U.S. NUCLEAR REGULATORY COMMISSION

REGION I

Report No. 84-34

Docket No. 50-247

License No. DPR-26 Priority -- Category C

Licensee: Consolidated Edison Company of New York, Inc.

4 Irving Place

New York, New York 10003

Facility Name: Indian Point Nuclear Generating Station, Unit 2

Inspection At: Buchanan, New York

Inspection Conducted: December 10-19, 1984

Inspector: T. Kenny, Senior Resident Inspector — 1.21.85 date

Approved By: for Leif Norrholm, Chief, Reactor Project Section 2B, DPRP — 1.22.85 date

Inspection Summary:
Inspection on December 10-19 and 22, 1984 (Report No 50-247/84-34)

Areas Inspected: This special inspection was conducted to identify the reason that throttle valves in the Auxiliary Feed Water System were set in the non-conservative direction. The inspection involved 18 hours by the resident inspector.

Results: The report attached, identifies concerns that contributed to the actual settings of the Auxiliary Feed Water throttle valve settings.

Event:

On December 7, 1984, the licensee informed the Resident Inspector and made a 50.72 notification concerning the discharge valves of the motor-driven auxiliary feed water pumps. In their report, the licensee identified that the valves were set to deliver approximately 60 gpm vs. 150 gpm as set forth in the NRC Safety Evaluation dated August 30, 1982, which is the basis for setting the flow to each steam generator to 150 gpm. The following is a chronology of the events leading to the improper setting:

Resident Inspector Findings:

- On November 13, 1973, the licensee experienced a severe water hammer shock in the feedwater system which damaged a containment penetration and broke the feed water line.

- In January 1974, the licensee discussed, with the former AEC, their intention to perform an extensive test program to assure modifications made to the plant would be adequate to prevent further water hammer problems. A program was conducted in early 1974 with a report to the Commission, dated March 12, 1974, which concluded that water hammer could be experienced at excessive flow rates in the auxiliary feed water system following a low-level steam generator trip. The report further identified that the water hammer began at approximately 200 gpm flow rate to each steam generator. The report concluded by stating that internal modifications should be made to the steam generators. The test program performed 14 controlled tests at various flow rates to the steam generators to validate when water hammer occurred. As of this writing, the actual test documents have not been recovered to validate the flow settings on the motor operated pump regulating valves.

- As a result of the above stated test program, Westinghouse issued a Technical Bulletin dated June 10, 1975, delineating to all Westinghouse plants the need to limit auxiliary feed water flow, following a steam generator low level trip to, 150 gpm. This conservative setting was below the 200 gpm where water hammer was encountered in the test program. The bulletin also recommended feed water line configuration changes.

On November 26, 1979, Westinghouse issued another Technical Bulletin indicating that the installation of J tubes in the steam generator feed water ring could prevent water hammer and negate the need for procedural controls on feed water flow rates, and their installation should permit timely recovery of the steam generator water levels.

The licensee installed the J tubes.

During subsequent reviews by the NRC concerning auxiliary feed water system operation, the NRC asked the licensee the following question, and got the response shown below: (This was in a licensee transmittal of December 19, 1979.)

Recommendation GS-3

The licensee has stated that it throttles AFW system flow to avoid water hammer. The licensee should reexamine the practice of throttling AFW system flow to avoid water hammer.

The licensee should verify that the AFW system will supply, on demand, sufficient initial flow to the necessary steam generators to assure adequate decay heat removal following loss of main feed water flow and a reactor trip from 100% power. In cases where this reevaluation results in a increase in initial AFW system flow, the licensee should provide sufficient information to demonstrate that the required initial AFW system flow will not result in plant damage due to water hammer.

Response

We have reviewed our operating procedure requirement for initiating auxiliary feedwater flow at a throttled condition, and consider it to be acceptable. The existing procedures require the flow to be throttled only at startup of the auxiliary feed water system to preclude the possibility of water hammer and, except for one special condition, the operator is permitted to immediately increase the flow rate. The one exception is noted in the following cautionary note from SOP 21.3 "Auxiliary Feed Water System:"

> If the feed ring is uncovered (steam generator level below 15% for more than 5 minutes with no feed flow) then feed flow, when resumed, should be limited to 150 gpm until the feed ring is full (steam generator level above 15%). This requirement does not apply in cold shutdown.

This limitation is further relaxed in the emergency procedures for shutdown following a unit trip which requires that the flow be throttled only until an increase in level, in the steam generator, is seen. The auxiliary feed water system is the normal mode for reactor cooldown, and the adequacy of the existing procedures is demonstrated by the fact that they have been in effect since 1974 and used more than 180 times without any problems.

Also in the same submittal was this recommendation and its response:

Plant Specific Recommendation (Short Term)

The pneumatic-operated valves in the steam supply line to the turbine-driven AFW pump, and all of the pneumatic-operated AFW flow control valves derive their power from the same non-safety grade bus. Although these valves are designed to fail open upon the loss of air or power, thereby assuring [illegible] feed water flow to the steam generators upon such los[illegible] cannot be concluded that all failures will result in opening the valves. The consequences of voltage degradation should be analyzed as well as other failures (e.g., restricted air flow) to assure that such events would not incapacitate the auxiliary feed water system. The licensee should establish suitable emergency procedures to assure AFWS function for such event.

Response

Appropriate procedures to assure auxiliary feed water (AFW) system function in the event of abnormal failure of the pneumatic operated AFW flow control or steam supply valves are being prepared and will be implemented by January 1, 1980. While it might be possible to postulate an abnormal condition that could conceivably have some effect on the fail safe functioning of the pneumatic operated valves, the potential for such an event occurring or having any significant safety effect is negligible. In making this evaluation, the following aspects of the plant design and operation were considered:

- At startup, after the main boiler feed water system has taken over the function of supplying secondary water to the steam generators and while still at a low power level, the AFW regulating valves are preset to the 35% open position for the next usage of the AFW system.

- With the regulating valves in an open position, any electrical or pneumatic system malfunction could only have an effect in the conservative direction, i.e., the valves could go to the fail safe open direction, but could never be driven to the closed position.

- Starting from a plant trip from the 100% power level with the steam generator water inventory at the low level (30%) point, there is in excess of 30 minutes available before the steam generators could boil dry because of a loss of all feedwater.

- The pneumatic valves have operating air bypass valves to relieve the pressure on the diaphragms permitting manual operation to control AFW flow. This feature along with the approximate 30 minutes boil dry time ensures that any event, caused by a malfunction, can be rectified before an unsafe condition could develop.

It should be noted here that the demand controller in the control room is demand for % closure of the auxiliary feed water regulating valve, and if this controller was set at 35% closed, then the valve would be 65% open.

On June 13, 1980, the Commission issued an interim safety evaluation on the auxiliary feed water system that once again asked the licensee to verify that the AFW system will supply the necessary water to the steam generators with the AFW regulation valves throttled. This document referred to the licensee's statements in letters dated December 19, 1979 and April 14, 1980, that indicated the valves were set to deliver ~50 gpm.

The licensee responded on August 11, 1980 as follows:

Question 3:

Verify that the AFW pumps in your plant will supply the necessary flow to the steam generator(s) as determined by items 1 and 2 above considering a single failure. Identify the margin in sizing the pump flow to allow for pump recirculation flow, seal leakage, and pump wear.

Response to 3:

Flow rates for all of the design transients described in Response 2 (not included in this report) have been met by the system for the worst single failure. The flows for those single failures considered are tabulated for the various transients in Table 3-1, including the following:

A. Turbine Driven Pump Failure

B. Motor Driven Pump Failure

C. AFWS check valve failure (failure to close on reverse flow).

There is approximately 15% margin for the turbine-driven auxiliary feed pump which allows for a continuous recirculation flow and bearing cooling flow, as well as any seal leakage and pump wear. The motor-driven auxiliary feed pumps do not utilize pump discharge flow for bearing cooling. Also, the recirculation flow path is automatically isolated when pump flow increases above 55 gpm (maximum recirculation flow), thus providing flow only to the steam generators at design conditions. Pump wear and seal leakage are considered to be negligible.

Table 3-1 includes the effect of throttling of the auxiliary feed water system. As can be seen in all cases, the minimum flow requirement of 400 gpm is clearly exceeded.

TABLE 3-1

Auxiliary Feedwater Flow (1) to Steam Generators
Following an Accident/Transient
With Selected Single Failure - GPM

Accident/Transient		Single Failure		
		TD Pump Failure	MD Pump Failure	CV(2) Failure
		A	B	C
1.	Loss of Main FW	600	900	1200
2.	Blackout	600	900	1200
3.	Cooldown	600	900	1200

Notes:

(1) Items 1 through 3 are minimum expected flows to intact loops.

(2) Including only those CV's in the AFWS. "Failure" is interpreted as failure to close on reverse flow; failure of the CV to open to permit flow in the normal direction is not considered.

Then on October 9, 1980, the Commission followed with the letter "Attachment A." The licensee responded on November 26, 1980 with "Attachment B."

In 1980, following the outage connected with the containment flooding event, the licensee replaced the trim in the AFW regulating valves with a "like in kind" replacement. A safety evaluation for the replacement of the trim stated that the same criteria existed for the new and old trims.

On August 30, 1982, the NRC issued Amendment #79 to Technical Specifications which made the following statement, in the safety evaluation, concerning auxiliary feed water flow:

> Basis for AFW System Flow Requirements
>
> On August 11, 1980, the licensee submitted an analysis indicating that the AFW system must have a capacity to supply at least 400 gpm total to at least two steam generators. The Indian Point 2 AFW control valves are preset to deliver 150 gpm maximum to each steam generator (600 gpm total).
>
> However, it is possible for a single failure to reduce total flow below the minimum capacity assumed in their analysis. Although operator action could increase flow by opening the control valves, the staff does not recognize operator action for at least 10 minutes following an accident or transient. On November 26, 1980, the licensee submitted the results of an analysis which demonstrated that without operator action for 10 minutes and assuming the limiting failure, the reduced flow rate will still adequately remove decay heat and meet the criteria used for the August 11, 1980 analysis. Therefore, the staff concludes that the basis for the Indian Point 2 AFW system flow requirements is acceptable.
>
> Recently, an engineer tasked with evaluating parameters of the AFW system could not obtain the necessary data points from an existing curve relating to the pressure drop across the AFW Copes Vulcan regulating valves, currently installed at the plant. The engineer contacted the vendor to get a better curve. When the curve was obtained, he discovered that the 35% valve open setting (65% on the demand controller) would only deliver 60 gpm instead of the 150 gpm desired. The licensee then made the necessary notifications.

Mitigating Factors

A. The accident scenario delineated in Chapter 14 of the FSAR discusses the 150 gpm flow rate with only one AFW motor driven pump in service, which corresponds to the analysis addressed in "Attachment B." The resident inspector asked the licensee to reproduce the scenario on the simulator with all existing conditions except 60 gpm rather than 150 gpm to the steam generators. The results were:

1. Flow delivered to two of the steam generators from one motor driven AFW pump was 45 gpm.

2. In 10 minutes, no loss of heat sink.

   In 20 minutes, still no loss of heat sink.

   In 45 minutes, 30% S/G level in the steam generators being fed and 20% in the non fed steam generators.

B. Operator training, operating procedures, and emergency procedures instruct the operator not to exceed 150 gpm and to take control of the feed regulating valves as soon as the operator can determine that no feed water line rupture has occurred. This is done by observing level in the steam generators, and then feeding the steam generator, as necessary, to maintain the desired steam generator level.

C. Of the trips that have occurred since the valves have been throttled, no instance has been identified that would indicate the loss of a heat sink.

D. The licensee has stated that Westinghouse is performing a safety evaluation for the lower valve settings. The inspector will review this document when it is issued.

Testing

Technical Specifications only requires that the AFW system motor driven pumps be tested to full flow every refueling outage. This is done with the feed water regulating valves full open.

No Technical Specifications require testing of the throttled flow through the feed regulating valve.

The inspector reviewed a special surveillance that was performed in order to verify the flow through the motor operated Auxiliary Feedwater Pump Feedwater Regulation Valves, which verified that two of the four valves, while set at 35%, will deliver the necessary 150 gpm per steam generator, while the remaining two valves would only deliver approximately 80 to 100 gpm to their respective steam generator. As a result of this surveillance, the licensee has documented, and set all of the regulation valves to deliver 150 gpm to each respective steam generator.

Items of Concern

1. The 35% setting referred to in one of the licensee submittals does not have a basis and does not delineate if the setting is the valve or the controller.

2. The curve relating to flow through the feed regulating valves that existed prior to the one recently acquired from the valve manufacturer was not an authorized curve and apparently had not been approved by engineering.

3. As delineated in Report 84-21, the record storage system is inadequate to retrieve records in a reasonable amount of time. In fact, during the course of this inspection, certain records could not be found.

4. No records could be produced that confirmed that the trim installed in the valves presently is the same as the trim that was in the original.

Exit Interview

An exit interview was held with senior facility management to discuss the inspection scope and findings. The licensee was asked to identify any proprietary information provided to the inspector in the course of the inspection. No such information was identified.

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

APPENDIX A

October 9, 1980

Docket No. 50-247

RECEIVED
OCT 30 1980
MIN L. LEE

Mr. Peter Zarakas
Vice President-Engineering
Consolidated Edison Company
of New York, Inc.
4 Irving Place
New York, New York 10003

Dear Mr. Zarakas:

To support the analyses submitted August 11, 1980 for the Indian Point 2 auxiliary feedwater (AFW) system, the AFW system must have a capacity to supply at least 400 gpm total to at least two steam generators. With the control valves preset to deliver 150 gpm maximum to each steam generator (600 gpm total), a single failure could reduce total flow to below the minimum capacity assumed in your analyses. Although operator action could increase the flow rate to the minimum requirement by opening the control valves, we do not recognize operator action for at least 10 minutes following an accident or transient. Assuming that you wish to maintain the preset throttle position on your control valves, demonstrate by analyses that, without operator action for at least 10 minutes, the reduced flow rate will adequately remove decay heat and still meet the criteria used for your analyses.

As an alternative, or if the accident analyses criteria cannot be met, you should increase the preset throttled position of the control valves to meet the minimum flow requirements assuming the worst case single failure. With the addition of J-tubes and your present criteria that allows increasing the flow rate at any time if the feedring has not been uncovered for more than 5 minutes, the increased flow rate may decrease the possibility of water hammer since the feedring would be less likely to become uncovered. Operator action would then only be required to decrease the flow rate if the feedring became uncovered and it appeared that it would remain uncovered for greater than 5 minutes.

Please respond within 30 days of receipt of this letter.

Sincerely,

Steven A. Varga, Chief
Operating Reactors Branch #1
Division of Licensing

cc: See next page

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APPENDIX B

John D. O'Toole
Assistant Vice President

Consolidated Edison Company of New York, Inc.
4 Irving Place, New York, N Y 10003
Telephone (212) 460-2533

November 26, 1980

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

Director of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

ATTN: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing

Dear Mr. Varga:

As requested by your October 9, 1980 letter, an analysis has been performed for the loss of main feedwater, assuming a single failure, which, due to the preset position of the auxiliary feedwater system control valves, results in 150 gpm of auxiliary feedwater being delivered to each of two steam generators. This flow rate is assumed to commence upon initiation of auxiliary feedwater for a period of ten minutes, at which time operator action is taken to increase the flow rate to 200 gpm to each of two steam generators.

The analysis was performed assuming the plant initially operating at 102% of the licensed power rating, (calorimetric error) and loss of main feedwater concurrent with a station blackout. As discussed in our August 11, 1980 letter, the loss of main feedwater concurrent with station blackout establishes the minimum flow requirements for the auxiliary feedwater system. Other values of plant parameters considered in this analysis are the same as those considered in the previous analysis described in our August 11, 1980 letter, for which no operator action was required.

The results of the analysis demonstrate that the reduced auxiliary feedwater flow rate profile of 300 gpm for the first 10 minutes, followed by 400 gpm thereafter, in conjunction with an initial

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power rating of 102% of the Indian Point Unit No. 2 power rating will satisfy the auxiliary feedwater design basis.

Should you or your staff have any additional questions, please contact us.

Very truly yours,

John D. O'Toole
Assistant Vice President