GPU Nuclear

GPU Nuclear
100 Interpace Parkway
Parsippany, New Jersey 07054
201 263-6500
TELEX 136-482
Writer's Direct Dial Number:

August 16, 1985
5211-85-2136

Mr. Harold Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

Three Mile Island Nuclear Station Unit 1 (TMI-1)
Operating License No. DPR-50
Docket No. 50-289
Emergency Feedwater (EFW) System Reliability and Status

In our conversation of July 30, 1985, GPUN agreed to provide additional information concerning the reliability of the TMI-1 EFW System as presently configured and the status of modifications to the system. This letter provides the information as summarized below:

- Contrary to some published reports, the reliability of the current TMI-1 EFW System is fully comparable to that of other operating plants,
- The adequacy of the System has been fully litigated before the ASLB and ASLAB and found satisfactory,
- The fundamental design is sound and not subject to major failures and
- Final upgrades are still committed for completion in the next refueling outage.

Following the accident at TMI-2 in March of 1979, one of the prime areas of focus was the Emergency Feedwater System (EFWS) and its reliability. For TMI-1, NRC established "Restart" Order requirements, one of which addressed the reliability of the EFW System. In February, 1980, GPUN transmitted the results of a B&W reliability analysis of TMI-1's EFW System. The NRC Staff, in response to questions posed by the ASLB, performed a fault-tree analysis of the TMI-1 EFWS (based, in part, on information derived from the B&W reliability analysis). From this analysis, the Staff prepared an estimate of the unavailability of the TMI-1 EFWS at five minutes (i.e., at the time of steam generator dryout) following a loss of main feedwater (LMFW). For the original (mid-1979) design, the staff found an unavailability of 8×10^{-3}, for the then

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proposed Restart design the unavailability was $3x10^{-3}$; and for the fully upgraded long-term design, it was $4.5x10^{-4}$. The staff also depicted the then current industry average as $2x10^{-3}$ (Reference b). As both GPUN and the Staff pointed out in the ASLB hearing record, these estimates were overly conservative in that use of the five minute criterion did not allow consideration of operator action to mitigate the event. No core damage would occur for a delay of at least 20 minutes in EFWS initiation following an LMFW transient, since operator action can be relied upon. The Staff also testified (as reported in ALAB-729) that based on realistic criterion, the reliability of EFW TMI-1 would compare favorably with other plants.

The Appeal Board, in ALAB-729, reviewed the issue of EFWS reliability and concluded that it was inappropriate to equate steam generator dryout with the total failure of the EFWS to perform its function. The Appeal Board further found that the reliability of the TMI-1 EFW System for an LMFW transient or small break LOCA is not significantly different from EFW systems at other nuclear power plants, and that it is sufficiently reliable to adequately protect the health and safety of the public.

The Commission, in its decision (CLI-84-11) on review of ALAB-729, agreed with the Appeal Board that the EFW System is sufficiently reliable to provide adequate assurance of protecting the public health and safety. More particularly, the Commission endorsed the Appeal Board's preference for the 20 minute criterion for EFW reliability based on core damage rather than a five minute criterion based on steam generator dryout, and noted that the actual historic performance of the TMI-1 EFW System has been above average.

In light of this history, we believe it is not appropriate to estimate TMI-1 EFWS reliability based solely on the five minute criterion, thus ruling out operator action. Further, it is our understanding that this was not the sole basis used in estimating EFWS reliability at other B&W plants. The staff thus categorized TMI-1 as having a low reliability, i.e., unavailability of greater than 10^{-3}. Based on a realistic criterion, TMI-1 EFW reliability would be ranked in the medium range (10^{-3} to 10^{-4} unavailability) at Restart.

The discussion above addresses only one measure of the overall reliability of an EFW System. Functionally, the TMI-1 EFW System has always had diverse sources of power to the EFW pumps. It has been modified significantly since the "original" design. GPUN has completed modifications, procedure changes, analyses, training, Technical Specification changes, surveillances and tests required for Restart (Reference d) as well as some of the long term items (References e, f, and g). The system has been reevaluated against more stringent seismic, flooding and environmental qualification criteria and has been modified and shown to meet these criteria. These issues were addressed

in GPUN (Reference h) and NRC (Reference i) responses to the UCS 2.206 petitions (Reference j). Further, the system has been simplified in its operation. No valves other than the control valve are required to operate for the system to perform its function and three different ways exist to control flow. There are no automatic closure signals to any EFW system valves in either the current or final design which would interrupt flow to the steam generators. Excessive flow is prevented by passive cavitating venturies. These features are similar to those of other PWR - EFW systems with a medium or high availability.

The existing EFW System is superior to that evaluated and accepted by the ASLB and ASLAB and is satisfactory for Restart. It is fully comparable to the system for many other operating plants. Additional improvements are planned for completion thereby making the system Safety Grade.

Mechanically, all EFW System valves controlling flow to the "A" steam generator, except the replacement for the original control valve and its new block valve, have been installed. For the "B" steam generator, only the original control valve remains to be replaced. The planned control signals and failure modes for the replacement control valves are different than those for the original valves, and control signals from the Heat Sink Protection System are required to make the redundant valves operational. In the interim, in the unlikely event of failure of both control valves, the redundant control and block valve (presently maintained closed) could be opened to provide EFW flow.

The remaining functional upgrades to the system are electrical. First, a safety grade control system will control flow through the redundant flow paths to each steam generator. Second, safety grade initiating signals for steam generator low level and containment high pressure will be added. Third, additional indication pertaining to the EFW system will be added to the control room. These features will improve the availability of the EFW system at five minutes after an initiating signal by providing more reliable automatic system initiation for a larger spectrum of events and more reliable EFW flow control. These automatic features will eliminate some potential failures which would be corrected by operators within 20 minutes. However, these features will have little effect on EFW availability at 20 minutes since these features do not significantly alter the probability of failures which require longer than 20 minutes to correct. Therefore, the primary reliability improvement gained from these remaining upgrades is a reduction in the probability of steam generator dryout (five minute EFW unavailability). They provide little reduction in the probability of core damage. In addition, we are continuing the review of the EFWS design in light of the recent event at Davis Besse.

In our October 3, 1984 letter, we confirmed our commitment to complete the EFW upgrades during the first refueling outage after Restart. We stated that, assuming full plant availability for construction (i.e., no Restart) our schedule showed construction completion during the third quarter of 1985 with the HSPS tested and fully operational during the fourth quarter of 1985. Primarily, because of problems encountered in obtaining qualified cables and trays, the current schedule now shows construction completion during the first quarter of 1986 with the system tested and fully operational during the second quarter 1986. This assumes TMI-1 shutdown and available for construction for portions of the installation and testing. We do not intend to begin final tie-ins and testing until such time as the plant is projected to be unavailable for operation for at least three months. GPUN remains dedicated to completion of all EFW long term upgrade modifications during the first refueling outage after Restart as previously committed.

We will be glad to provide additional information or answer questions on this matter.

Sincerely,

P. R. Clark
President

References:
a) PID dated December 14, 1981, Section Q "EFW Reliability"
b) Testimony by J. Wermiel and Curry, ff.Tr16,718 at 31 to 43
c) N. Palladino letter to E. Markey, dated July 24, 1985
d) NRC SER NUREG 0680 and supplements
e) GPUN letter dated August 23, 1983 (5211-83-2232)
f) GPUN letter dated May 3, 1985 (5211-85-2057)
g) GPUN letter dated October 3, 1984 (5211-84-2244)
h) GPUN Response dated May 31, 1984 to UCS 2.206 petition
i) NRC Response dated April 27, 1984 and September 25, 1984 to UCS 2.206 petition
j) UCS 2.206 petitions dated January 20, 1984 and May 9, 1984

cc: R. Conte
J. F. Stolz
R. Thoma

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