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June 5, 2001

Re: Indian Point Unit No. 2
Docket No. 50-247
NL-01-072

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station O-P1-17
Washington, DC 20555-0001

Subject: Review of NRC's Preliminary Accident Sequence Precursor Analysis of August 1999 Operational Event at Indian Point Unit 2

Reference: USNRC Letter to Con Edison dated April 17, 2001

The referenced letter transmitted to Consolidated Edison Company of New York, Inc. (Con Edison) for comments, a copy of the NRC's preliminary Accident Sequence Precursor (ASP) Program analysis of an operational event, which occurred at Indian Point Unit 2 on August 31, 1999. We have completed a review of the subject analysis, and have provided our comments in the attachment to this letter.

No new regulatory commitments are being made by Con Edison in this correspondence.

Should you or your staff have any questions regarding this matter, please contact Mr. John McCann, Manager, Nuclear Safety & Licensing at (914) 734-5074.

Sincerely,

A. Alan Blind

Attachment

JE22

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ATTACHMENT TO NL-01-072

Comments on Accident Sequence Precursor Analysis of August 1999 Operational Event

Consolidated Edison Company of New York, Inc.
Indian Point Unit No. 2
Docket No. 50-247

The following comments to the NRC preliminary Accident Sequence Precursor (ASP) analysis are identified by their respective headings and page numbers.

Page 2 - **Additional Event Related Information**

Loss of DC Bus 24 and consequences

As indicated in the second paragraph, the turbine driven AFW Pump continued to run for 7.4 hours and was not stopped and restarted until Battery 24 was depleted. This timeline is significant in the later discussion of failure rates and sequences. It is also significant that recent evaluations have shown that bleed and feed cooling with a single PORV would have been adequate for decay heat removal at that point.

Pages 3, 4, and 5 - **Modeling Details and Key Assumptions**

Probability of failing main feedwater (MFW)

Main feedwater was indeed available following this event and could in fact have provided makeup to the steam generators without additional operator action had the remaining AFW pumps failed to operate. Following the trip, the reactor coolant system temperature drops below 541°F, which closes the main feedwater regulating valves and ninety seconds later, closes the main feedwater bypass valves. Had AFW not been available, the primary system temperature would have begun to recover. Once the primary system temperature rose above 541°F, the signal to the regulating valves would have cleared and the valves would have automatically re-opened. Since the MFW pumps were still running, makeup would have been restored to the steam generators.

Probability of failing the turbine driven AFW Pump

It is true that the turbine driven AFW pump was stopped and restarted to control flow to the steam generators. However, as stated in the event description section, this did not occur until more than seven hours after the event, following Battery 24 depletion. As a result, it is not appropriate to use the higher failure rate (.093) during the first seven hours of the event. This is significant in several respects when examining the dominant contributors for Sequence 17, described in Table 6 of your analysis.

1) The dominant contribution to failure of EDG 22 is failure to start or failure to run within the first hour, both of which would have occurred far in advance of battery depletion. Since the dominant cutsets combine failure of the TDAFW pump with failure of EDG 22 (which provides emergency power to AFW pump 21), we do not believe it is reasonable to assume that the operators would have turned off the only remaining AFW pump as they did in the event, where they knew that the other motor driven pump remained available. As a result, we believe that use of the base probability for failure of the TDAFW pump would be more appropriate when considering this combination of basic events.

2) The basic event value used for recovery associated with this sequence (LOOP-17-NREC) is based on a two-hour recovery time window. Since the higher value proposed for the TDAFW pump failure rate applies after battery depletion at seven hours, a more appropriate value for this recovery term, when used in association with the higher TDAFW pump failure rate would be one associated with a nine hour (seven hour delay + two hour recovery) time window. Based on the information provided in your report, this time window would produce a frequency for the time after battery depletion that is more than two orders of magnitude lower than that which would be associated with the time prior to battery depletion. Again, use of the base probability for failure of the TDAFW pump would be more appropriate when combined with the currently proposed recovery term.
3) Sequence 17 includes guaranteed failure of the bleed and feed cooling method. As mentioned previously, decay heat removal would be substantially reduced at the time of battery depletion, and bleed and feed cooling with a single PORV would be a success path at that point. As a result, cutsets that include the TDAFW pump failure to start should really be evaluated under two conditions:
    a) Initial failure to start, with the base (0.03) failure to start probability and no assumed bleed and feed backup capability, and
    b) Failure to start (re-start) after battery depletion with some credit for bleed and feed backup cooling

   Given the time available for the operator to initiate bleed and feed cooling seven hours after the event, even with a single relief path, it would not be unreasonable to expect a reduction of two orders of magnitude in cutset frequency for case (b) above. As a result, the failure frequency associated with the second time period would be relatively insignificant compared to the initial time period.

Based on the above, we believe that use of the base probability for failure of the TDAFW pump would be more appropriate when considering the combination of basic events included in the LOOP Sequence 17 cutsets.

Probability of failing feed-and-bleed cooling

See comments provided above.

Probability of failing to recover emergency power to bus 6A

Bus 6A was not actually tagged out until more than four hours after the event. Since the dominant contribution to failure of the other two EDGs is failure to start or failure to run within the first hour, Bus 6A would not yet have been tagged out and the recovery (basic event EPS-DGN-FC-23-OB) analyzed in Section 1 of Attachment 1 of the preliminary accident sequence precursor analysis should not include tag removal time (which currently dominates that human action).

Probability of failing to recover offsite power to safety related buses from 6.9kv buses

The human error probability calculation for recovering power to the 480V buses from the 6.9kv buses is not accurate in that it assumes the same actions as required for loss of Bus 6A would have to be performed in the event of failure of all EDGs. In such a case, the operators would actually be directed to emergency operating procedure ECA- 0.0, "Loss of All AC Power." This is a much clearer path. ECA-0.0 is a well-recognized and understood procedure and part of operator ongoing training. In fact, in response to the station blackout rule, it was demonstrated that offsite power can be restored using the gas turbines in less than one hour. As noted in the preliminary accident sequence precursor analysis, there would have been no need to start the gas turbines for this event, since offsite power was already available from the 138kV and 13.8kV offsite power feeders.

Time available to recover high-pressure injection in the event of an RCP seal LOCA

The comment provided above with respect to loss of all AC power also applies for this scenario.

Page 12 - **Table 1: Definitions and Probabilities for Selected Basic Events**

Basic Event MFW-SYS-TRIP

This event represents "Main feedwater system unavailable given a reactor trip" and is given a very high value of 0.8.

As noted in your report, main feedwater was available following this event and would normally be expected to be available for the type of event that occurred. As previously mentioned, had the remaining AFW pumps failed to operate, the primary system temperature would have risen above 541°F, the close signal to the main and low flow bypass regulating valves would have cleared and the valves would have automatically re-opened. Since the MFW pumps were still running, makeup would have been restored to the steam generators without further operator action.

Basic Event MFW-SYS-UNAVAIL

This event is represented as "Main feedwater system fails after the reactor trip" and is given a value of 0.2.

It is not clear what this event actually represents since the previous event addresses MFW unavailability following a trip. If it represents the MFW response to other than reactor trip initiated conditions, then it would appear that cutsets containing this event would not be applicable to this CCDP analysis.

Basic Event EPS-DGN-FC-23-OB

This event represents "Operator fail to close output breaker of EDG 23" and is given a value of 0.1.

As discussed previously, this recovery action, as analyzed in Section 1 of Attachment 1 of the report, is dominated by the time required to remove the tagout on Bus 6A. Since Bus 6A was not actually tagged out until more than four hours after the event, the above value would only be reasonable for scenarios where recovery of the EDG was not attempted prior to that point. For loss of all power events, the other EDGs would have to be initially successful and not fail until after four hours. As noted previously, the dominant contribution to failure of the other two EDGs is failure to start or failure to run within the first hour, both of which would have occurred in advance of the tagout of the bus. For loss of AFW caused by failure of Bus 3A and failure of the turbine driven AFW pump, again the dominant contributors are early failures. Since in both instances, Bus 6A would not yet have been tagged out, the recovery analyzed in Section 1 of Attachment 1 of the report should not include tag removal time (which currently dominates that human action). Without that contribution, this basic event would be reduced by a factor of ten.

Page 15 - **Table 2: Basis for the probabilities of sequence-specific recovery actions**

Notwithstanding our abovementioned position that the human error probability calculation for restoration of offsite power is inaccurate for loss of all three EDGs, it appears that the offsite power recovery values used for a number of the LOOP-18 sequence specific recovery actions is not consistent with the calculations performed in Section 2 of Attachment 1.

Page 19 - **Table 6: Conditional Cutsets for Higher Probability Sequences**

<u>LOOP Sequence 17</u>

Cutsets 1, 2, 3 and 4:	The comment on treatment of basic event EPS-DGN-FC-23-OB applies to these cutsets.
Cutsets 1 and 4:	The comment on MFW-SYS-UNAVAIL applies to these cutsets
Cutsets 2 and 3:	The comment on MFW-SYS-TRIP applies to these cutsets.
Cutsets 1, 2, 3 and 4:	The comment regarding the probability of failing the turbine driven AFW Pump applies to these cutsets.

<u>LOOP Sequence 18-02</u>

Cutsets 1, 2 and 3:	The comment on loss of all AC power and use of ECA-0.0 applies to these cutsets.
Cutset 2:	The comment on treatment of basic event EPS-DGN-FC-23-OB applies to this cutset.

NOTE: Cutsets associated with LOOP Sequences 18-02 assume that battery depletion precludes further use of the turbine driven auxiliary feedwater pump. Indian Point 2 has installed pneumatic steam generator level and pressure monitoring instrumentation that is located in the auxiliary feedwater pump room and does not depend on DC power. This would allow the operators to continue local control and use of the turbine driven pump to feed the steam generators even after battery depletion.

LOOP Sequence 18-08

Cutsets 1, 2 and 3:	The comment on loss of all AC power and use of ECA-0.0 applies to these cutsets.
Cutset 2:	The comment on treatment of basic event EPS-DGN-FC-23-OB applies to this cutset.

NOTE: Indian Point 2 also has an installed Alternate Safe Shutdown System (ASSS) which can provide power to a minimum set of equipment (including auxiliary feedwater pump 21) required to achieve safe shutdown without use of power from the 480VAC vital buses. Although this system requires operator action, it was available during this event and its use is described in an abnormal operating procedure (AOI 27.1.9) that is referred to in Emergency Operating Procedure ECA-0.0, discussed above.