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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 31 TO FACILITY OPERATING LICENSE NO. DPR-64

POWER AUTHORITY OF THE STATE OF NEW YORK

INDIAN POINT NUCLEAR GENERATING UNIT NO. 3

DOCKET NO. 50-286

INTRODUCTION

The results of the September 1979 steam generator inspection at Indian Point Unit No. 3 indicated an increase in the amount and extent of denting since the last inspection was performed in July 1978. These results were discussed during a meeting held on October 25, 1979 between representatives of the Power Authority of the State of New York (the licensee), Westinghouse, and the NRC, and were documented by the licensee in its submittal dated January 28, 1980. At the request of the NRC staff, the January 28, 1980 submittal includes a proposal for a license amendment to require a steam generator inspection midway through Cycle 3 operation, and proposed changes to the Indian Point 3 Technical Specifications to incorporate more stringent operating limits on primary to secondary leakage.

DISCUSSION

Previous Inspection

During the first refueling outage of Unit No. 3 in 1978, the first inservice inspection of the steam generators was performed on steam generators 33 and 34. This inspection revealed many dent indications with an average dent magnitude of 0.004 inches for tubes in the tubelane region. Away from the tubelane region, the dent indications were not of sufficient magnitude to be quantified. A substantial number of the dent indications occurred at the top tube support plates. No hourglassing (flow slot deformation) of the support plate flow slots was reported.

September 1979 Inspection Program

The original program for the steam generator inspection during the second refueling outage in September 1979 had called for multifrequency eddy current and gauging inspection of 491 tubes (9% sample), hot and cold legs and through U-bend, in steam generators 32 and 33. Tubes to be inspected included Row 1 and Row 2 tubes near the flow slots, Row 1 tubes between the flow slots, "hardspot" areas of the tube bundle periphery, and selected tubes throughout the center of the tube bundles. This program had been submitted for NRC staff review and had been modified to reflect ensuing staff comments.

Inspection of steam generator 32 indicated that the amount and extent of denting had progressed since the last inspection and flow slot hourglassing of the upper support plates was observed. Based upon these initial findings, it was decided to (1) plug all Row 1 tubes in each of the four steam generators, (2) complete the inspection of steam generators 32 and 33 as originally planned (with the exception that the eddy current inspection of steam generator 33 was performed using single frequency (400 KHZ) rather than multifrequency ECT), and (3) expand the program to include a gauging inspection of steam generators 31 and 34. The gauging inspection of steam generators 31 and 34 was performed on the hot leg side in the peripheral and patch plate areas and Row 2 tubes where denting could be expected to occur first.

The eddy current inspection of each steam generator involved the use of a 720 mil probe. If any tube did not pass this size probe, successively smaller probes were used until the size of the restriction was quantified. In all, five different size probes were used to determine the size of a restriction (720 mils, 700 mils, 650 mils, 600 mils, and 540 mils). In addition, all tubes adjacent to any tube which failed to pass a 650 mil probe were also subjected to eddy current testing with a 650 mil probe.

The implemented steam generator inspection included a photographic examination of the lower tube support plate and flow slots for all four steam generators using the hand holes above the tubesheet for access.

Sludge lancing was performed on all four steam generators to remove sludge from the areas above the tubesheet.

INSPECTION RESULTS

Eddy current inspection revealed no tubes with detectable indications (such as due to thinning or cracking). Significant tube restriction activity at support plate intersections (denting) was observed, however, as indicated in the following table:

HOT LEG

Steam Generator	No. of Tubes Inspected	No. of Tubes Restricting Probe Sizes of 720 mil	700 mil	650 mil	600 mil	540 mil
31	488	254	73	5	2	[illegible]
32	537	288	161	15	3	0
33	682	294	130	19	9	1
34	498	243	127	18	3	1

COLD LEG

Steam Generator	No. of Tubes Inspected	720 mil	700 mil	650 mil	600 mil	540 mil
32	501	74	5	0	0	0
33	526	107	41	8	1	0

Photographs of the flow slots for the lower two support plates revealed that "hourglassing" had occurred and that some support plate cracking had occurred at the flow slots. Flow slot closures ranged to a maximum of 0.55 inch with an average value of 0.37 inch. The average rate of hourglassing was calculated to be 0.033 inch per month since the previous inspection.

Tube plugging

All 92 Row 1 tubes in each of the four steam generators were preventively plugged as a result of the observed flow slot hourglassing in the lower support plates and the potential for hourglassing in the upper support plate. This was done to preclude leaks and potential tube rupture due to cracks at the apex of the tube U-bends which could be induced by the support displacement of the legs of the U-bends because of the hourglassing of the flow slots. This phenomenon was responsible for an 80 GPM tube rupture event at Surry Unit 1 in 1976 affecting a Row 1 tube at the apex of the U-bend. Laboratory examinations and analyses of tubes from units which have experienced hourglassing, and operating experience indicate the Row 1 tubes to be the most susceptible to this U-bend cracking pheonomenon. U-bend cracks or leaks due to this phenomenon have not been observed at any unit to date beyond Row 1 tubes.

In addition to Row 1 tubes, all tubes restricting passage of a 650 mil probe were plugged, including five (5) tubes in steam generator 31, 15 tubes in steam generator 32, 21 tubes in steam generator 33, and 18 tubes in steam generator 34. These numbers do not include 10 tubes which were inadvertantly plugged. The total plugging count to date at Indian Point Unit No. 3 is 104 tubes (3.2%) for steam generator 31, 115 tubes (3.5%) for steam generator 32, 117 tubes (3.6%) for steam generator 33, and 119 tubes (3.7%) for steam generator 34.

PROPOSED LICENSING AMENDMENT AND TECH SPEC CHANGES

In view of concerns expressed by the NRC staff during the October 25, 1979 meeting regarding the apparent high rate of denting at Indian Point Unit No. 3, the licensee has proposed a change to its operating license to require a mid-cycle inspection of one steam generator during the 18 month (approximately) period of Cycle 3 operation, and an inspection of all four steam generators at the conclusion of the cycle. NRC approval would be required before critical operation could be resumed following both the mid-cycle and end of cycle inspections.

As requested by the NRC staff, the licensee has proposed changes to the Technical Specification limits on primary to secondary leakage through the steam generators. With the proposed changes, the leak rate limit for any one steam generator would be reduced from 0.348 gpm to 0.30 gpm, beyond which the unit would be required to shutdown for steam generator inspection and repair. The proposed changes include an added requirement to shutdown for steam generator inspection and repair if any two separate tubes are found to leak during any 20 day period, regardless of the leakage level of each tube. Whenever the reactor is shutdown, or a steam generator removed from service, to investigate a steam generator leak and/or to repair a leaking tube, the Technical Specifications would require that the NRC be notified before the reactor is brought critical.

The remaining changes to the Technical Specifications proposed by the licensee involve clarifications in the reporting requirements for steam generator inspections. We have reviewed these changes and consider them not to change, in a substantive sense, current reporting requirements.

EVALUATION

Based upon previous denting related tube leak occurrences on December 7, 1978 and March 20, 1979, and the finding of widespread tube restrictions and hourglassing of the tube support plate flow slots during the most recent inspection, the staff considers Indian Point Unit No. 3 to be the latest among 10 operating PWR units which have experienced moderate to extensive denting of the steam generator tubes. The number of tubes restricting passage of a .650 inch probe or less is still small compared to the number of affected tubes in more severely degraded units such as Indian Point Unit No. 2, Turkey Point Unit Nos. 3 and 4, and Surry Unit Nos. 1 and 2 (prereplacement steam generators). However, the average rate of flow slot hourglassing, calculated to be 0.033 inches per month since the previous inspection, is high compared to what has been observed at other units and suggests that the denting phenomenon may be developing at a significant rate at Indian Point Unit No. 3.

As requested by the staff, the licensee has proposed a change to its operating license to require a mid-cycle inspection of one steam generator during Cycle 3 operation, and an inspection of all four steam generators at the end of the cycle. Under this proposal, NRC approval would be required before critical operation could be resumed following both the mid-cycle and end of cycle inspections. We find that the licensee's proposal provides adequate provision for monitoring the rate of denting and for establishing, on a timely basis, the need for additional licensing actions (e.g., more restrictive preventive plugging criteria). The amendment requires that Unit No. 3 be required to shutdown for the mid-Cycle 3 inspection within nine (9) equivalent full power months from the start of Cycle 3 operation, but not after January 1, 1981. For purposes of this SER, equivalent full power operation is defined as operation with primary coolant temperature greater than 350°F.

It should be noted that NRC approval to resume equivalent full power operation following the mid-cycle and end of Cycle 3 steam generator inspections will be contingent upon the adequacy of the inspections performed in view of the results obtained, and also the adequacy of the implemented preventive plugging program to support continued operation to the next scheduled steam generator inspection. In addition, approval to resume full power operation following the mid-cycle inspection of one steam generator will be contingent on whether the inspection results adequately justify not performing a mid-cycle inspection of the other three steam generators.

The more restrictive primary to secondary leakage rate limits proposed by the licensee are consistent with those currently in effect at other more severely degraded units. The proposed changes provide additional assurance that the occurrence of a through wall crack during operation will be detected and appropriate corrective action will be taken such that an individual crack will not become unstable and burst under normal operating, transient, or accident conditions.

In conclusion, we find that the proposed changes to the Indian Point Unit No. 3 operating license and Technical Specifications, as identified in the licensee's submittal dated January 28, 1980, will provide reasonable assurance of continued safe operation of the unit.

Environmental Consideration

We have determined that the amendments do not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendments involve an action which is insignificant from the standpoint of environmental impact and, pursuant to 10 CFR §51.5(d)(4), that an environmental impact statement or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of these amendments.

Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the amendments do not involve a significant increase in the probability or consequences of accidents previously considered and do not involve a significant decrease in a safety margin, the amendments do not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of these amendments will not be inimical to the common defense and security or to the health and safety of the public.

Date: June 27,1980