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September 24, 1993

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

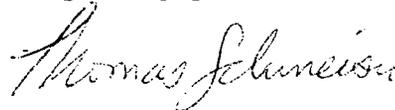
Mr. Thomas T. Martin
Regional Administrator - Region I
US Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

SUBJECT: Preliminary Evaluation - Service Water Pump
Failures

Attached is documentation of the event associated with the recent failure of service water pump No. 23, the evaluation performed to date and the conclusions of the review by the Station Nuclear Safety Committee. This preliminary evaluation is being provided to the NRC at their request for their information.

Should you have any questions regarding this matter, please contact Mr. Charles W. Jackson, Manager, Nuclear Safety and Licensing.

Very truly yours,



Attachment

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ATTACHMENT

PRELIMINARY EVALUATION

SERVICE WATER PUMP FAILURES

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
INDIAN POINT UNIT NO. 2
DOCKET NO. 50-247
SEPTEMBER, 1993

PRELIMINARY EVALUATION

SERVICE WATER PUMP FAILURES

Description of the System and Its Safety Function

The service water system is designed to supply cooling water from the Hudson River to various heat loads in both the primary and secondary portions of the plant. Provision is made to ensure a continuous flow of cooling water to those systems and components necessary for plant safety, either during normal operation or under abnormal and accident conditions.

Six vertical, centrifugal sump-type pumps supply service water to two independent discharge headers; each header is supplied by three of the pumps. Either of the two supply lines can be used to supply the essential loads with the other feeding the non-essential loads. The essential service water loads include the containment fan cooler units, emergency diesel generator coolers and the instrument air compressor heat exchangers. The non-essential service water loads include the component cooling water heat exchangers and conventional plant loads. However, the conventional plant loads are normally cooled from the Unit 1 river water pumps. Only two of the set of three service water pumps on the header designated the essential header are required immediately following a postulated loss of coolant accident. During the recirculation phase of the accident, one additional service water pump on the non-essential header will be manually started to supply the minimum cooling water requirements for the component cooling system.

Observed Condition

On Wednesday, September 22, 1993, Indian Point was operating at full power with two service water pumps (SWP 21 and SWP 22) operating on the non-essential service water header. SWP 23 was tagged out for scheduled maintenance on an electrical transfer switch.

At approximately 1140 hours SWP 23 was started and run from its Alternate Safe Shutdown Supply (ASSS) electrical feed as part of the Post Maintenance Test (PMT) for the transfer switch. The Central Control Room (CCR) did not observe any increase in the non-essential service water header pressure during the pump run. This may have been due to the non-essential service water header pressure being at approximately 80 psi prior to pump start.

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This is close to the maximum pump discharge pressure, so the addition of the third pump on the header may not increase the header pressure significantly. When SWP 23 was secured, the operator at the pump noted that pump rolldown in the reverse direction took an unusually long time and was at an unusually high speed. Some pump rolldown in the reverse direction is normal as the column of water in the discharge pipe flows back through the pump on shutdown of the pump.

The transfer switch was shifted to the normal Unit 2 electrical feed (Bus 6A). The shaft on SWP 23 was verified to be stopped and the pump was then started on its normal electrical feed. The CCR again observed no increase in the non-essential service water header pressure. The operator at the pump checked the pump for normal operation and then went to the zurn strainer pit to check the pump strainer. While the operator was in the pit, the CCR secured SWP 21 and noted a 20 psi reduction in the non-essential header pressure. When the operator exited the strainer pit he noted an unusual amount of noise from SWP 23. He immediately informed the CCR and recommended that SWP 21 be started and SWP 23 be secured. The CCR operators complied with this recommendation. During the rolldown of SWP 23 the operator noticed an unusual amount of play (1/8" - 1/16") in the pump shaft and the pump came to a stop without the normal reverse roll. This is indicative of a parting of the pump shaft. The total pump run time on Bus 6A was 1-1/2 to 2 minutes.

The plant was never in a technical specification limiting condition for operation (LCO) action statement because only two service water pumps are required to be operable on the non-essential header. SWP 23 was removed and sent to the vendor for failure analysis. A replacement pump has been installed on the non-essential header.

This failure follows two previously identified and reported service water pump failures. On August 9 and 10, 1993, two service water pumps on the non-essential header failed due to shaft coupling failures. These pumps had been operating at their times of failure. Analysis of these couplings indicated failure due to sudden torsional impact such as would result from the impact of the pump impeller against entrained debris. However, no debris was found in the pumps or in the service water piping. Some debris was found in the service water bay but could not be determined to be the cause of the failures. These failures were the described in Licensee Event Report (LER) No. 93-09 sent to the NRC on September 9, 1993.

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Applicable Regulatory Requirements

The Indian Point Unit No. 2 Technical Specification Section 3.3F provides the requirements for operability of the service water pumps. This Technical Specification section requires that whenever the reactor is brought above 350°F three service water pumps with their associated piping and valves are to be operable on the designated essential header, and two service water pumps with their associated piping and valves are to be operable on the designated non-essential header.

A limiting condition for operation action statement is required when one of the three service water pumps on the essential service water header is inoperable and/or when one of the two required service water pumps on the non-essential service water header is inoperable.

Evaluations and Conclusions

Upon failure of SWP 23 on September 22, 1993, all technical specification requirements were still fully satisfied because three service water pumps on the essential header and two service water pumps on the non-essential header were operable. When SWP 23 was replaced on September 24, 1993, this restored the "spare" non-technical specification pump (i.e., there were a total of six operable service water pumps).

Although SWP 23 is an Aurora manufactured pump similar to SWP 21 and SWP 22 which failed in August, 1993, this failure of SWP 23 occurred during pump startup while the earlier two pumps failed while in service. In addition, the laboratory analyses of the earlier failed SWP 21 and SWP 22 determined that "impact" or sudden torsional coupling failures occurred at the No. 1 and No. 4 couplings, respectively. Initial visual observation of SWP 23 indicated that the No. 2 coupling had failed. This failure appears to be impact related, however the cause of this impact may be different than the earlier two. This failure may be consistent with the shaft having backed out of the coupling due to reverse rotation of the pump and then rethreading upon pump start. If the shaft backs out of the coupling and then rethreads upon pump start with the shafts impacting each other, the coupling can exhibit impact failure. This mode of failure has been observed in the past.

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The discharge check valve for 23 SWP was removed and inspected. The valve was found to hang up when manipulated by hand and there was evidence that it may not have been seating properly. This supports the operator's observation of pump reverse rotation on shutdown and the impact related failure of the coupling. Tests are being conducted to verify the operation of the remaining discharge check valves starting with the one associated with SWP 26.

Currently, the essential header consists of SWP 24 (a Layne Bowler pump), SWP 25 (a first-time use new Aurora pump in service since November 1991), and SWP 26 (an Aurora pump with reused couplings in service since October 1992). The non-essential header consists of SWP 21 (a Layne Bowler pump), SWP 22 (an Aurora pump with new couplings in service since August 1993), and the newly replaced SWP 23 (a Layne Bowler pump). The diversity of age and manufacturer of these pumps results in a very low probability of common design catastrophic failure. Nonetheless, since SWP 26 is an Aurora pump with reused couplings, we intend to replace it as soon as a spare service water pump becomes available. As an additional precautionary measure, all service water pumps are being monitored every 6 hours via a supplemental log for pump vibration, discharge pressure, and bearing seal water leak off flow, along with service water header pressures. This monitoring will continue until SWP 26 is replaced.

All of the installed couplings currently meet design strength criteria. The couplings are designed to fail on impeller or shaft impact in order to preserve shaft integrity. NRC Information Notice 93-68 entitled "Failure of Pump Shaft Coupling Caused By Temper Embrittlement During Manufacture", dated September 1, 1993 alerted licensees to problems caused by temper embrittlement of certain couplings. Con Edison has determined that two of the three couplings that have failed in the last five weeks (SWP 21 and SWP 23) were temper embrittled. However, these couplings were tested and found to meet design specifications. These couplings are designed to withstand stresses associated with normal and startup loads and are designed to fail under sudden impact loads.

With regard to hypothetical "impact" failures potentially caused by foreign objects, no such objects were found in the removed SWP 23 impeller. Subsequent inspection of the bay yielded several foreign objects, none of which have been directly linked to this current pump failure. These objects are in the process of being evaluated as to acceptability or removal. In addition, a QC boundary control practice is in place for the service water bay areas to assure that maintenance activities do not introduce any unknown objects.

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Only 2 of 3 pumps on the essential header and only 1 of 3 pumps on the non-essential header are needed to satisfy minimum safeguards for the design basis accident. In addition, with manual manipulation of service water loads, any 2 of 6 service water pumps can satisfy minimum long-term cooling requirements. Also, even though not designed as safeguards equipment, an intertie to the Unit 2 service water system from Indian Point 1 exists which is supported by two river water pumps and four screenwash pumps which can supply contingency cooling water to Unit 2 loads.

Based upon the above considerations, we believe that there is reasonable assurance that the service water pumps are operable and are not susceptible to a design common mode failure.