



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

UNITED STATES NUCLEAR REGULATORY COMMISSION

In the Matter of )  
Metropolitan Edison Company ) Docket No. 50-289  
(Three Mile Island Nuclear )  
Station, Unit 1 Restart) )

NRC STAFF TESTIMONY OF LAURENCE E. PHILLIPS  
REGARDING REACTOR WATER LEVEL INSTRUMENTATION  
(UCS Contention 7, Sholly Contention 6(b) and  
ANGRY Contention 5(b))

- Q.1. Please state your name and position with the NRC.
- A. My name is Laurence E. Phillips. My position is Section Leader, of the Thermal-Hydraulics Section, Core Performance Branch, Division of Systems Integration, Office of Nuclear Reactor Regulatory.
- Q.2. Have you prepared a statement of professional qualifications?
- A. Yes, a copy of this statement is attached to this testimony.
- Q.3. Please state the nature of the responsibilities that you have with respect to the Three Mile Island Nuclear Station, Unit 1.
- A. I am responsible for managing the review of licensee responses to the requirements of TMI Task Action Plan II.F.2 in particular and Inadequate Core Cooling requirements in general.
- Q.4. What is the purpose of your testimony?
- A. The purpose of this testimony is to respond to three similar contentions; UCS contention 7, Sholly Contention 6(b), and Angry Contention 5(b)

UCS Contention 7 reads as follows:

"NRC regulations require instrumentation to monitor variables as appropriate to ensure adequate safety (GDC 13) and that the instrumentation shall directly measure the desired variable.

IEEE 279, §4.8, as incorporated in 10 CFR 50.55a(h), states that:

To the extent feasible and practical protection system inputs shall be derived from signals which are direct measures of the desired variables.

TMI-1 has no capability to directly measure the water level in the fuel assemblies. The absence of such instrumentation delayed recognition of a low water level condition in the reactor for a long period of time. Nothing proposed by the staff would require a direct measure of water level or provide an equivalent level of protection. The absence of such instrumentation poses a threat to public health and safety."

Sholly Contention 6(b) reads as follows:

"The Commission's Order and Notice of Hearing dated 9 August 1979 are insufficient to provide the requisite reasonable assurance of operation without endangering public health and safety because these short-term actions do not include the following items:

- b. Completion of installation of instrumentation for detection of inadequate core cooling:"

Angry Contention 5(b) reads as follows:

"The NRC Order fails to require as conditions for restart the following modifications in the design of the TMI-1 reactor

without which there can be no reasonable assurance that TMI-1 can be operated without endangering the public health and safety:

- (b) Installation of instrumentation providing reactor operators direct information as to the level of primary coolant in the reactor core."

Q.5. What may cause inadequate core cooling?

A. A small break LOCA. However, our objective is to detect the symptoms of inadequate core cooling and to initiate and monitor the progress of corrective action independent of the cause of the condition and of other preceding actions which should have precluded the ICC condition.

These contentions allege that until the instrumentation to detect inadequate core cooling includes a means for direct measurement of core water level, it will not be safe to allow TMI-1 to restart.

Q.6. What is the relationship between the reactor water level and the inadequate core cooling?

A. As long as the reactor is shut down and the two phase froth level is above the top of the core, cooling is adequate. When the two-phase froth level begins to drop below the top of the core, the exposed fuel begins to heat up and will ultimately reach temperatures where fuel damage occurs. This is inadequate core cooling.

Q.7. What conditions must be monitored to provide a direct indication of inadequate core cooling?

- A. Fuel temperature or surface temperature of the fuel cladding and the two phase froth level.
- Q.8. Why isn't instrumentation to directly measure these variables required?
- A. There are serious questions concerning the technical feasibility and the reliability of techniques for continuous direct measurement of these variables in commercial PWR cores. In addition, there are other indirect indicators (e.g., core exit thermocouples) of inadequate core cooling and of conditions which could lead to inadequate core cooling (e.g., saturation meters) which can be monitored more reliably and can provide equivalent information to the operator if properly processed for display and incorporation into emergency procedures. Core exit thermocouples provide an indication of the magnitude of steam superheat when the core is uncovered and also provide indication that the core is covered when no superheat exists.
- Q.9. Does the absence of direct water level measurement instrumentation conflict with GDC 13 and 10 CFR 50.55a(h) of NRC regulations as inferred by UCS Contention 7?
- A. GDC 13 states: "Instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to assure adequate safety, including those variables and systems that can affect the fission process, the integrity of the reactor core, the reactor coolant pressure boundary, and the containment and its associated systems. Appropriate controls shall be provided to maintain these variables and systems within prescribed operating ranges."

For TMI-1 and other PWRs, the normal water level range in the reactor coolant system is within the pressurizer and is maintained by the pressurizer level control system. For transient and accident conditions resulting in low coolant inventory, the high pressure and low pressure safety injection systems are initiated on low pressure signal to reflood the primary system. Reactor vessel water level is not an appropriate input to the safety injection system since the corrective action is initiated by a low pressure signal well in advance of core uncover.

The regulation 10 CFR 55a(h) is applicable only to construction permits issued after January 1, 1971. The TMI-1 construction permit was issued in 1968. Additionally, reactor water level instrumentation, if installed, will be used for monitoring and operator actions only and will not provide input to protection systems. 10 CFR 55a(h) applies only to protection systems.

- Q.10. What instrumentation is currently available at TMI-1 to indicate inadequate core cooling?
- A. The instrumentation available at TMI-1 that could indicate inadequate core cooling includes core exit thermocouples sensors, reactor coolant pressure sensors, cold leg and hot leg resistance temperature detectors (TRDs), in-core neutron detectors, ex-core neutron detectors, and reactor coolant pump current, and subcooling meters.
- A.11. Have emergency procedures for response to inadequate core cooling in TMI-1 using existing instrumentation systems been approved by the staff?

A. The licensee has submitted emergency procedures for inadequate core cooling (EP 1202-39 and 1202-6B), which rely on the information available from the core exit thermocouples, reactor coolant system temperature, and the new saturation (subcooling) meters to identify the approach and existence of inadequate core cooling and to specify the operator actions required to prevent or recover from inadequate core cooling. These procedures are under review by the staff and revised submittals have been requested from the licensee. Although we have not completed our review at this time, we are confident that procedures acceptable for TMI-1 restart can be developed which rely on the indicated process information from the existing instrumentation upgraded to a level acceptable to the staff. The staff has found ICC emergency procedures based on similar instrumentation to be acceptable for other PWRs. We will keep the Board apprised of our progress in the development of acceptable procedures for TMI-1 restart.

Q.12. How are the existing instrumentation systems at TMI-1 being upgraded to accomplish the inadequate core cooling response objectives?

A. Prior to restart of TMI-1, we will require an upgrading of those existing instrumentation systems, information displays, and operating procedures which relate to the detection and response to inadequate core cooling conditions. These modifications in conjunction with improved operator training will substantially enhance the capability of the operator to recognize and respond to conditions of inadequate core cooling.

The licensee has committed to install a primary coolant saturation meter which will be required to implement some of the emergency procedures. The licensee had also described two short-term modifications to existing instruments to satisfy the NUREG-0578 (TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations, July 1979) requirements. These changes involve routing the in-core thermocouple signals outside of containment and connecting the 52 in-core thermocouples to the plant computer (for display purposes) and providing an extended range for reactor outlet ( $T_H$ ) temperature measurement (from 520° - 620°F to 120° - 920°F). The signals from 52 T/Cs will be connected to the computer and will also be used as inputs to the saturation temperature instrument. This modification will be made to four  $T_H$  channels, two in each reactor coolant loop. In addition, it is intended to isolate the new wide range T signal from the existing control signals. These signals will then be seismic Category I and separated for use as redundant signals. It is anticipated that all modifications required for existing instrumentation will be resolved and implemented prior to TMI-1 restart.

Q.13. What are the design criteria for instrumentation for detection of inadequate core cooling? Will the TMI-1 instrumentation meet these criteria prior to restart?

A. All instrumentation in the final inadequate core cooling monitoring system must be evaluated for conformance to TMI Task Action Plant II.F.2 as clarified in NUREG-0737, November 1980, including Attachment 1 (In-core Thermocouple criteria) and Appendix B, "Design and Qualification Criteria for Accident

Monitoring Instrumentation," of the cited document. Such an evaluation will be required prior to restart and deviations must be justified.

Q.14. What additional instrumentation, if any, will be required for detection of inadequate core cooling for TMI-1. Will any new instrumentation be installed prior to restart?

A. The staff requirements for new instrumentation to detect inadequate core cooling are presented in NUREG-0578 and supporting documents (D. Eisenhut (NRC) letter to All Operating Nuclear Power Plants On "Followup Actions Resulting from the NRC Staff Reviews Regarding the Three Mile Island Unit 2 Accident," dated September 13, 1979; H. Denton (NRC) letter to All Operating Nuclear Power Plants on "Discussion of Lessons Learned Short-Term Requirements," dated October 30, 1979) and are further clarified in NUREG-0737. These documents state that the licensee shall provide a description of any additional instrumentation or controls proposed for the plant to supplement those devices cited in the preceding section of the requirement (2.1.3.b) which give an unambiguous, easy-to-interpret indication of inadequate core cooling.

The clarification provided with the Denton letter to Operating Nuclear Power Plants specifically states that "The evaluation is to include reactor water level indication." The purpose of the evaluation is to determine the feasibility and practicality of direct water level measurement in the core and to allow the licensee to select the best of several instrumentation concepts and/or data processing schemes, for obtaining a clear indication of inadequate core cooling conditions.



Metropolitan Edison and Babcock & Wilcox have proposed the use of existing instruments (that is, no additional instrumentation) to provide an indication of inadequate core cooling. The basis for this proposal is that there is no need for additional instrumentation, particularly a reactor vessel water level measurement, to determine inadequate core cooling. We have reviewed the justification for no additional instrumentation and have found it unacceptable (D. Eisenhut (NRC) letter to R. Arnold (Met. Ed. Co.) on "Lessons Learned Short-Term Requirements 2.1.3.b "Instrumentation For Detection of Inadequate Core Cooling - Additional Information" dated September 24, 1980).

We will require that Metropolitan Edison provide an acceptable response to the Inadequate Core Cooling requirements, as detailed in our clarification for TMI-2 Task Action Plan II.F.2 (NUREG-0737), by January 1, 1981. Identification of new instrumentation to be installed and the schedule for installation cannot be provided until we review the submittal. Based on the current status of our review, it is likely that a water level measurement system will be required. Installation of such a system prior to TMI-1 restart is a distinct possibility. In the absence of such a system, the NRC staff will assure that the instrumentation and procedures for detection and response to inadequate core cooling conditions are adequate for safe operation.