March 26, 1984

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE DIRECTOR OF NUCLEAR REACTOR REGULATION

In the Matter of	)	
	)	
GPU NUCLEAR CORPORATION	)	Docket No. 50-289
	)	(10 CFR 2.206)
(Three Mile Island Nuclear Station, Unit No. 1)	)	

LICENSEE'S AMENDED RESPONSE TO UNION OF CONCERNED SCIENTISTS' PETITION FOR SHOW CAUSE CONCERNING TMI-1 EMERGENCY FEEDWATER SYSTEM

On January 20, 1984, the Union of Concerned Scientists filed a Petition for Show Cause Concerning TMI-1 Emergency Feedwater System. Licensee filed its response to the UCS petition on February 24, 1984. This amendment is necessary to reflect factual developments which have occurred since February 24, 1984, with respect to matters addressed in Licensee's response.

Addressing issues raised on the environmental qualification of the TMI-1 EFW system, Licensee reported that qualification of that system would be completed by June, 1984, with the exception of one piece of equipment. Since no qualification testing basis is available to show that the E/P converters for the EFW control valves will survive a high energy line break in the Intermediate Building, Licensee stated that a decision had been made to replace the E/P converters with qualified I/P converters. A justification for continued operation was provided. Licensee's Response at 17; Attached GPU Nuclear Technical Response at 4-5.

Licensee has continued to work, however, on improving the schedule for implementing this modification. Licensee has now determined that the E/P converters will be replaced with qualified I/P converters by June, 1984. As a result of this change, the failure mode of the EFW flow control valves will be modified prior to restart such that, upon loss of control power, the valves will fail in the open position. (Previously, the valves would have failed to the mid-position on loss of signal.)

For convenience, a replacement page 17 of Licensee's Response is attached, along with a Revision of the GPU Nuclear Technical Response, with the changes identified by asterisks in the margin.

Respectfully submitted,

SHAW, PITTMAN, POTTS & TROWBRIDGE

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called upon to do so. See San Onofre, supra, DD-81-19, 14 N.R.C. 1041 (1981) (no significant interim hazard).

The environmental qualification issue raised in the UCS Petition has been addressed by the Commission on a generic basis and through the promulgation of a rule -- 10 C.F.R. § 50.49. The compliance date for TMI-1, under that regulation, is March 31, 1985. The Staff and its contractor Franklin Research Center have evaluated in detail the environmental qualification of TMI-1 safety-related electrical equipment for harsh environments created by postulated accidents. Licensee has responded to the outstanding concerns raised in that review.

* The environmental qualification of the TMI-1 EFW system,
* including the replacement of the EFW flow control valves' E/P
* converters with qualified I/P converters, will be completed by June, 1984 -- in time for the Commission's decision on plant restart. Attachment at 2-5.

The backfit of seismic requirements to the EFW systems of operating pressurized water reactors has been the subject of an extensive and generic NRC program. The Staff has stated that

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CERTIFICATE OF SERVICE

I hereby certify that copies of "Licensee's Amended Response to Union of Concerned Scientists' Petition for Show Cause Concerning TMI-1 Emergency Feedwater System" and Revised "GPU Nuclear Technical Response to Union of Concerned Scientists' Petition for Show Cause Concerning TMI-1 Emergency Feedwater System" were served this 26th day of March, 1984, by deposit in the U.S. mail, first class, postage prepaid, to:

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Attachment
REVISED (March 26, 1984)

GPU NUCLEAR TECHNICAL RESPONSE TO UNION OF CONCERNED SCIENTISTS' PETITION FOR SHOW CAUSE CONCERNING TMI-1 EMERGENCY FEEDWATER SYSTEM

I. Introduction

The UCS Petition describes what UCS alleges to be deficiencies in the Emergency Feedwater (EFW) System at TMI-1 as it will be configured at the time of plant restart and throughout Cycle 5 operation. Each of the alleged deficiencies is addressed below. While the UCS Petition concentrates on perceived shortcomings in the EFW system, these allegations should not be weighed in a vacuum, but rather should be assessed with an understanding of the capabilities of the EFW system and the substantial improvements made to the qualification and reliability of that system since the accident at TMI-2. In brief, Licensee has already implemented the following modifications to the EFW system:

- safety-grade automatic starting of the EFW pumps;
- control of EFW independent of the ICS;
- condensate storage tank low-level alarm;
- safety-grade steam generator level indications, independent of the ICS;
- redundant two-hour air supply in the event of a loss of all AC power;
- EFW flow control valves' failure mode modified to fail open on loss of instrument air; and
- addition of flow-limiting cavitating venturis in each EFW line.

The additional modifications which will be undertaken during the Cycle 6 refueling outage will result in a fully safety-grade EFW system. Contrary to UCS's assertion that Licensee admitted, in our August 23, 1983 submittal, that the "EFW system needs to be upgraded" in order to provide increased

reliability to mitigate design basis accidents (UCS Petition at 4, emphasis added), Licensee's submittal was merely noting the "purpose" of the additional, long-term modifications. (Ref. 2.) Licensee stands by its original position that the TMI-1 EFW system is sufficiently reliable to allow operation during Cycle 5, pending completion of the long-term modifications.

II. Environmental Qualification

UCS alleges that the TMI-1 EFW system is not environmentally qualified, and begins the discussion in its petition on this point with a reference to General Design Criterion 4 of Appendix A to 10 C.F.R. Part 50. As relevant background for this and other references in the UCS Petition to the General Design Criteria, the Staff's finding associated with the issuance of the TMI-1 operating license is quoted:

> The Three Mile Island Unit 1 plant was designed and constructed to meet the intent of the AEC's General Design Criteria, as originally proposed in July 1967. Construction of the plant was about 60% complete and the Final Safety Analysis Report (FSAR) had been filed as Amendment 12 with the Commission before publication of the revised General Design Criteria in February 1971 and the present version of the criteria in July 1971. As a result, we did not require the applicant to reanalyze the plant on the basis of the revised criteria. However, our technical review did assess the plant against the General Design Design Criteria now in effect and we conclude that the plant design conforms to the intent of these newer criteria. (Ref. 1 at 3-1.)

With respect to safety-related electrical equipment, the NRC has been pursuing environmental qualification (i.e., compliance with GDC-4) on a generic basis first through IE Bulletin 79-01B, and now through its regulation on environmental qualification of electric equipment important to safety for nuclear power plants, 10 C.F.R. § 50.49, which first became effective June 30, 1982. Pursuant to section 50.49, TMI-1 is to achieve final environmental qualification of the electric equipment within the scope of that section by March 31, 1985. The EFW system has been included in the overall evaluation of TMI-1 under these generic programs.

Focusing upon a steam line break outside of containment, UCS states ". . . GPU recognizes that the TMI-1 EFW system is not qualified for the hostile environmental conditions resulting from a main steam line break." UCS Petition at 6. What

GPU in fact stated in the reference cited by UCS, which describes long-term modifications to the system, is that:

> Equipment which is part of the EFW system or which is required to act in support of this system and which is located in the Intermediate Building, shall either be upgraded to be qualified for the hostile environmental conditions resulting from a Main Steam Line Break (MSLB) in this building or be replaced with qualified equipment or be relocated to an environmentally acceptable location which is otherwise suitable for their safety function. (Ref. 2, Enclosure at 11.)

While UCS asserts that ". . . several pipes carrying steam or high temperature water are located in the Intermediate Building . . .", UCS Petition at 6, the qualification program has utilized two specific main steam line breaks (24 inch and 12 inch), which produce the most severe environment for electrical equipment. Other breaks in the feedwater lines produce a much less severe environment and are not the basis for qualification.

The implications for the EFW system of a high energy line break in the Intermediate Building were recognized in the original licensing of TMI-1. As a result of an analysis of the consequences of all the postulated breaks in the Intermediate Building, utilizing criteria and guidelines provided by the Staff, corrective actions were identified. These included shielding of the EFW suction line and installation of additional piping restraints to prevent pipe whip damage and the failure of a line connected to one steam generator from causing the failure of a line connected to the other steam generator. In addition, a significantly augmented inservice inspection of critical welds was instituted for the postulated break locations. The Staff's conclusion was stated as follows:

> The staff has evaluated the assessment performed by the applicant and has concluded that the applicant has analyzed the facilities in a manner consistent with the criteria and guidelines provided by the staff. The staff agrees with the applicant's selection of pipe failure locations and concludes that all required accident situations have been addressed appropriately by the applicant. Furthermore, the staff has evaluated the locations where increased inservice inspection is proposed in lieu of plant modification and we find this justified and acceptable. (Ref. 1 at 10-7.)

The augmented inservice inspection program for the Main Steam system is incorporated in the TMI-1 operating license (No. DPR-50, Technical Specification 4.15).

The harsh environment in the Intermediate Building following a main steam line break is being addressed in the review for TMI-1 under IE Bulletin 79-01B and section 50.49. UCS argues that the current status is not known of EFW system components for which the Technical Evaluation Report (TER) concluded that environmental qualification had not been established, and that "it is known that many vital components in the TMI-1 EFW remain incapable of functioning properly during a steam line break." UCS Petition at 7, 8.

As UCS and the Staff are aware, the deficiencies identified in the Franklin Research Center TER on TMI-1, dated November 5, 1982, were predominantly based on the uncertainty by Franklin Research Center as to whether Licensee had adequate documentation to demonstrate the qualification of the identified equipment (although Franklin had not requested the documentation). The purpose of the October 5, 1983 meeting with the Staff was not to achieve final resolution of the TER deficiencies, as UCS implies, but to discuss Franklin's concerns. (UCS also inaccurately represents the December 16, 1983 meeting. Licensee discussed 120 equipment deficiencies, not 120 types of equipment having deficiencies. The 120 deficiencies address the entire plant and not just the EFW system -- the focus of the UCS Petition.) There is no equipment at TMI-1 classified by the NRC in the category II.b, "EQUIPMENT NOT QUALIFIED." (Ref. 3, TER at 4-3.) As discussed below, some equipment is classified category II.a, "EQUIPMENT QUALIFICATION NOT ESTABLISHED."

While UCS may not be aware of the current status of the specific components identified in its petition, Licensee documented the resolution of outstanding qualification items in * letters to the Staff of February 10 and 22, 1984 (Refs. 4, 24.) * and by the Revised Technical Response. The environmental qual- * ification of the TMI-1 EFW system under 10 C.F.R. §50.49 will * be completed by June, 1984, including replacement of the Bailey * E/P Converters for the EFW control valves with qualified I/P * Converters. (Licensee has continued to work on improving the * schedule for this modification, which had been set for the * Cycle 6 refueling outage, and has now determined that it will * be completed by June, 1984.) Thus, the environmental qualifi- * cation of the TMI-1 EFW ystem poses no undue risk to the public * health and safety and does not provide an appropriate basis for * the UCS Petition.

III. Seismic Qualification

The seismicity analysis for the licensing of TMI-1 indicated that the Pennsylvania area is relatively inactive seismically, based upon 200 years of historical data and 40 years of instrumental data. The TMI site is characterized by infrequent earthquakes of low intensity. This low intensity corresponds to a ground acceleration of 0.04g. (Ref. 5, section 2.8.) The Seismic I portion of TMI-1 was designed to withstand a ground acceleration of 0.12g acting horizontally for the Safe Shutdown Earthquake (SSE) condition (Ref. 5, section 5.1.2), which exceeds the 0.1g specified ground acceleration of Appendix A to 10 C.F.R. Part 100. Consequently, the portions of the TMI-1 EFW system that are Seismic Category I are designed to more severe criteria than NRC regulations require. Mechanical portions of the EFW system that are not now Seismic Category I are designed to the requirements of ANSI B31.1, "Power Piping." Fossil power plants and conventional portions of nuclear power plants designed to this standard have exhibited significant seismic resistance. (Refs. 6, 7; Ref. 8 at 2.)

It is clear that while Staff guidance for seismic qualification of PWR auxiliary feedwater systems has been evolving over a long period of time, the evaluation to determine how to backfit seismic requirements to earlier plants has not resulted in the imposition of specific seismic requirements. (Ref. 9.) In its information request of February 10, 1981 (Ref. 8), the Staff stated:

> Although we are not at this time requesting that the AFW System be modified to be in conformance with the facility design seismic requirements, we have stated that our plan is to increase the seismic resistance, where necessary, to ultimately provide reasonable assurance that the system will function after the occurrence of earthquakes up to and including the SSE.

Licensee has made numerous submittals of information to the Staff, in response to Generic Letter 81-14, on the seismic qualification of the TMI-1 EFW system. The Staff's contractor, Lawrence Livermore National Laboratory (LLNL), has reviewed these responses and issued Technical Evaluation Reports dated October 29, 1982 and July 7, 1983. While the first TER identified deficiencies in Licensee's responses, LLNL concluded in its second TER that, with the actions taken and planned by Licensee (i.e., the long-term EFW modifications detailed in Reference 2), the TMI-1 EFW system will be fully qualified to Seismic Category I at the next refueling outage (prior to start

up for Cycle 6 operation). Based upon this TER and its own evaluation of Cycle 5 operation, the Staff has concluded that there is reasonable assurance that the TMI-1 EFW system will be able to withstand a SSE and perform its safety function. (Ref. 10.)

UCS challenges this conclusion, apparently, in its assertions that the TMI-1 EFW system is not seismically qualified and that operation of TMI-1 therefore would pose an undue risk to the health and safety of the public. As the assessment below will demonstrate, the UCS Petition is without technical merit and does not undermine the validity of the Staff's previous safety evaluation.

A major fault in the UCS Petition is the extensive reference, in the present tense, to findings in the first TER issued by LLNL, while virtually ignoring the second TER. UCS Petition at 9-15 (especially the list of "many vital components in the TMI-1 EFW system which are not environmentally qualified," UCS Petition at 10-11).

In its final TER, LLNL concluded that the TMI-1 EFW system piping, valves, structures and power supplies possess a SSE level of seismic capability, and that the initiation/control system will possess such capability after the Cycle 6 refueling outage.

The available information, which provides reasonable assurance that the EFW system will perform its safety function after a SSE, and that has been ignored by the UCS Petition (at 10-11), includes:

a. Recirculation lines of the EFW pumps. The TMI-1 Emergency Procedure for Earthquakes (1202-30) calls for closing of the Condensate Storage Tank B isolation valve (CO-V-176) and the EFW pump recirculation isolation valves (EF-V20A/B and EF-V22) if the EFW pump recirculation lines are ruptured. (Ref. 11, Item 1.)

b. Portions of the EFW suction piping to the condenser hotwell, for which there are no double isolation valves between the seismic Class I piping and the non-seismic Class I piping. Although TMI-1 does not have a second isolation valve between SI/SIII piping to the condenser hot well for each line, the condensate storage system is single failure proof. There are two condensate storage tanks (CST) and Technical Specifications water inventory in either tank is sufficient for safe shutdown. The common cross connect between the two condensate pipes (containing CO-V14A/B) has two isolation valves (CO-V111A/B) and closure of either valve (CO-V111A/B) will ensure integrity of one CST inventory if one of the CO-V14A/B cannot be closed.

All of the valves involved (CO-V14A/B & CO-V111A/B) are Seismic I and by the end of Cycle 6 refueling outage their routing (CO-V14A/B and CO-V111A/B) and power supplies (CO-V111A/B) will also be Seismic I. In the interim, manual operator action will ensure proper operation following a seismic event.

The TMI-1 Emergency Procedure for Earthquake (1202-30) and relevant Alarm Response Procedures have been revised to instruct the operator to isolate the damaged Condensate Storage Tank from the EFW system by closing valves CO-V14A/B and CO-V111A/B when tank level reaches the Tech Spec limit following EFW actuation, and following any recognizable seismic event (a seismic instrumentation alarm is available in the control room). (Ref. 12, TER Item 2.)

c. EFW pumps' minimum flow valves (recirculation valves) and their controlling flow switches and associated circuitry. The EFW pumps' minimum flow valves (EF-V8A/B/C) are seismically qualified. (Ref. 25.) The fact that their controlling flow switches and circuitry are not seismically qualified has been resolved by locking open EF-V8A/B/C. This will prevent the possibility of dead heading the EFW pumps, and sufficient flow will still be available to the steam generators. (Refs. 18, 19.)

d. Electro-pneumatic converters for the EFW flow control valves, EF-V-30A and EF-V-30B. The E/P Converters will be replaced by June, 1984 with seismically qualified I/P Converters. A seismic event will not result in a failure of the converters for the EFW flow control valves and thus sufficient flow will be established for the EFW system to perform its safety function.

e. Condensate storage tank low level alarms. The actions described above in "a, b and c" will ensure sufficient inventory in the Condensate Storage Tanks and a sufficient flow path to the steam generators for the EFW system to perform its safety function. (Ref. 11, Item 1.) Licensee has reviewed the failure modes in a seismic event for the condensate tank level instrumentation, (Ref. 11, Item 3.), and concluded that only in the event of a transmitter sensing line crimp (due to the transmitter falling) would the transmitter continue to read a static level. However the operator would note that no drawdown is indicated and investigate the problem. It is incredible to assume that both transmitters would fail in this manner. Therefore, at least one transmitter is expected to be available.

In the Restart proceeding, the Licensing Board recognized and explicitly endorsed for Cycle 5 operation the non-safety-grade CST low-low level alarms as adequate pending the

installation of safety-grade alarms during the Cycle 6 refueling outage. LBP-81-59, 14 N.R.C. 1211, 1363-64, 1373 (¶¶ 1033, 1037, 1059). These low-low alarms use the same transmitter as the low level alarms.

f. Circuitry for main steam dump isolation valves MS-V2A, MS-V2B, MS-V8A and MS-V8B. Since the EFW system safety function can be achieved with the motor driven EFW pumps without relying on the turbine driven pump, the circuitry for these valves is not essential and need not be seismically qualified. (Ref. 10, TER at 5; Ref. 12, Item 7.)

g. Circuitry for condensate storage tank isolation valves CO-V10A, CO-V10B, CO-V14A and CO-V14B. The only non-seismic parts of the circuitry for valves CO-V10A/B are the cable routing through the turbine building and the electric power supplies. CO-V10A/B are normally open and are not required to change position for the system to become operational. Valves CO-V10A/B are locked open now and there is no need to seismically qualify the circuitry for these valves. The only non-seismic part of the controls for valves CO-V14A/B is the cable routing through the turbine building. CO-V14A/B are normally open and are required to change position for the system to become operational if a pipe break occurs in the hotwell makeup piping. (Ref. 19.) Manual closing of CO-V14A/B is provided as discussed above in "b".

h. Circuitry for condensate storage tank cross connect valves CO-V111A and CO-V111B. The non-seismic parts of the circuitry for valves CO-V111B are the cable routing through the turbine building and the electric power supplies. CO-V111A/B are not required to change position for the system to become operational. (Ref. 19.) (See "b" above.)

i. Control systems for the atmospheric relief valves MS-V4A and MS-V4B. These valves are within the seismic boundary and will maintain their structural integrity during a seismic event. However, the control of these valves is not essential for safe hot shutdown and, therefore, the control system need not be seismically qualified. These valves will remain closed on loss of instrument air or loss of electrical signal. The MSV-4A/B can be manually operated.

j. Vent stacks for both the main steam relief and atmospheric dump valves. UCS argues that "it is very likely that the operator will not be able to enter the Intermediate Building to isolate the leak following an earthquake because of steam released to the building by failure of equipment which is not seismically qualified" -- the vent stacks for MS-V-22A/B and MS-V-4A/B valves. UCS Petition at 13.

The pressure control valve (MS-V6) upstream of valves MS-V22A/B was modified to limit its travel at 65% of stroke to protect the EFW pump turbine from overpressurization due to the failure of any steam supply valve. This reduces the potential for opening of valves MS-V22A/B. In addition, these valves will not lift simply because a vent stack fails or the EFW turbine driven pump is started.

Licensee previously had evaluated the design of the vent stacks for these valves and found that these vent stacks were classified non-seismic and were designed for dead weight and discharge loads only. However, the supporting scheme for the MS-V22's stacks was judged by inspection to be seismically acceptable. (Ref. 14, Question 1 of Enclosure 1; Ref. 15.) Also, as noted in item "i" above, operation of MSV-4A/B is not required for safe hot shutdown and the failure mode of these valves is closed. Consequently, there is a low probability of release of steam to the Intermediate Building from these vent stacks, and there is reasonable assurance, during Cycle 5 operation, that the operator will be able to function in the Intermediate Building.

k. Main steam isolation valve circuitry. Circuitry for these valves (MSV-1A, B, C, D) is not essential for plant shutdown (since the EFW turbine driven pump is not needed) and need not be seismically qualified. (Ref. 10, TER at 5; Ref. 12, Item 9; Ref. 11, Item 9.)

Following the dated list which is evaluated above, the UCS Petition proceeds to criticize use of a "static analysis" to establish the seismic qualification of valves. UCS Petition at 11. The very Standard Review Plan passage quoted by UCS belies its claim that static analysis has been rejected by the NRC: "Analysis without testing is acceptable if structural integrity alone can assure the intended function." UCS Petition at 12. Further, the seismic analyses for the 47 EFW valves utilized as inputs accelerations which were determined from a dynamic analysis of the EFW piping system -- using the response spectrum approach specified in the Standard Review Plan. The valves and their characteristics (i.e., center of gravity, weights and geometry) were realistically included in the dynamic model of the piping system. The piping was analyzed considering the Operating Basis Earthquake, and the acceleration results were then doubled to account for the SSE pursuant to the TMI-1 FSAR. This approach is conservative since the increase in damping of the piping system during the SSE was not considered.

The accelerations used to analyze the valves were generated using a fully qualified, realistic, "state of the art" dynamic analysis of the EFW piping system. The dynamic model has been checked during the TMI-1 review in response to IE Bulletins 79-02 and 79-14, which showed that the pipe routing

support locations and pipe support construction are consistent with the analysis.

The analyses applied the dynamic acceleration from the piping analysis to the valve internals, pressure boundaries and actuators in a static manner, along with other consequential loads. This approach is justified because the valve internals are sufficiently stiff to preclude dynamic amplification within the valve itself.

Here, stress analysis of the valves, considering accelerations derived from a dynamic analysis of the EFW piping system, reveals that the highest stress in the valves -- considering consequent loads due to the SSE, internal pressure and deadweight -- ranges from 3 to 91 percent of the ASME Code allowable stress values. (These ASME allowable stresses are based on a safety factor of at least four, considering the ultimate strength of the materials.) This means that both the structural integrity and operability of the valves are assured because the materials experience stresses and strains within their elastic limits. Consequently, deformations are small and temporary, such that the moving parts inside the valves and actuators are not affected. For all of these reasons, the valve analyses are valid.

As shown above, the TMI-1 EFW system has the capability to perform its safety function following a seismic event, coincident with loss of offsite power with a single failure of any active component. Even if the inventory from either one or both Condensate Storage Tanks is depleted due to the single failure of isolation valve CO-V14A or B, a secondary backup supply of river water is available from the reactor building emergency cooling pumps -- an entirely seismic Class I supply, although establishment of this supply may require operator action in the Intermediate Building. (Ref. 14, Question 1 of Enclosure 1, Enclosure 2 at 5.)

UCS states that GPU apparently performed no evaluation of the potential effects of flooding the Intermediate Building from failure of the EFW system, and concludes that this is a "significant omission." UCS Petition at 14. It might be if it were true, but it is not. Licensee has evaluated the condensate piping from valves CO-V14A/B to the turbine building wall to determine if this piping will stay intact during an earthquake. Seismic stress analysis of the condensate piping has included the restraining capability of the supports in the non-seismic piping from the valves CO-V14A/B to the Turbine Building wall and into a portion of the piping that extends into the Turbine Building. These supports, which have a combined restraining capability in three directions, will result in low seismic stresses in the non-seismic part of the system. If a pipe rupture is postulated beyond these supports, the

break would be isolated and will not cause flooding in the Intermediate Building. Furthermore, there are no components vital to the EFW system which can be adversely affected by spray from a broken EFW pump recirculation line. (Ref. 11, Item 1.) Finally, the procedural action (discussed above) to isolate the recirculation line will limit the leakage rate through this small line and avoid a flooding problem.

With respect to a main feedwater line break, the time required to jeopardize EFW equipment is 5.5 minutes, not 86 seconds -- UCS Petition at 15, n. 40. (Ref. 16.) In addition, evaluation of the stress analysis for the main feedwater lines from containment penetration to the turbine building indicates that the maximum stress levels from combined operating and seismic conditions are at most 51 percent of the limits designated as the potential pipe rupture stress level. (Ref. 5, Section 3.1 of Appendix 14A.) The results of these stress analyses show that the non-seismic portion of the main feedwater lines inside the Intermediate Building has seismic resistance. Consequently, there is a low probability that a main feedwater line break would cause flooding in the Intermediate Building following a seismic event.

Finally, Licensee notes that UCS repeatedly cites to the plans for further hardware modifications to the EFW system (Ref. 2) as support for the proposition that the system is not seismically qualified, and asserts that GPU has concluded that at restart the TMI-1 EFW system cannot withstand a Safe Shutdown Earthquake. UCS Petition at 16. In contrast, it is Licensee's position that the TMI-1 EFW system at restart, considering accomplished modifications and with the implementation of the plan of procedural actions described above, will be able to perform its system function, in the unlikely event it should be called upon to do so following a design basis seismic event during Cycle 5 operation.

IV. Single Component Failure

UCS states that "[t]he TMI-1 EFW system does not meet the single failure criterion because there is only a single flow control valve in the pipe used to deliver EFW to each steam generator." UCS Petition at 19, 20. UCS does not address, however, the design modifications already accomplished which improve the reliability of the system.

The Main Steam Line Rupture Detection System (MSLRDS) signals to the EFW control valves, EF-V30A/B, have been deleted to prevent unnecessary isolation of emergency feedwater under single failure conditions. In addition, a cavitating venturi installed for each EFW line will limit flow to a ruptured steam

generator to prevent containment overpressurization (or steam generator overfill condition), and will also ensure sufficient EFW flow to the intact steam generator. (Ref. 17.)

* At restart, the arrangement of the EF-V30A/B controls will
* result in the valves failing open on either loss of instrument
* air or loss of control signal. Additionally, the EFW control valves are equipped with a handwheel which permits manual operator action to establish flow to the intact steam generator. When there is an initiation of the EFW system or failure of an EFW control valve, an auxiliary operator will be stationed at the control valves. (See TMI-1 Abnormal Transient Procedure 1210-10.) The auxiliary operator will establish communications with the control room and will control the valves if EFW flow cannot be established from the control room.

Isolation of EFW flow, if required, to a ruptured steam generator can be achieved either by closing the affected EFW control valve or by closing the discharge header sectionalizing valves (EF-V2A/B), and then tripping the respective EFW pump.

UCS next states that "[a]nother way in which the EFW system does not meet the single failure criterion is that the EFW flow control valves are presently controlled by the Integrated Control System (ICS) which is not safety grade." UCS Petition at 20. The relationship between the EFW system and the ICS was considered extensively in the TMI-1 Restart proceeding. Pursuant to Short-term action 1(b) of the Commission's August 9, 1979 Order and Notice of Hearing in that proceeding, Licensee has implemented automatic initiation of the EFW pumps independent of the ICS and, further, has provided separate manual EFW flow control capability in the control room, which will allow the operators to manually control EFW flow to the steam generators in the event of an ICS malfunction. The Licensing Board examined this issue and required no further modifications, finding that the actions taken provided a significant improvement in safety. LBP-81-59, 14 N.R.C. 1211, 1285-86 (¶ 802), 1362 (¶ 1031) (1981). The Appeal Board also evaluated the matter and considered ". . . the concerns regarding dependence on the ICS for control of emergency feedwater to be resolved." ALAB-729, 17 N.R.C. 814, 833-34 (1983).

In addition, Licensee notes that the ICS has a reliable, uninterruptible, on-site power supply. It is normally fed from an inverter which is powered from the "A" diesel backed 480 Volt AC bus. When the 480 Volt bus is unavailable, the inverter takes its power directly from one of the DC station batteries. In the unlikely event of an independent inverter failure, the ICS power supply will be switched to a regulating transformer which is fed directly from the same 480 Volt AC bus. The independent manual control stations described in the previous paragraph are powered from a different inverter which

is backed up by a separate set of DC station batteries. In the event of an independent failure of this inverter, the power supply for the manual control stations automatically switches to an alternative source backed by the "B" diesel generator.

In summary, means are available during Cycle 5 operation to prevent the EFW system from being disabled by a single component failure.

V. Emergency Feedwater Flow Instrumentation

UCS attacks the adequacy of the new EFW flow indicators, alleging that the replacement of the unqualified sonic flow devices by differential pressure (D/P) transmitters "amounts to a request for exemption from the short-term lessons learned requirement for safety grade EFW flow instruments." UCS Petition at 24. (UCS's complaints regarding the EFW flow indicators are currently pending before the Commission in the Restart proceeding by virtue of UCS filings dated December 9, 1983 and January 6, 1984.) UCS here is patently wrong; as detailed in our submittal to the Staff of August 25, 1983, the EFW flow instrumentation meets all applicable environmental, seismic and other safety-grade criteria. (Ref. 20, Attachment at 1, 2).

UCS's complaints regarding the qualification of the EFW flow indicators rest upon its claim that this instrumentation does not "meet the ± 10% accuracy requirement in effect during the restart hearing." UCS Petition at 24. As Licensee reported, at low EFW flow conditions (i.e., below approximately 120 gpm), cavitation of the EFW flow control valves (EFV-30's) due to low flow against negligible backpressure resulted in indications of EFW flow oscillations outside ± 10% of the flow rate. (Ref. 21; Ref. 22, Attachment at 1). However, recently reported test data, requested by the NRC (Ref. 23), confirm that at flows of 120 gpm and above, the flow oscillations recorded are within ± 10% (e.g., at 200 gpm flow rate the oscillations were ± 7.5% (15 gpm); at 600 gpm, the oscillations were ± 4.2% (25 gpm).) (Ref. 22, Attachment at 1.) (The oscillations reported were measured on recorder traces. The EFW flow meter face contains 25 gpm graduations and thus these small oscillations combined with meter damping are not readable on the meter itself. (Ref. 22, Attachment at 1.)) Further, as discussed in Licensee's most recent submittal, operators are directed to refer to the EFW flow indicators only in limited circumstances (i.e., upon EFW actuation with steam generator (SG) level below the SG level setpoint) and, additionally, are instructed not to rely on EFW flow indication for flow control at rates below 225 gpm. (Ref. 22, Attachment at 2.) Thus, it is clear that the EFW flow indicators are sufficiently accurate to perform their intended function.

With respect to UCS's reliance on the ± 10% accuracy requirement, Licensee would merely note that (while this criterion was part of an interim clarification of lessons learned requirements dated October 30, 1979) Item II.E.1.2 of NUREG-0737, which sets forth the latest position and clarification for EFW flow indication, contains no such set accuracy requirement. (Moreover, the Licensing Board decision itself makes no reference to this ± 10% accuracy requirement. LBP-81-59, 14 N.R.C. 1211, 1362 (¶ 1029) (1981).) Rather, as recognized by UCS, NUREG-0737 merely referenced IEEE Standard 279-1971 which states, in pertinent part, that the system design basis shall document the "minimum performance requirements including . . . system accuracies." See "UCS Rebuttal to Licensee's Reply Regarding EFW Flow Instrumentation," (January 6, 1984) at 5, quoting IEEE 279-1971, § 3(9). Licensee contends that its documentation of EFW flow indication accuracy meets this requirement and, moreover, that the earlier ± 10% accuracy criterion is met at EFW flows of 120 gpm and above.

VI. Main Steam Line Rupture Detection System

UCS asserts that the Main Steam Line Rupture Detection System (MSLRDS) ". . . is not safety grade and requires modifications so that a single failure will not prevent isolation of main feedwater to the steam generator affected by a main steam line break." UCS Petition at 29. As UCS notes, the potential for inadvertent isolation of feedwater was considered in the TMI-1 Restart proceeding as a part of the emergency feedwater reliability issues. LBP-81-59, 14 N.R.C. 1211, 1373-74 (¶¶ 1060-64) (1981). The Appeal Board found that the operators' capability to bypass the MSLRDS and manually open the EFW flow control valves if the MSLRDS isolates feedwater inadvertently is an adequate solution for restart. ALAB-729, 17 N.R.C. 814, 834, 887-88 (1983). In an Order (January 27, 1984) issued in the TMI-1 Restart proceeding after the UCS Petition was filed, the Commission called for comments on the adequacy of Licensee's proposed solution to the MSLRDS "problem."

In its submission of August 2, 1982 to the Staff, Licensee described the design changes to the MSLRDS to prevent unnecessary isolation of emergency feedwater under single failure conditions. (Ref. 17.) In addition to those changes, existing pressure switches inside containment for MSLRD (Static-O-Ring devices) will be replaced by June, 1984, with fully qualified pressure switches. (Ref. 4.) Therefore, in the event of a main steam line rupture in containment, the pressure switches will be capable of performing their intended function. All components of the MSLRDS located inside containment will then be environmentally qualified. The following describes the MSLRD system configuration:

1. Each steam generator (S.G.) has two outgoing steam lines, each line has two pressure switches for MSLRD.

2. Each S.G. has a parallel combination of startup and main FW control valves, and each control valve has a motor operated block valve upstream.

3. Upon MSLRD, the FW is isolated from the affected S.G. by closing its control valves and the block valves. Valve isolation logic is as follows:

   A. Startup and Main Control Valves (FW-V16A/B & FW-V17A/B):

      (1) For isolation purposes, each valve is provided with two paths in the pneumatic control circuit; however, only one path is required to achieve isolation.

      (2) Each isolation path in the pneumatic control circuit has two solenoids. Each solenoid is energized by a separate pressure switch upon MSLRD. Both solenoids in either of the control paths must be energized for isolation.

      (3) The solenoids in the same control path are powered from the same source but the two paths receive power from separate sources.

   B. Block Valves:

      (1) For Main FW Controls Valves (FW-V5A/B):

      Two pressure switches associated with either of the pneumatic control paths (discussed in paragraph 3.A.2) must detect MSLR to cause a closure signal for the block valves. In this case, the isolation signals from RED & GREEN sources are tied together. Also the power for both the block valves is from the same source.

(2) For startup FW Control Valves (FW-V92A/B):

Separate power sources are available to the motor operators. A single failure will prevent block valve isolation, but the same failure will not prevent control valve isolation.

4. On loss of instrument air, the control valves (FW-V16A/B and 17A/B) will fail closed which will result in FW isolation.

5. Electrical Separation. Outside containment the MSLRDS circuits are not all routed in safety-related trays and therefore separation is not maintained throughout.

In conclusion, the MSLRDS is considered to be adequate from a single failure standpoint -- that is, a single active failure (such as a pressure switch, solenoid, control relay, 125V DC power source) will not prevent isolation of feedwater and will not result in inadvertent isolation of feedwater. The MSLRDS is seismic Class I inside containment. Following a main steam line break in the reactor building the system will function to isolate feedwater from the affected steam generator since qualified pressure switches (for MSLRD) to be installed by June, 1984 will be suitable for the accident environment. While electrical separation between the redundant circuits is not maintained outside containment, since a few of them run in the same trays/conduits, electrical separation outside containment is not required for a main steam line break inside containment. The MSLRDS, therefore, is adequate for operation until the fully safety grade modification is installed.

VII. Conclusion

There is reasonable assurance that the emergency feedwater system at TMI-1, as modified for restart and as augmented with

plant procedures, will perform its function if called upon to do so.

Richard F. Wilson
Vice President-Technical
Functions
GPU Nuclear Corporation

Sworn to and subscribed before me this 26th day of March, 1984.

Notary Public

My commission expires [illegible].

REFERENCES

1. Safety Evaluation by the Directorate of Licensing, U.S. Atomic Energy Commission, in the Matter of Metropolitan Edison Company, Jersey Central Power & Light Company, Pennsylvania Electric Company, Three Mile Island Nuclear Station Unit 1, Dauphin County, Pennsylvania, Docket No. 50-289, July 11, 1973.

2. GPU Nuclear letter 5211-83-232 to NRC, Long Term EFW Mods (NUREG 0737 II.E.1.1), August 23, 1983.

3. Safety Evaluation Report by the Office of Nuclear Reactor Regulation for GPU Nuclear Corporation, TMI-1, Docket No. 50-289, Environmental Qualification of Safety-Related Electric Equipment, December 10, 1982.

4. GPU Nuclear letter 5211-84-2038 to NRC, Environmental Qualification of Electrical Equipment, February 10, 1984.

5. GPU Nuclear, Final Safety Analysis Report (Updated Version), Three Mile Island Nuclear Station Unit 1.

6. USNRC NUREG-0766, Reconnaissance Report: Effects of November 8, 1980 Earthquake on Humboldt Bay Power Plant and Eureka, California Area.

7. USNRC NUREG/CR-1665, Equipment Response at the El Centro Steam Plant During the October 15, 1979 Imperial Valley Earthquake (October 1980).

8. USNRC Generic Letter No. 81-14 to All Operating Pressurized Water Reactor Licensees, Seismic Qualification of Auxiliary Feedwater Systems (February 10, 1981).

9. USNRC letter to All Operating Pressurized Water Reactor Licensees, Seismic Qualification of Auxiliary Feedwater Systems (October 21, 1980).

10. USNRC Safety Evaluation Report, Three Mile Island Unit 1, Seismic Qualification of the Auxiliary Feedwater System, August 12, 1983.

11. Attachment 1 to GPU Nuclear letter 5211-83-040 to NRC, EFW Seismic Qualification, February 4, 1983.

12. GPU Nuclear letter 5211-82-301 to NRC, Emergency Feedwater System-Seismic, December 20, 1982.

13. GPU Nuclear letter 5211-83-133 to NRC, EFW Seismic Qualification, May 2, 1983.

14. GPU Nuclear letter 5211-82-150 to NRC, Emergency Feedwater System-Seismic, July 7, 1982.

15. GPU Nuclear letter 5211-82-238 to NRC, Seismic Qualification of Emergency Feedwater System (EFW), September 29, 1982.

16. GPU Nuclear TDR-250, Rev. 1 (January 16, 1984), Review of Intermediate Building Flooding Following a Feedwater Line Break in the Intermediate Building of TMI Unit 1.

17. GPU Nuclear letter 5211-82-153 to NRC, Main Steam Line Rupture Detection System Changes, August 2, 1982.

18. GPU Nuclear letter 5211-83-055 to NRC, EFW Seismic Qualification Supplement, March 22, 1983.

19. GPU Nuclear letter 5211-82-018 to NRC, EFW Seismic Qualification-Electrical, February 16, 1982.

20. GPU Nuclear letter 5211-83-231 to NRC, EFW Flow Devices -- D/P Transmitters, August 25, 1983.

21. GPU Nuclear letter 5211-83-346 to NRC, EFW Flow Devices (D/P) Testing, November 23, 1983.

22. GPU Nuclear letter 5211-84-2032 to NRC, EFW Flow Instrumentation, February 22, 1984.

23. USNRC letter to GPU Nuclear, January 18, 1984.

24. GPU Nuclear letter 5211-84-2044 to NRC, Environmental Qualification of Electrical Equipment, Supp. 1, February 22, 1984.

25. GPU Nuclear letter 5211-82-216 to NRC, Seismic Qualification of Emergency Feedwater System, September 14, 1982.