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

Dear Sir:

Three Mile Nuclear Station Unit 1 (TMI-1)
Operating License No. DPR-50
Docket No. 50-289
NUREG 0737 Item II.F.2
Reactor Coolant Inventory Trending System
and Incore Thermocouple Display

By letter dated January 21, 1987, the NRC Staff identified disagreement with positions expressed in GPUN letter 5211-86-2184, dated January 5, 1987, with respect to Reactor Coolant Inventory Trending System (RCITS) Display and the Incore Thermocouple Display.

GPUN recently has compiled data with respect to the availability of the TMI-1 computers. As discussed with members of the NRC Staff in a telephone conversation on January 31, 1987, we believe this new information demonstrates TMI-1 compliance with the specific requirements of NUREG 0737 Item II.F.2, based on considerations separate from those expressed in the January 21, 1987 letter.

RCITS Display

Clarification Item 7 of NUREG 0737 II.F.2 specifies that all instrumentation in the final ICC system must be evaluated for conformance to Appendix A(B), "Design and Qualification Criteria for Accident Monitoring Instrumentation", as clarified by item 8 that follows. Item 8 specifies that if a computer is provided to process liquid level signals for display, the single failure criterion of item 2, Appendix A(B) need not apply to the channel beyond the isolation device if it is designed to provide 99% availability with respect to functional capability for Liquid Level display.

For the Reactor Vessel and Hot Legs level indications, signals enter a separate section of the Bailey 855 multiplexer and are displayed through the Bailey or Mod Comp computers. The Bailey 855 multiplexer interface is a common component as shown in Figure 1 and the computers function as display devices.

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As discussed in the January 31 telephone conversation a design availability was not specified at the time the computer system was specified and built. However, the manufacturer, Bailey, provided a System Description which specifies the following:

"The organization of the complete 855 Process Computer System has been established to meet certain specific objectives of on-line process applications... Hardware reliability and maintainability, as well as program integrity, are necessary to meet the requirements for high system availability. The Bailey 855 Computer System is so organized, from both a hardware and a software standpoint, to take fullest advantage of the computer speed and performance capability in the most flexible and reliable manner."

Actual operating experience demonstrates high system availability. Based on a review of computer maintenance records, there were only 8.1 hours in 1986 when both the Bailey and Mod Comp systems were inoperative at the same time. The discussion of computer availability for 1986 provided as Attachment 1 demonstrates that the reactor vessel water level display availability was greater than 99.9% during 1986. We feel the 1986 data is representative. Both systems showed a trend of improved availability during the second half of 1986. We believe this is due to correction of a number of system problems during 1986 and leads us to conclude that system performance will be as good or better in the future.

As shown on Figure 1, the input multiplexer is common to both the Bailey and Mod Comp systems, and it is for this component alone that demonstrated availability is an issue, per Clarification item (8). The multiplexer had some relays fail during the year which resulted in some of the greater than 1500 points being inoperative; however, the RCITS level inputs were operable during the entire year. Based on the fact that the RCITS level inputs through the multiplier experienced no failures through 1986, it is apparent that this is a highly available device. With no failure data, a statistical evaluation (and associated level of confidence determination) is not appropriate. Four separate water level signals are input to the input multiplexer (i.e., Hot Leg Level A and B, and Reactor Vessel Head Level A and B).

In summary, although a percentage was not specified, the TMI-1 computer system was designed to have high system availability. System performance during 1986 exceeded the 99% availability specified in the Clarification statements for NUREG 0737 item II.F.2.

Incore Thermocouple Display

As shown in Figure 2 and as discussed in previous submittals, the Incore Thermocouple System is comprised of a primary system and a backup system, as required by NUREG 0737 item II.F.2. There are a total of 52 incore thermocouples. From these 52, 16 thermocouples (4 per quadrant) are branched

to the backup display system. Upon exit from the containment building electrical penetration assemblies, the 16 thermocouples are fed to the selection switches. From the selection switches, any thermocouple circuit can be routed to the Backup Incore Thermocouple System Instrumentation, where the signal is conditioned and amplified by power from a Class 1E source. Signals from these 16 thermocouples also are fed back to the primary display system via the input multiplexer, and are available on an individual basis for readout as part of the primary display system.

As part of our evaluation of the availability of the TMI-1 computer system discussed above and in Attachment 1, we found that the incore thermocouple relay modules were operable during the entire year; thus, the availability of the computer system to display 52 thermocouple readouts, including the 16 which are also available for display by the backup system, was greater than 99.9% in 1986.

The TMI-1 Technical Specifications provide requirements regarding operability and surveillance of the backup incore thermocouple display; namely, a display of four thermocouples per core quadrant and a minimum of two thermocouples operable per quadrant; calibration is required at each refueling period and a monthly check of capability to display four incore thermocouples per core quadrant also is required.

Item (3) of Attachment 1 to item II.F.2 specifies that a "backup display (or displays) should be provided with the capability for selective reading of a minimum of 16 operable thermocouples, 4 from each quadrant." Item (5) specifies that the "instrumentation must be evaluated for conformance to Appendix B, as modified by the provisions of items 6 through 9 which follow". Item (8) specifies that the "primary and backup display channels should be designed to provide 99% availability for each channel with respect to functional capability to display a minimum of four thermocouples per core quadrant. The availability shall be addressed in technical specifications".

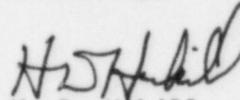
The functional capability to display a minimum of four thermocouples per core quadrant is ensured by the TMI-1 Technical Specifications, as discussed above.

Finally, Appendix B to NUREG 0737 specifies that no single failure within either the accident monitoring instrumentation, its auxiliary supporting features or its power sources concurrent with the failures that are a condition or result of a specific accident should prevent the operator from being presented the information necessary for him to determine the safety status of the plant and to bring the plant to a safe condition and maintain it in a safe condition following that accident. This requirement is satisfied by the fact that 52 incore thermocouples are available for computer readout, of which 16 also are hardwired to a digital backup incore readout display which is powered from a 1E power supply.

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The Bailey/Mod Comp system is being replaced by a Gould/SEL 3297 System with CPI multiplexers. The system has redundant processors with automatic failover capability. The multiplexer cabinets are being wired to plant sensors in 6R, the computers will be delivered in February 1987, and the system is scheduled to be functional by 8R. The Process Computer System Description (SDD 602I) defines as a design goal for the new computer system an availability of 99.5%.

Sincerely,



H. D. Hukill

Vice President and Director, TMI-1

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COMPUTER AVAILABILITY FOR 1986

Based on a review of computer maintenance records, there were only 8.1 hours in 1986 when both systems were inoperative at the same time. During the end of June and in early July, there were problems for longer periods in the computers that prevented both systems from running concurrently; however, during the time that the 855 was being repaired, the multiplexer was occasionally switched to the 855 when the ModComp was not needed for operations. When required, the multiplexer was switched back to the ModComp for use by Operations.

The multiplexer had some relay modules fail during the year, which resulted in some points being inoperative; however, the RCITS levels and incore thermocouples were operable during the entire year.

SUMMARY OF COMPUTER AVAILABILITY

<u>12/31/85 - 12/31/86</u>	<u>Total Time</u>	<u>Downtime ModComp</u>	<u>Downtime Bailey</u>	<u>Combined Downtime</u>
January 1986	768	1.2	2	.075
February 1986	672	1.0	0	0
March 1986	744	1.0	72	.025
April 1986	720	.4	0	0
May 1986	744	1.5	0	0
June 1986	720	41.6	84	0*
July 1986	744	48.9	44	8.0
August 1986	744	.1	0	0
September 1986	720	.2	0	0
October 1986	744	10.6	0	0
November 1986	720	.1	0	0
December 1986	<u>744</u>	<u>.1</u>	<u>0</u>	<u>0</u>
	8784	106.7 hr.	202 hr.	8.1 hr. 99.91% combined availability

*During periods Bailey was failed, ModComp was available, although was not continuously run, so that MUX could be used to support Bailey repair.

Although both systems had similarly high availabilities, the types and times of failures were very different. During the first half of the year, the ModComp system was troubled by spurious system halts and auto restarts quite frequently by an intermittent hardware problem which was corrected in July.

The Bailey 855 was characterized by far fewer failures (3) which took longer to repair.

System Comparison

	<u>No. of Failures</u>	<u>Total Repair Time (hr)</u>	<u>MEAN Time to Repair (hr)</u>	<u>MEAN Time Between Failures (hr)</u>	<u>Availability</u>
ModComp	315	106.8	.34	27.9	98.8%
Bailey	3	202	67.3	2928	97.7%

Combined system availability calculated from the product of each system unavailability is 99.97 percent.

The availabilities calculated only include times that the system was unavailable due to unplanned outages. The normal weekly diagnostics and preventative maintenance periods were not included as unavailable periods since the system could be quickly restored for operator use. This is a standard approach for determining availability values. For the intended use of displaying long-term information during accidents, the number of ModComp failures could be reduced from 315 to 6 if outages shorter than five minutes were excluded.

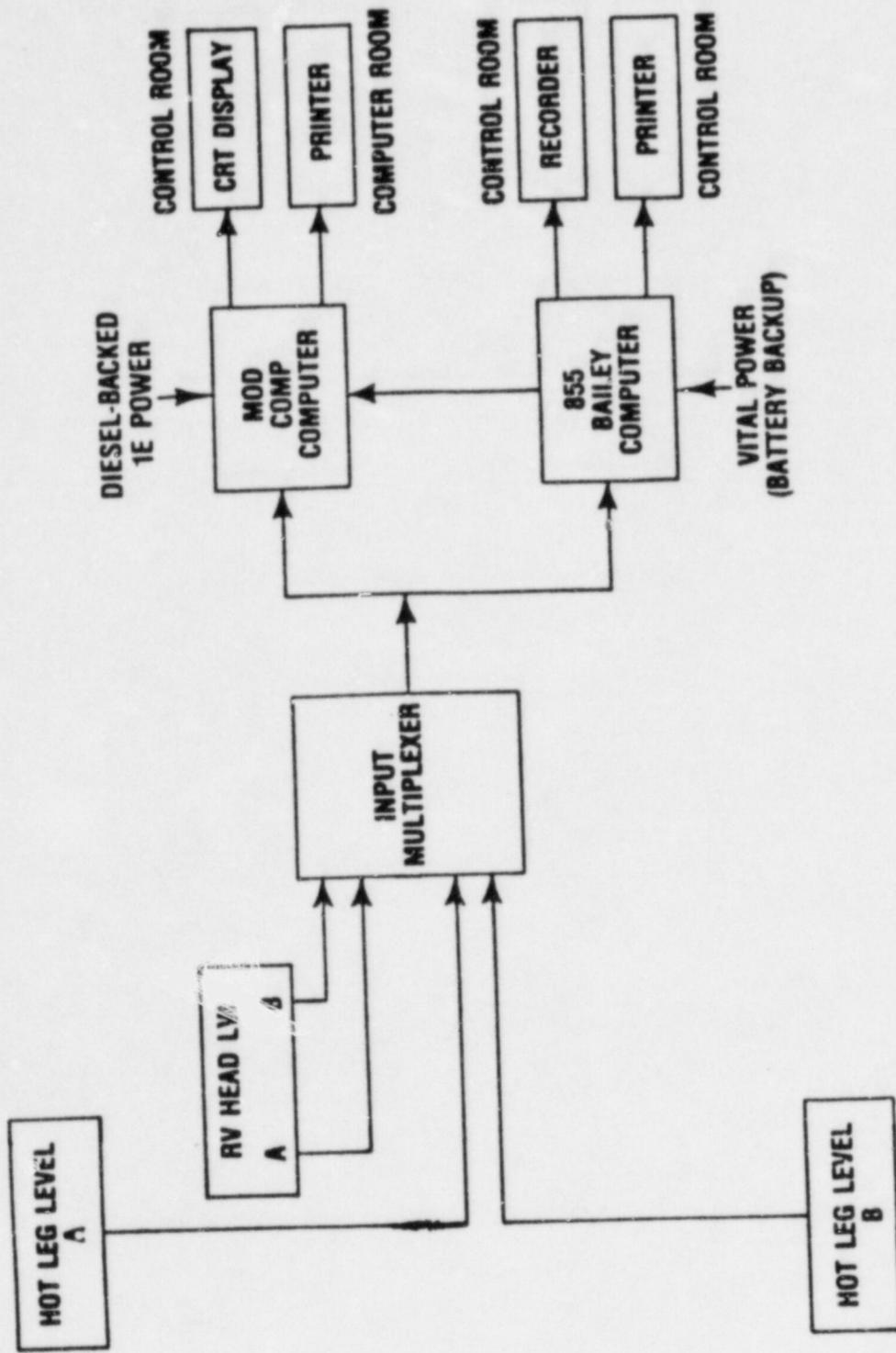


Figure 1 WATER LEVEL DISPLAY SYSTEM

