completed maintenance work orders for these valves in the last five years.

As discussed earlier, the analyzed CCW system performance with the heat exchanger bypass valves closed indicates little margin available for a power level of 2,440 Mwt and eroded margin at power levels above 2,440 Mwt. If the heat exchanger bypass valves fail to close as required during design bases events, the CCW system cannot fulfill its required safety function even at 2,440 Mwt. Plant operating experience and ISA team findings provide little assurance that the CCW bypass valves will function as required. The bypass valves must be blocked closed until their performance under all design conditions is assured.

In addition to the specific problems discussed above, the ISA team also reported that the backlog of corrective actions at Maine Yankee was relatively large and increasing. According to the ISA report, there were approximately 1,000 issues identified in the major tracking systems and approximately 2,200 items in the minor tracking systems. The average age of the items was stated as 8 to 9 months, with some items being unresolved for a decade. The impact on nuclear safety from such a huge backlog of items cannot be quantified. Plant safety analyses assume that all equipment, except in specific cases where single failures are postulated, operates at design capability. The magnitude of the affect on these plant safety analyses of many minor discrepancies and variations is uncertain, but potential impact is unquestionably to erode rather than increase safety margins..

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CONCLUSIONS

The Independent Safety Assessment (ISA) report on the Maine Yankee Atomic Power Station documented three technical deficiencies that challenge nuclear safety margins at the presently authorized power level:

- The emergency diesel generator loading must be reconciled against cooling limitations that require the emergency diesel generator output to be derated. The revised loading calculation indicates emergency diesel generating loading margin of only 0.28% without accounting for any derating. Therefore, the emergency diesel generators may not have sufficient capacity to power essential equipment under all design bases accident conditions. **The extent of the potential emergency diesel generator derating problem identified by the ISA team must be quantified or plant operation when ambient temperatures exceed 90°F prohibited.**
- The Maine Yankee Individual Plant Examination (IPE) must be updated to reflect the actual offsite power configuration since it differs from that configuration described in the Final Safety Analysis Report. The two 115 kV lines are not fully redundant as is probably assumed in the Individual Plant Examination. **The IPE must be revised to reflect the installed configuration and determine the safety risk appropriately.**
- The ability of the component cooling water system bypass valves to close under all design bases conditions must be confirmed. Plant operating experience and ISA team findings provide little assurance that these bypass valves will function as required. Therefore, emergency equipment may fail due to inadequate cooling during design bases accidents. **The bypass valves must be blocked closed until their performance under all design conditions is assured.**

The ISA report concludes that the plant's design and analyses support operation up to a power level of 2,440 Mwt. The allegations which triggered the sequence of events that culminated in the ISA had only contended that the analyses in support of the requested power uprate from 2,630 Mwt to 2,700 Mwt were flawed; the ISA team was unable to find engineering justification to support plant operation above the initially licensed power level of 2,440 Mwt. Therefore, the ISA team implicitly validated the allegations made in December 1995.

NRC Commissioner Gail Dicus stated, *"if we [the NRC] had not had the allegation, from my view, and then responded to it, we wouldn't be sitting here today with this plant, and that is a concern."*¹⁰ The Union of Concerned Scientists concurs with the Commissioner's assessment with its implication that the nuclear industry is not conforming with safety regulations and that the NRC's oversight is deficient. **It is imperative that the nuclear industry and the NRC develop meaningful mechanisms for monitoring nuclear safety margins, particularly with the increased economic pressure resulting from utility restructuring/deregulation activities.**

¹⁰ Transcript of Public Meeting, "Briefing On Integrated Safety Assessment Team Inspection (ISAT) At Maine Yankee," October 18, 1996.

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Not once in its 75 page report does the ISA team discuss the safety implications of Maine Yankee operating above the 2,440 Mwt power level which the team specifies as the maximum justifiable design condition, even though the facility routinely operated at power levels between 2,440 Mwt and 2,700 Mwt for 17½ years between June 1978 and January 1996. The NRC must address the safety implications of Maine Yankee operating between June 1978 and January 1996 at power levels in excess of 2,440 Mwt. A significant civil penalty should be imposed if it is substantiated that this facility did not have adequate safety margins when operating at power levels up to 2,700 Mwt.

The ISA report documents several instances of Maine Yankee personnel failing to correct safety deficiencies that were known, or should have been known, for years. The NRC issued Maine Yankee its operating license on September 15, 1972. Along with authorization to operate, the license carried with it an obligation to conform with federally mandated safety regulations. That obligation was clearly not honored. In addition to ensuring the technical deficiencies are corrected, the NRC must require substantive assurance that Maine Yankee personnel understand, accept and honor the obligation that comes with an operating license.

The ISA report described a backlog of several thousand items requiring resolution and identified a primary root cause as economic pressure. In responding to the recent NRC letter concerning design and licensing bases adequacy,¹¹ Maine Yankee personnel must describe the evaluations performed of this backlog that provide reasonable assurance that there are no remaining safety significant items and must address the measures instituted to prevent recurrence of eroded nuclear safety margins.

The intent of the design and licensing bases requirements is to implement a defense-in-depth approach to managing the risk from nuclear power plant operation. Maine Yankee's operation outside its design and licensing bases corrupted these defense-in-depth principles, potentially eliminating one or more of the required safety barriers. It is extremely fortunate that Maine Yankee did not experience a reactor accident during this prolonged period of operation outside its design and licensing bases. From a nuclear safety perspective, luck is an unreliable barrier that must not be accepted as a substitute for conformance with federally mandated safety regulations.

¹¹ James M. Taylor, NRC Executive Director for Operations, to Mr. Charles D. Frizzle, President, Maine Yankee Atomic Power Company, "Request for Information Pursuant to 10 CFR 50.54(f) Regarding Adequacy and Availability of Design Bases Information," October 9, 1996.