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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

OFFICE OF SECRETARY  
DOCKETING & RECORDS  
WASHINGTON, D.C.

BEFORE THE COMMISSION

In the Matter of )  
METROPOLITAN EDISON COMPANY )  
(Three Mile Island Nuclear )  
Station, Unit No. 1) )

Docket No. 50-289  
(Restart)

UCS REBUTTAL TO LICENSEE'S REPLY  
REGARDING EFW FLOW INSTRUMENTATION

Introduction

On December 6, 1983, counsel for GPU transmitted to the Commission a document which it characterized as "potentially relevant and material to matters under adjudication in the plant design and procedures phase" of the TMI-1 restart proceeding. The document is a letter from H. D. Hukill, Director of TMI-1, to J. F. Stolz, NRC Staff, dated November 23, 1983. The letter disclosed that the emergency feedwater (EFW) flow instruments installed at TMI-1 to comply with the short-term "lessons learned" requirements do not meet NRC's criteria or GPU's commitment in the restart proceeding. On December 9, 1983, UCS filed with the Commission, "Union of Concerned Scientists Response to GPU Letter of December 6, 1983, Regarding Emergency Feedwater Flow Instrumentation." (Hereinafter, "UCS Response") On December 23, 1983, GPU filed with the Commission, "Licensee's Reply to UCS Response to GPU Letter of December 6, 1983, Regarding Emergency Feedwater Flow

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Instrumentation." (Hereinafter, "Licensee's Reply") Licensee's counsel claimed that its reply was submitted "in order to correct the serious factual errors in the UCS pleading, which might otherwise be overlooked because of the extent and exaggerated nature of the misplaced arguments which are built upon them."<sup>1/</sup> UCS has evaluated Licensee's arguments and submits this rebuttal to demonstrate that UCS made no factual errors and that the evidence supports our arguments.

#### Discussion

GPU's first defense is that +10% accuracy is not "a performance criterion which is part of the 'lessons learned' requirement for EFW flow instrumentation."<sup>2/</sup> Licensee claims unenuivocally that "there is absolutely no basis for the UCS characterization of +10% accuracy as a 'requirement' for EFW flow instrumentation."<sup>3/</sup>

Perhaps the Licensee has not read all of the pertinent material. In fact, during the TMI-1 restart hearing, the requirement for EFW flow indication was as follows:<sup>4/</sup>

#### POSITION

Consistent with satisfying the requirements set forth in GDC 13 to provide the capability in the control room to ascertain the actual performance of the AFWS when it is called to perform its intended function, the following requirements shall be implemented:

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<sup>1/</sup> Licensee's Reply at 1-2.

<sup>2/</sup> Id. at 2.

<sup>3/</sup> Id. at 2-3.

<sup>4/</sup> Staff Ex. 1, NUREG-0680, "TMI-1 Restart," June 1980, p. C8-38, emphasis added.

1. Safety-grade indication of auxiliary feedwater flow to each steam generator shall be provided in the control room.
2. The auxiliary feedwater flow instrument channels shall be powered from the emergency buses consistent with satisfying the emergency power diversity requirements of the auxiliary feedwater system set forth in Auxiliary Systems Branch Technical Position 10-1 of the Standard Review Plan, Section 10.4.5.

#### CLARIFICATION

1. Auxiliary feedwater flow indication to each steam generator shall satisfy the single failure criterion.
2. Testability of the auxiliary feedwater flow instrument channels shall be a feature of the design.
3. Auxiliary feedwater flow instrument channels shall be powered from the vital instrument buses.
4. Auxiliary feedwater flow indication to each steam generator shall satisfy safety-grade requirements.
5. For items 1-3, the flow indication channels should by themselves satisfy the single failure criterion for each steam generator. As a fall-back position, one auxiliary feedwater flow channel may be backed up by a steam generator level channel.
6. Each auxiliary feedwater flow channel should provide an analog indication of feed flow with an accuracy on the order of +10%.

Thus, a +10% accuracy criterion was clearly in effect. The NRC Staff testified that the licensee had committed to installing two safety grade sonic flow devices on each of the two EFW supply lines to the steam generators and that the licensee "indicated that the new flow devices have an accuracy of better than +5%, which is acceptable to the staff."<sup>5/</sup> Based on its review and evaluation of this information, the Staff concluded that TMI-1 was "in compliance with all the requirements of NUREG-0578, item 2.1.7.b, subject to

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<sup>5/</sup> Id., p. C8-39. Actually, the Staff exaggerated Licensee's claim. GPU only said that the EFW flow instruments would have an "accuracy of better than or equal to 5%." See Lic. Ex. 1, Am. 22, p. 2.1-23.

submittal of the vendor environmental qualification certification."<sup>6/</sup> The Licensing Board relied upon the information provided by GPU and the Staff's conclusion "that Licensee is in compliance with the NUREG-0578 recommendation, in item 2.1.7.b, for emergency feedwater flow indication to the steam generators."<sup>7/</sup>

In November 1980, after the licensee and staff testimony on which the Licensing Board relied was submitted, NUREG-0737 was published. With respect to EFW flow instrumentation, the most pertinent part of NUREG-0737 is the following:<sup>8/</sup>

#### Clarification

The intent of this recommendation is to assure a reliable indication of AFW performance. This objective can be met by providing an overall indication system that meets the following appropriate design principles:

- (1) For Babcock and Wilcox Plants
  - (a) To satisfy these requirements, B&W plants must provide as a minimum two auxiliary feedwater flowrate indicators for each steam generator.
  - (b) The flow indication system should conform to the following salient paragraphs of IEEE 279-1971:

#### IEEE 279-1971, PARAGRAPH

- |              |   |
|--------------|---|
| 4.1*         | General Functional Requirements           |
| 4.2*         | Single Failure                            |
| 4.3 & 4.4    | Qualification                             |
| 4.6          | Channel Independence                      |
| 4.7          | Control and Protection System Interaction |
| 4.9* & 4.10* | Capability for Testing                    |

\* These requirements were part of the short-term control-grade requirements.

6/ Id., p. C8-40. The Staff subsequently addressed the environmental qualification of the sonic flow devices. See Staff Ex. 14, NUREG-0680, Supp. No. 3, April 1981, pp. 38-39.

7/ Metropolitan Edison Co., (Three Mile Island Nuclear Station, Unit 1), LBP-81-59, 14 NRC 1211, 1362, December 14, 1981.

8/ NUREG-0737 at 3-82 - 3-83.

In effect, the earlier "Clarification" items listed in NUREG-0680 were folded into the "Clarification" in NUREG-0737 that the EFW flow instruments should meet the listed portions of IEEE 279-1971. One of the pertinent IEEE 279-1971 sections cited provides as follows:

4.1 General Functional Requirement. The nuclear power generating station protection system shall, with precision and reliability, automatically initiate appropriate protective action whenever a condition monitored by the system reaches a preset level. This requirement applies for the full range of conditions and performance enumerated in Sections 3(7), 3(8), and 3(9).

[In turn, Section 3(9) provides as follows:]

3. Design Basis

A specific protection system design basis shall be provided for each nuclear power generating station. The information thus provided shall be available, as needed, for making judgments on system functional adequacy.

The design basis shall document as a minimum, the following:

\* \* \*

(9) minimum performance requirements including the following:

- (a) system response times;
- (b) system accuracies;
- (c) ranges (normal, abnormal, and accident conditions) of the magnitudes and rates of change of sensed variables to be accommodated until proper conclusion of the protective action is assured. [Emphasis added.]

Since the only accuracy figure reported by GPU itself was +5% (See n. 5, supra), one could conclude that if NUREG-0737 is applied rather than NUREG-0680, the +5% criterion rather than the +10% criterion is in effect. NUREG-0737 surely provides no "out" for GPU. Moreover, in reporting to the NRC Staff six weeks ago, GPU itself stated the following:<sup>9/</sup>

Recent tests performed on the EFW system in conjunction with OTSG testing indicated oscillations at low flow conditions (less than approximately 100 gpm) outside the +10% criteria.

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<sup>9/</sup> H. D. Hukill, Director of TMI-1, to J. F. Stolz, NRC Staff, "EFW Flow Devices (D/P) Testing", November 23, 1983, p. 1, emphasis added.

Thus, there seems to have been no question in GPU's mind until very recently that a +10% criterion existed for EFW flow instrumentation accuracy.

In summary, GPU's denial that +10% accuracy is a requirement for EFW flow instrumentation is inaccurate.

GPU's second argument is that UCS "ignores the limited flow regime for which the oscillations occur, and proceeds to postulate the complete absence of EFW flow indication."<sup>10/</sup> To begin with, UCS did not postulate "complete absence" of flow indication (whatever that may mean). We postulated "the lack of reliable flow indication."<sup>11/</sup> GPU seems to be arguing that the inability to reliably measure EFW flow at low flow rates is insignificant because "[i]n a TMI-2 accident condition, full EFW flow would be desired . . . ."<sup>12/</sup> It is of course true that full EFW flow would be desired at the outset. However, once the water level in the steam generators reaches the desired level and decay heat diminishes, flow would be throttled to a low flow condition to safely cool the plant down. This is precisely the condition when the EFW flow instruments are said to be inaccurate and the condition UCS referred to when we postulated that the lack of reliable flow indication could affect proper operator action.

In addition, it is worth noting that GPU's November 23, 1983, letter to the NRC Staff does not precisely indicate for what flow range the instruments are reliable. Mr. Hukill states that it stating at flows less than approximately 100 gpm "indicated" that the +10% criterion was not met and that tests

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<sup>10/</sup> Licensee's Reply at 3.

<sup>11/</sup> UCS Response at 4.

<sup>12/</sup> Licensee's Reply at 3.

"indicate" that above 400 gpm the instruments are within +10%.<sup>13/</sup> He also states that "during the Power Escalation testing data will be collected and used to assist the operators in understanding how the EFW flow devices are expected to perform under various EFW flow conditions."<sup>14/</sup> Thus, it appears that it is not known how the instruments will perform under a variety of flow conditions.

GPU's third argument relates to UCS's point that the EFW pumps are cooled by flow through the pumps and that, therefore, "failure of the recirculation flow paths could require prompt operator action to prevent failure of the EFW pumps."<sup>15/</sup> GPU responded by stating that "UCS apparently is not aware that Licensee has committed to lock open the EFW pump recirculation line valves."<sup>16/</sup> GPU is correct that, as of December 9, 1983, UCS was unaware that the recirculation valves are supposed to be locked open. This was subsequently announced at a NRC Staff/GPU meeting on December 16, 1983. However, this does not affect UCS's observation that failure of the recirculation flow paths could require prompt operator action because: 1) GPU has demonstrated a proclivity for failing to have valves in their correct positions; 2) there are other valves in the recirculation flow paths which, if closed, could block recirculation flow; and 3) locking open the EFW pump recirculation line valves creates an additional safety hazard. We explain each of these seriatim.

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<sup>13/</sup> H. D. Hukill, Director of TMI-1, to J. F. Stolz, NRC Staff, "EFW Flow Devices (D/P) Testing", November 23, 1983, p. 1.

<sup>14/</sup> Id. at 2.

<sup>15/</sup> UCS Response at 5-6.

<sup>16/</sup> Licensee's Reply at 3.

The adequacy of the plant design features and administrative controls provided to assure that valves are in their correct positions was a subject of the restart hearing. In response to a contention first advanced by UCS and later adopted as a Licensing Board question, the ASLB found "that the EFW system is important to safety whether or not it was classified as a safety system at the time of the accident." The Board also found that "[t]he existing automatic indicators . . . in conjunction with the additional administrative control being implemented by Licensee . . . will serve to verify the operational readiness of systems important to safety."<sup>17/</sup>

Despite these predictions by the Licensing Board, GPU has continued to demonstrate its inability to ensure that important valves are in their correct positions. For example, when containment integrity was required, a conflict between plant procedures caused a containment isolation valve to be partially open. In another instance, two independent verifications of valve position failed to identify a valve in the "stuck" open position. Finally, the Staff identified "three apparent violations during hot functional testing in which valves were inadvertently left open or were misoperated, that resulted in safety components being inoperable for short periods of time."<sup>18/</sup>

Thus, in view of GPU's history of mispositioning valves both prior and subsequent to the TMI-2 accident, GPU's claim that the EFW recirculation line valves will be locked open provides little assurance that recirculation flow will be available. Therefore, the availability of EFW flow instrumentation

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<sup>17/</sup> Metropolitan Edison Co., (Three Mile Island Nuclear Station, Unit 1), LBP-81-59, 14 NRC 1211, 1313, December 14, 1981. See also generally paragraphs 887-906 at pp. 1312-1317.

<sup>18/</sup> See Richard W. Starostecki, IE, to H. D. Hukill, Director, TMI-1, October 28, 1983, and enclosed Inspection Reports 50-289/83-25 and 50-289/83-26.

which is accurate at low flows is required so that, among other things, prompt operator action might be taken to prevent damage to the EFW pumps if the recirculation flow path is blocked.

Second, UCS is aware from attending NRC Staff/GPU meetings that GPU's promise to lock open the EFW recirculation line valves applies specifically to valves EF-V-8A, EF-V-8B and EF-V-8C. However, the recirculation lines also contain check valves (EF-V-19A, EF-V-19B and EF-V-21) and throttle valves (EF-V20A, EF-V20B and EF-V22).<sup>19/</sup> Even if these valves were added to the list of those which are supposed to be locked open (in the case of the check valves, this might not be possible), the above discussion regarding GPU's history of mispositioning valves would still apply.

Finally, even if all EFW recirculation line valves were actually locked open, this would create another safety problem, namely: the loss of excessive water from the condensate storage tank following an earthquake. The recirculation lines are not seismically qualified and have not even been shown to be capable of remaining intact during the very mild Operating Basis Earthquake.<sup>20/</sup> As GPU has noted, the combination of the loss of water from the broken recirculation lines and the CST "B" de-ice line "would present a safety concern" since there would be not be sufficient water in the Condensate Storage Tanks to cool down the plant.<sup>21/</sup> If the recirculation line valves are locked open, the operator would be unable to close them promptly to halt the water loss. (Of course, since the recirculation line valves are not presently

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<sup>19/</sup> Lic. Ex. 1, "Restart Report," Figure C-302-081, Rev. 17.

<sup>20/</sup> H. D. Hukill, Director, TMI-1, to Darrell G. Eisenhut, NRC Staff, Seismic Qualification of Auxiliary Feedwater System, September 29, 1981, p. 1.

<sup>21/</sup> H. D. Hukill, Director, TMI-1, to J. F. Stolz, NRC Staff, July 7, 1982, Encl. 2, "Evaluation of TMI-1 Condensate Supply for Emergency Feedwater," p. 4.

seismically qualified either,<sup>22/</sup> the operator might not be able to close them even if they were not locked open. This is only one aspect of the dilemma GPU faces in trying to justify operation with an EFW system that is not safety grade.)

In summary, locking open the EFW recirculation line valves is not a viable alternative to providing EFW flow indication which is accurate at low flows.

Another argument advanced by GPU in its attempt to justify operation of TMI-1 with inaccurate EFW flow instrumentation is that during manual takeover of the emergency feedwater system, "the operator would not control flow based upon this indication alone."<sup>23/</sup> Mr. Hukill also made this point, stating that "Emergency Feedwater continues to be controlled based on the OTSG level and pressure (level to prevent over/under-filling and pressure to prevent over-cooling). The operator's attention is focused on these instruments when regulating flow."<sup>24/</sup>

First of all, the requirement for safety grade EFW flow indication was adopted by NRC with full recognition of the existence of steam generator level indication.<sup>25/</sup> However, the utility of steam generator pressure in

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<sup>22/</sup> H. D. Hukill, Director, TMI-1, to D. G. Eisenhut, NRC Staff, February 16, 1982, enclosure, Table A.

<sup>23/</sup> Licensee's Reply at 4.

<sup>24/</sup> H. D. Hukill, Director of TMI-1, to J. F. Stolz, NRC, "EFW Flow Devices (D/P) Testing," November 23, 1983, p. 2.

<sup>25/</sup> During the TMI-1 restart hearing, the requirement for two flow indicators for each steam generator was clarified as follows: "As a fall-back position, one auxiliary feedwater flow channel may be backed up by a steam generator level channel." Staff Ex. 1, NUREG-0680, "TMI-1 Restart," June 1980, p. C8-38, emphasis added.

controlling EFW flow is not explained by GPU nor is it apparent. In any event, the TMI-1 emergency procedures focus on venting of the steam generators (using the turbine bypass or atmospheric dump valves) as the principal means the operator should use to control steam generator pressure. A review of the TMI-1 emergency procedures in UCS's possession indicates that the operator does not use steam generator pressure to control EFW flow rate and we have nowhere previously heard this asserted. In addition, cavitating venturis in the EFW discharge lines minimize the potential for overcooling as a result of excessive EFW flow, a condition in which the EFW flow instruments are allegedly accurate anyway.

Secondly, the requirement for EFW flow indication was adopted to provide the capability in the control room to ascertain the actual performance of the EFW system. This requirement was relaxed, for Westinghouse and Combustion Engineering plants, to the extent that only one EFW flow indicator for each steam generator is required "for PWRs with U-tube steam generators because flow indication is of secondary importance in assuring steam generator cooling capability for steam generators of this design."<sup>26/</sup> Because TMI-1 uses a once-through steam generator design, EFW flow indication is of primary importance.

Finally, GPU's arguments ignore the TMI-2 accident lessons learned in another respect. During the accident, the operators focussed their attention on pressurizer level and shut off the emergency core cooling system to the detriment of core integrity. The operators then ignored indications of extremely high temperatures in the core because they knew the incore thermo-

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26/ NUREG-0737, "Clarification of TMI Action Plan Requirements," November 1980, p. II.E. 1.2-4.

couples were not safety grade and thus potentially unreliable.<sup>27/</sup> Now GPU proposes to have the operators focus their attention on the steam generator level and pressure instruments and assist the operators in understanding how the EFW flow instruments perform, i.e., inaccurately at low flows. It is unlikely that such an approach can meet the requirement that the EFW flow instruments "not increase the potential for operator error."<sup>28/</sup>

GPU's final response is related to our point that GPU has turned its back on the experience of the TMI-2 accident by putting the operators in a position where they have to take important actions on the basis of unreliable instruments. We noted that during the TMI-2 accident, the operators ignored the thermocouple readings showing extremely high core temperatures because they knew the instruments were not safety grade and thus potentially unreliable.<sup>29/</sup> GPU's breathtaking response is that the "EFW flow instrumentation at TMI-1, however, is safety grade."<sup>30/</sup> This response is remarkable on several levels. First, an instrument without reasonable accuracy cannot be said to be safety grade. Secondly, these instruments are not reliable and cannot therefore be relied upon by the operators. That is precisely what the fundamental problem was with the thermocouples. GPU has missed the forest for the trees -- whatever the cause of the unreliability, the result is that the operators cannot be assured that the information they need to safely operate the plant is accurate.

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<sup>27/</sup> NRC Special Inquiry Group, "Three Mile Island, A Report to the Commissioners and to the Public," January 1980, Vol. 1, p. 126; Vol.II, Part 3, pp. 898, 901.

<sup>28/</sup> NUREG-0737, p. II.E.1.2-5.

<sup>29/</sup> UCS Response at 5.

<sup>30/</sup> Licensee's Reply at 4.

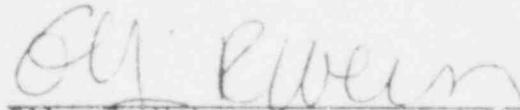
In summary, the lessons learned from the TMI-2 accident specifically require what TMI-1 does not have -- emergency feedwater flow instruments meeting strict, detailed performance criteria to ensure that operators can rely on them. Faced with the reality that it lacks sufficient technical competence to design accurate EFW flow instruments despite two attempts, GPU essentially attempts to argue that accurate instruments are unnecessary. Such an argument was not advanced by GPU during the restart hearing. Its advancement at this late date does not cure its fundamental defect -- it has no merit.

#### Conclusion

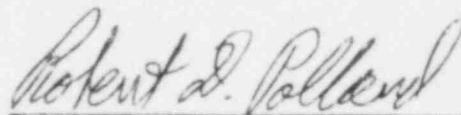
The root cause of most of the difficulties discussed above is that GPU is attempting to patch bandaids over a fundamentally deficient EFW system. If the EFW system were truly safety grade, each of its component parts could be relied upon to perform its function and not to fail in ways that compromise safety. Instead, each time GPU tries to jury rig a temporary "cure" for one part of the system's deficiencies, it causes or accentuates others.

UCS urges the Commission at the least to reject GPU's attempt to circumvent the short-term lessons-learned requirements for EFW flow instrumentation.

Respectfully submitted,



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Dated: January 6, 1984

UNITED STATES OF AMERICA  
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METROPOLITAN EDISON COMPANY )  
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Docket No. 50-289  
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CERTIFICATE OF SERVICE

I hereby certify that copies of "UCS REBUTTAL TO LICENSEE'S REPLY REGARDING EFW FLOW INSTRUMENTATION" have been served on the following persons by deposit in the United States mail, first class postage prepaid, this 6th day of January 1984, except as noted by an asterisk.

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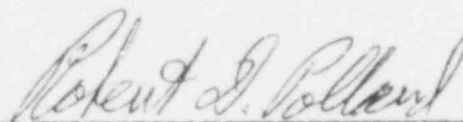
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