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November 8, 1985

Dr. T. Huang
Core Performance Branch
Division of Systems Integration
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Dr. Huang:

Attached is our review and status report of one supplementary submittal describing Inadequate Core Cooling Instrumentation. The submittal includes:

38. Maine Yankee

Sincerely,

John L. Anderson

JLA:rlo

Attachment

cc: R. L. Anderson
T. C. Morelock
File-NoRC

B132

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STATUS REVIEW OF

INADEQUATE CORE COOLING INSTRUMENTATION

FOR

MAINE YANKEE ATOMIC POWER PLANT

A meeting was held on July 17, 1985 at Maine Yankee Atomic Power Plant (M-Y) in Wiscasset, Maine to evaluate the status of inadequate core cooling instrumentation required by NUREG-0737 and NRC Generic Letter 82-28. A summary of the reported status is presented below. Additional information was provided by letter MN-85-159, dated September 6, 1985.

PLANT INVENTORY TREND SYSTEM (PITS)

The PITS consists of three differential pressure transmitters calibrated to read in feet of plant elevation. One transmitter, dp T-3001, will measure differential pressure (dp) across the entire primary system from the top of the pressurizer on the static side to an in-core instrument tube located at the bottom of the reactor vessel on the variable side of the transmitter. Dp T-3001 is intended to measure inventory from a full, cold pressurizer to zero inventory above the core support plate. The second transmitter, dp T-3002, will measure dp across the reactor vessel from a reactor head vent line to the same in-core instrument tube as dp T-3001. The third transmitter, dp T-3003, will measure dp from the reactor head vent line to the bottom of the hot leg. At the audit meeting, M-Y indicated plans to modify the design previously described in submittal MN-83-83 dated April 29, 1983. These charges were further described in MN-85-159.

The changes consist of relocating the reference leg tap for transmitter dp T-3003 to a separate reactor vessel penetration, re-routing the reference line through an area separated from the reference lines for the other transmitters and changing the transmitter ranges to 750 inches of water for all three transmitters. The transmitters will be cold calibrated to 768 inches of water. The transmitters will be connected to a single three-pen recorder on the main control board.

Transmitter	Range	Location	Pen	Indication
3001	0-768"	Btm core to top pzr	Blue	0-100%
3002	0-768"	Btm core to top reac ves	Green	0-50%
3003	0-768"	Btm hot leg to top reac ves	Red	25-50%

M-Y claims that the transmitter changes will result in increased overall accuracy of the system to:

Transmitter	Normal/SGTR	Steam line break	D-B accident
3001	±1%	-3 to +7%	-4 to +10%
3002	±1%	-3 to +5%	-4 to +7%
3003	±1%	-2 to +3%	-3 to +5%

The three transmitters are qualified to IEEE 323 1974 qualification standards. While redundant transmitters are not provided at each location, the measurement ranges overlap so that some functional redundancy is achieved when all are working. The outputs are displayed on a single, three-pen, two speed continuous strip chart recorder. Signal processing is used to achieve the desired display ranges. The dp transmitters are cold calibrated and adjusted for a specific gravity difference of 0.8 between the static and variable sensing lines. The transmitters are located within containment and have no temperature compensation for vertical sensing line runs. M-Y plans also to display PITS trend information in the Safety Parameter Display System (SPDS).

The three dp transmitters used cover different level ranges with overlap and are not completely redundant. Separate Class 1E power sources are not used for the three transmitters and wiring and displays are not separated or redundant. M-Y plans to power one transmitter from a different vital bus.

The system, in its present configuration, does not meet the requirements of NUREG-0737, Item II.F.2, Appendix B, and therefore is unacceptable in that regard. M-Y has not provided adequate justification for exemption to the requirements of NUREG-0737.

Changing the transmitter spans is expected to improve the system accuracy from an earlier estimate as high as 19% to approximately 7-10%. However, these estimates do not include the major calibration shift which occurs from the cold calibration condition to normal operating temperatures and pressures. As the impulse lines are not temperature compensated, this shift amounts to about 25% of indication. Hot, full indications are 75%, 43%, and 37% respectively instead of 100%, 50%, and 50% as when cold. This lack of compensation results in a total uncertainty of level interpretation by the operator of as much as 35% which represents more than 20 feet of equivalent level uncertainty. We believe this to be inadequate, even for "trending."

An additional source of inaccuracy apparently has not been considered by M-Y. If voiding occurs in the primary system, it is likely that the impulse lines will be partially drained of fluid. No provisions are made to assure refilling of the impulse lines when the voids are excluded from the system. All other dp systems that we have reviewed which use dp transmitters inside containment, utilize some form of condensate pot or reservoir to assure that the impulse lines are refilled after voiding. Very substantial errors can result from the trapped gas in the impulse lines and potentially at a critical phase of the recovery process from a loss of coolant event. Planned shortening and relocation of the impulse lines should reduce this problem somewhat, but not eliminate it.

The PITS has no provision for indication of system voiding with pumped flow, as required by II.F.2, clarification 4(a). M-Y indicated that their primary coolant pumps are hydrostatically lubricated and would be severely damaged if operated with voids in the system. Present procedures call for the pumps to be tripped if subcooling margin is less than 25 degrees subcooled.

MYAPCO is currently in the process of revising their Emergency Operating Procedures for Maine Yankee Atomic Power Plant. The Writers Guide has been submitted to the NRC staff for review. In no case will the operator be dependent upon a PITS reading alone for action.

MYAPCOs states that PITS indication is not used as a pump trip criterion and its placement was not a concern in the control room design review. Human factor modifications underway during the current refueling outage will place a saturation monitor display near the RCP controls.

SUBCOOLING MARGIN MONITOR (SMM)

The SMM installed at Maine Yankee consists of three calculators (core region, head region, and steam generator) with two primary system pressure inputs, two reactor head RTD inputs, eight core exit thermocouple inputs and three steam generator pressure inputs. All three calculators utilize the same primary system pressure signal as selected by a common two-position selector switch. The core region calculator and the head region calculator utilize the eight CET and two RTD inputs as selected by separate selector switches. The steam generator pressure selector switch selects one of the three steam generator secondary pressure signals as input to the steam generator calculator. The output displays of the core region and head region calculators are selected temperature input and margin to saturation. The output display of the steam generator calculator is saturation margin.

The functional characteristics of the system appear to be adequate, but it apparently does not meet the requirements of NUREG-0737, Appendix B. Two independent channels are not provided in that input signals can be shared by the separate calculators simultaneously and independent power and physical separation are not provided. It also is not clear that all parts of the system are qualified. MYAPCO contends the SMM presently provides separate qualified displays for margin to saturation for the core region and the reactor vessel head region. Each of the calculators and display units has access to all of the many inputs available though they operate independently and serve as backup for each other. Because pressurizer pressure was considered a type A variable in the context of Reg. Guide 1.97, MYAPCO has agreed to provide independent power supplies for the two channels. Each of these will be available to the SMMs. MYAPCO does not plan any further modifications to the SMM. The present SMM systems appears to have capability for being independent and qualified, but are not. Lacking are qualified displays, qualified and independent inputs, channel separation, and separate class 1E power sources.

CORE EXIT THERMOCOUPLES (CET)

Maine Yankee now has 45 core exit thermocouples installed, 18 of which are qualified with ten additional CETs to be qualified during the current refueling outage. Normal display is through the plant computer with a range of 200-2250 degree F. A backup display is provided in the SMM system for selective reading of a minimum of 8 thermocouples, 2 per quadrant with display range of 200 to 2250 degrees F. M-Ys stated position is that 2 CETs per quadrant are adequate, in contradiction of the NUREG-0737, II.F.2, Attachment 1, Part 3 requirement for 16 operable CETs, 4 from each quadrant. M-Y has not justified this position to NRC except to state that Combustion Engineering thinks they have enough. All CETs are displayed on the plant computer which is being upgraded with redundant units to achieve greater than 99% availablility. A core map will be available on demand to the printer and a CRT display will be included in the SPDS during the cycle 9/10 refueling outage.

Isolation is provided between safety class hardware and non-safety class hardware. The sensors, cabling, cold junction, backup display up to and including the isolation device are Class 1E and powered from a Class 1E power source. Primary display and main process computer is non-safety class, but is powered by a battery-packed highly reliable power source. The two CET backup displays (in the SMM) may not have separate Class 1E power sources. It is not clear that the SMM systems which allegedly provide the qualified, redundant backup displays are completely qualified and redundant (see SMM description). It appears that the installed system has the potential for being made fully redundant in accordance with NUREG-0737. Additional qualified CETs could be added to the backup displays to satisfy the minimum CET requirements. It is expected that M-Y will address this concern in the August 1985 response.

PROCEDURES

Emergency Operating Procedures incorporating ICC are now being written and reviewed, but were not available for inspection. These procedures are based on Westinghouse Revision 2 guidelines rather than C-E guidelines, because of the uniqueness of the 3-Loop CE plant. ICC instruments will be installed in the plant simulator in September 1985; Procedure validation will occur in November and December 1985; Operator training will take place in January and February 1986; and procedure implementation is expected by April 1, 1986. Technical Specification revisions for ICC are expected to be ready for implementation by April 1, 1986.

HUMAN FACTORS

The location of ICC instrumentation in relation to primary pump controls and indications appears to be adequate. The single 3-pen inventory recorder is compact and placed low on the vertical portion of the console so as to be difficult to see. It was necessary to open the recorder door to see the three traces. The pens were visible, but it was difficult to see their relationship to the scale with the door

closed. The poor visibility coupled with the potential inaccuracy of this indication may lead the operators to discount its significance.

SUMMARY

The system, as presently configured, does not satisfy the requirements of NUREG-0737, II.F.2, or Regulatory Guide 1.97, Rev. 3. The PITS has no provisions for indication of system voiding with pumped flow as required by Item II.F.2 clarification 4(a). The PITS is a single train instrumentation system consisting of three ranges of overlapping differential pressure indication necessary to cover the full range of reactor coolant system inventory and does not meet the requirements of NUREG-0737 Item II.F.2 Appendix B criteria (2). The CET system does not meet the requirements of II.F.2 Attachment 1(3) backup display. The SMM does not meet the requirements of Item II.F.2 Appendix B, criteria (2).