UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 9, 1994

Docket No. 50-247

Mr. Stephen B. Bram
Vice President, Nuclear Power
Consolidated Edison Company of
New York, Inc.
Broadway and Bleakley Avenue
Buchanan, New York 10511

Dear Mr. Bram:

SUBJECT: RESOLUTION OF CONSOLIDATED EDISON COMPANY OF NEW YORK INC. COMMENTS ON ACCIDENT SEQUENCE PRECURSOR ANALYSIS - INDIAN POINT NUCLEAR GENERATING UNIT NO. 2, LER 92-007

On June 11, 1993, Consolidated Edison Company was requested to provide written comments on the Preliminary Evaluation of Licensee Event Report 247/92-007, "RPS Actuation Resulting From Turbine Trip On High Steam Generator Level," one of the 1992 precursor events included in the NRC Office for Analysis and Evaluation of Operational Data (AEOD) draft Accident Sequence Precursor Report (ASP). You provided comments by letter of June 25, 1993, and they were sent to the ASP contractor, Oak Ridge National Laboratory (ORNL), for consideration in the final analysis of the precursor events.

We appreciate the comments and the additional information furnished for our analyses and, for your information, we are enclosing documentation from ORNL which provides the resolution of your comments. Volumes 17 and 18 of the issued ASP report NUREG/CR-4674 contain a more complete perspective of the analyses that have been performed and Appendix G of Volume 18 includes your comments on the precursor analysis along with NRC comments.

Sincerely,

Francis J. Williams, Project Manager
Project Directorate I-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosure:
ASP Analysis of LER 247/92-007

cc w/enclosure:
See next page

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ASP Analysis of LER 247/92-007

Reference 1: Letter from M. L. Miele, Consolidated Edison Company of New York, Inc., Indian Point Station to the U.S. Nuclear Regulatory Commission, dated June 25, 1993, Docket No. 50-247.

Comment 1: The event is described as a "reactor trip and auxiliary feedwater pump failures". This description suggests that the auxiliary feedwater (AFW) pump failed during this event. In fact, the pumps were fully capable of providing the required flow, even under the reduced suction pressure condition, but were prevented from starting by a protective feature. To more accurately reflect the condition experienced, we suggest that the event description be revised to read: "reactor trip and auxiliary feedwater pump protection actuation".

Response 1: Motor-driven auxiliary feedwater pump (MDAFWP) 21 started and stopped 6 times in rapid succession. MDAFWP 23 did not start when a valid start signal was present and the turbine-driven auxiliary feedwater pump (TDAFWP) was not started. For the purposes of the accident sequence precursor (ASP) analysis, this is assumed not to be nominal system performance. The title has been changed to "reactor trip and AFW pump problems."

Comment 2: In the fifth sentence of this paragraph [B.5.1] it is noted that one of the two MDAFWPs failed to start. As stated above, a more accurate representation of this anomaly is that the pump was prohibited from starting by its protection circuit. Accordingly, this sentence should be revised to reflect this.

Response 2: The sentence was revised to, "... and the other did not start."

Comment 3: In line 10 of this paragraph [B.5.2] it is noted that "No information was available concerning the TDAFWP; presumably its operation was not demanded." We confirm that the TDAFWP did not receive a demand to start signal, however, it would have performed its function on demand during this event. Its function was not demanded due to the immediate mitigating action of closing valve LCV-1128. The TDAFWP would have functioned on demand because its required net positive suction head (NPSH) was well below the low pressure transient condition existing at the suction of the MDAFWP. Furthermore, as noted in the supplemental information provided in Licensee Event Report (LER) 92-17, the TDAFWP does not have a low suction pressure trip. This pump's availability was further confirmed in a test subsequent to the event.

Response 3: It is unclear why the TDAFWP was not employed as indicated in plant procedures during the event, unless there were concerns about its availability. In any event, the ASP AFW model employed correctly reflects the fact that manual intervention is required to utilize the TDAFWP. The Updated Final Safety Analysis Report (UFSAR) for Indian Point indicates that, "The pump itself will only operate on recirculation flow since the AFW regulating valves in its discharge are normally closed. In order to deliver flow to the steam generators (SGs) using this pump, the operator must open one or more of the associated AFW regulating valves, and manually adjust the speed controller for the turbine."

LER 92-017 reports that the MDAFWPs were found to be incapable of performing their safety functions under some design basis conditions. It also reports, in apparent contradiction to LER 92-007, that "it was discovered that both MDAFWPs tripped on low suction pressure when a demand to-start occurred concurrent with the interconnected hotwell vacuum drag make-up line fully open." No data regarding the TDAFW test was provided.

Comment 4: This paragraph [B.5.4] reflects several potential misunderstandings. First, the second sentence indicates that reduced condensate inventory to the AFW system could have occurred had the operators not responded in a prompt manner. However, there are specific system design features to ensure adequate

condensate inventory. Had the operators failed to isolate valve LCV-1128, valve LCV-1158 would have closed automatically when a preset storage tank level was achieved. This action would also have alleviated the low suction pressure condition (i.e., isolated the vacuum drag from the condenser). This valve-tank level control system interlock ensures a minimum water level will be maintained in the condensate storage tank (CST) to preserve AFW system inventory. Second, AFW system design provisions, as noted in our UFSAR and in your report includes an alternate supply of water from the 1.5 million gallon city water storage tank.

Response 4: Wording has been modified to make it clear that the concern is for system operability, not water inventory.

Comment 5: Third, the omission of appropriate valve actuation and diverse makeup capability represented by the TDAFWP in your model substantially affects the analysis results. Inclusion of this capability alone would cause the analysis results to approach the cut off frequency. Moreover, an additional recovery was available through the condensate pumps, one of which continued to operate throughout this event. This SG makeup path does not require operation of the main boiler feed pump (MBFP) and is called for by procedure should both the AFW system and MBFPs fail. Further, the operator's response and early recognition of the problem were the result of knowledge and understanding of this phenomena, due to similar past experiences with condensate and AFW system interactions.

Response 5: The ASP analysis assumes the aberrant AFW system behavior indicates or could itself cause a reduction in system availability. For example, starting a large electric motor six times in 74 seconds can cause the motor windings to overheat or cause the supply breaker for the motor to trip. Subsequent removal of the low suction pressure condition does not necessarily restore the system to full availability.
In the actual event, the TDAFWP was not started even though both MDAFWPs were not performing their required function. This implies that there may have been some concern about its availability. In any event, the TDAFWP must be manually aligned to supply condensate to the SGs. Therefore, it is appropriate to model it as requiring operator action to succeed.

Limited data is available concerning the thermal hydraulics, reactor physics, human factors, and other issues related to secondary side depressurization and alignment of a condensate pump for SG makeup. Using available information, an attempt was made to credit this strategy.

It is possible that a review of prior events involving interactions between the condensate and AFW systems could provide additional information on the event analyzed, however no information was available regarding these events so they were not considered.

Comment 6: Lastly, in the third sentence of this paragraph [B.5.4], reference is made to the operation of the AFW pumps with inadequate suction supply, which could result in damage to the pumps. As noted previously, the AFW pumps required NPSH is below the low pressure suction switch setpoint. Thus, the pumps were prevented from starting by a conservatively set protection device. The pumps would have functioned as designed, and were therefore not challenged by this specific condition. As a result of extensive analyses subsequent to this event, we have eliminated the trip function of the MDAFWPs low suction pressure switch, retaining only the alarm function. In regards to the fourth sentence, we confirm that a high SG level trip would result in the trip of the main feedwater (MFW) pumps.

Response 6: This sentence was rephrased.

With respect to the MFW pumps, the LER indicated that a subsequent report was to be issued regarding the aberrant behavior of the MBFP 21, however this report has not been received. In addition, the status of the other feedpump is not clear. If neither of the feedpumps could have been promptly put back in service, then the ASP model for this event may be non-conservative, as it allows for recovery of MFW.

Comment 7: Actuation of the TDAFWP (which was available throughout the event and would have been demanded by procedure had valve LCV-1128 not been immediately closed) was not modeled.

Response 7: The TDAFWP is modeled in the ASP analysis as not being automatically available to supply the SGs, but credit is given for its manual alignment. This is consistent with the information provided in the UFSAR. See the response to comment 3.

Comment 8: An additional, available and operating recovery path, i.e. condensate pumps, one of which continued to operate throughout this event was omitted from the model.

Response 8: This path was credited in the analysis.

Comment 9: The nonrecovery value assigned (i.e., 0.04) is too pessimistic in as much as the immediate response of the operators reflected a knowledge and understanding of the potential for an open path to the condenser to cause a low AFW pump suction pressure.

Response 9: No information was provided regarding other events in which AFW operability was compromised by use of the condensate makeup line. The recovery value employed is a standard value used in the ASP program for recoveries which may be performed from the control room and which are considered routine or procedurally based. See Vol. 17, Section A.1.3 of this report and references therein for further discussion.

Comment 10: Adequate inventory to the AFW system was never threatened given the automatic control features of the valve LCV-1158 mentioned previously; and

Response 10: Wording of the description has been changed to clarify that pump availability, not water inventory, is the concern.

Comment 11: Automatic operation of LCV-1158 would allow the start (automatic and/or manual) of both MDAFWPs,

Response 11: As above, the concern is that the events described could indicate or cause reduced availability of AFW pumps.

Comment 12: It is our assessment that the estimated conditional probability of core damage of 2.9×10^{-4} is too high and excessively overstates the true risk significance of this event. We believe that the additional information provided herein calls for a conditional core damage probability below the ASP cutoff (i.e., 1×10^{-6}).

Response 12: The event has been re-analyzed, incorporating recently provided information. While the conditional core damage probability estimate has been reduced, this event is still classified as a precursor. In the ASP program, a reactor trip, AFW demand and AFW pump failure or failures will inevitably result in a conditional core damage probability estimate greater than the cutoff.

March 9, 1994

Docket No. 50-247

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Original signed by:

Francis J. Williams, Project Manager
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Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosure:
ASP Analysis of LER 247/92-007

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