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March 10, 1998
IPN-98-031

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Subject: Indian Point 3 Nuclear Power Plant
Docket No. 50-286
Response to NRC Generic Letter 97-06:
Degradation of Steam Generator Internals

Reference:
1. NRC Generic Letter 97-06, J.W. Roe, NRC to Operating Licensees, "Degradation of Steam Generator Internals," dated December 30, 1997.
2. NYPA letter IPN-97-173 to the NRC, dated December 19, 1997 titled, "Steam Generator Inservice Inspection Results."

Dear Sir:

Generic Letter 97-06, "Degradation of Steam Generator Internals" was issued to provide to licensees, and to request of licensees, information related to degradation of steam generator internals. The response to the generic letter for Indian Point 3 is included in Attachment I, along with some background information. Attachment II provides a discussion of the steam generator inspections performed and the results obtained.

There are no commitments made by the Authority in this submittal. If you have any questions, please contact Mr. Ian Mew at (914) 287-3197.

Very truly yours,

Robert J. Barrett
Site Executive Officer
Indian Point 3 Nuclear Power Plant

A001

STATE OF NEW YORK
COUNTY OF WESTCHESTER
Subscribed and sworn to before me

this 10th day of MARCH 1998.

Notary Public

CHRISTINA LEITMANN
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Qualified in Putnam County
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ATTACHMENT I

RESPONSE TO GENERIC LETTER 97-06
FOR INDIAN POINT 3

Response to Generic Letter 97-06 for Indian Point 3

Background Information:

Generic Letter 97-06 (GL), "Degradation of Steam Generator Internals" was issued to provide to licensees, and to request of licensees, information related to degradation of steam generator internals.

Prior to issuance of the GL, the Westinghouse Owners Group (WOG), the Electric Power Research Institute (EPRI) and the Nuclear Energy Institute (NEI) developed an action plan to assess the susceptibility to secondary-side degradation. Indian Point Unit 3 intends to follow the industry action plan. Included in the action plan is a requirement to understand the causal factors involved in the degradation experienced in the French units. This information is captured in EPRI report GC-109558, "Steam Generator Internals Degradation: Modes of Degradation Detected in EdF Units". This report was submitted to the NRC via NEI letter, dated December 19, 1997.

The Westinghouse Owners Group has reviewed EPRI GC-109558 relative to the design of Westinghouse Series 51 steam generators and determined limited susceptibility. For plants with Series 51 steam generators, this conclusion is documented in report WCAP-15002, Rev. 1, "Evaluation of EdF Steam Generator Internals Degradation – Impact of Causal Factors on Westinghouse 51 Series Steam Generators", December 1997. The 51 Series designs are the most similar to the EdF units.

WCAP-15002, Rev. 1, documents visual inspections of the plants. It is concluded that the number of plants that have been inspected and the inspection results demonstrate that the causal factors identified by EdF do not jeopardize the continued operability of Westinghouse Series 51 steam generators. Eddy current inspection of the tubes would detect any detrimental effects on the tubing due to wear caused by TSP ligament degradation, loose parts, and secondary side flow distribution changes. Foreign object search and retrieval efforts are conducted to discover loose parts.

Indian Point 3 has Westinghouse Model 44F steam generators. Because a detailed evaluation has not been completed for the Model 44F steam generators, inspection recommendations have been defined on an interim basis. For Model 44F steam generators, a more detailed evaluation should be completed by the end of May of 1998.

A response to item 1 for Indian Point 3 Model 44F steam generators is provided. A tentative inspection plan is discussed. Item 2 of the GL does not apply.

Response to GL Item 1 for the Indian Point 3 Model 44F Steam Generators

(1) *Provide a discussion of any program in place to detect degradation of steam generator internals and a description of inspection plans, including the inspection scope, frequency, methods and equipment.*

Background

As discussed in WCAP-15002, Rev. 1, surveys were sent to all WOG utilities requesting the results of all steam generator, secondary side inspections and relevant tube inspections for tube support plate conditions. Completed surveys were received for 37 of 49 plants. For the Model D, E, 44F and F steam generators, responses were received for 12 plants. Of these, 11 responded as having inspected or reviewed inspection data for TSP ligament indications and 8 having performed SG secondary side entries that give confidence of not having wrapper drop. TSP ligament indications were not found in either steam generators with carbon steel or with stainless steel, support plates.

The modes of degradation detected include many cases of flow-assisted corrosion, or erosion-corrosion, and of premature cracking that results from either surface fatigue or from corrosion cracking that is associated with surface conditions such as pitting or geometric concentrations. For the most part, however, the surveys do not report detection of several modes of degradation experienced in the EdF units. There is no evidence of post chemical cleaning inspections discovering any significant material losses. There is no evidence of any wrapper having dropped. There is no evidence of TSP ligament cracking or thinning that is progressive and continuing. TSP ligament cracking or missing pieces of ligaments have been observed, but only in units with carbon steel support plates with drilled round tube holes and flow holes. These conditions are generally traceable to initial inspections and are not progressing based on sequential inspection data. Many of the conditions are probably related to original TSP drilling alignment. There are cases of indications in TSPs that have been linked to patch plate welds.

Plants with significant hour glassing of the tube support plates as a result of the denting process have exhibited ligament cracking throughout the thickness of the support plate between the flow holes in the plate or the flow holes in the tube lane. If denting remained uncontrolled, as subsequent support plate corrosion occurs, the potential exists for fragments of the support plate material to become completely free of the main TSP structure. However, these plate segments generally remain locked in place because of the in-plane forces that give rise to denting, as well as the deformation that contains the individual piece. Operating plants with active denting are under periodic monitoring by the utility have long-standing criteria reviewed by the NRC. In addition, the EdF experiences reported are not related to support plate degradation that has progressed to the tube denting stage. These plants are therefore not included in this response to GL 97-06.

The secondary side internal degradation types found in Westinghouse steam generators are identified in Table 1.0.

Table 1.0
Secondary Side Internal Degradation Types In Westinghouse Design SGs

SG Category:	Feed Ring Carbon Steel TSPs	Preheat Carbon Steel TSPs	Feed Ring Stainless Steel TSPs	Preheat Stainless Steel TSPs
Degradation Type				
Erosion-Corrosion:				
Moisture Separator	X	S	X(3)	S
Water Box	NA	X	NA	S
TSP Flow Hole/Ligaments	S	S	NA	NA
Feed Ring/J-tubes	X	NA	X(3)	NA
Cracking:				
TSP Ligaments(1)(2)	X	S	L	L
Wrapper Near Supports (2)	L	L	L	L
Transition Cone Girth Weld	X	L	X(3)	L
Other:				
Wrapper Drop(2)	L	L	L	L

X = Observed in some steam generators
S = Susceptible
L = Low Susceptibility
NA = Not Applicable
(1) Various indications of possible tube degradation may be artifacts of manufacturing anomalies related to patch plate welds and drilling alignment
(2) Various Westinghouse design features are beneficial relative to some steam generator design features of foreign manufacturers.
(3) In SG replacements with the original shell and/or upper internals not replaced

NOTES

For IP3 replacement steam generators Model 44F, both shell and upper internals were replaced. IP3 has stainless steel support plates (ASME-SA-240 type 405) and feedring with material type (ASME-SA-106 GR B).

Discussion

The New York Power Authority's current inspection practices for the secondary side inspection are as follows:

- Flow distribution baffle and tubesheet cleaning
- Foreign object search and retrieval (FOSAR)
- In-bundle inspection
- Support plate Inspection using Support Plate Inspection Device (SID)
- Upper Support Plate Inspection
- Cleanliness Inspection
- Steam Drum inspection and Assessment
- Feedring visual inspection
- Wrapper Support Inspection
- Upper girth weld inspection

Flow distribution baffle and tubesheet cleaning, FOSAR, In-bundle Inspection and Cleanliness Inspections are performed at every refueling cycle on all steam generators. A steam drum inspection and assessment is also performed every outage on one steam generator on a revolving basis since the baseline inspection was performed, on all four steam generator, in 1993. See Attachment II for a discussion of inspection results from the Indian Point 3 refueling outage conducted in 1997.

The upper support plate, the SID inspections and wrapper support inspections were performed during the cycle 9 refueling outage as a result of NRC Information Notice 96-09 and Supplement. The inspection scope implemented during cycle 9 was planned for two steam generators (33 & 34), although SID inspections were only performed in one steam generator as a result of equipment malfunction. A similar inspection plan is tentatively planned for the remaining generators (31 & 32) for the next scheduled refueling outage. The inspection plans have been defined on an interim basis.

Since Indian Point Unit 3 intends to follow the industry action plan for model 44F generators, inspection scope and frequency may be adjusted as necessary based on site specific experiences and evaluation of industry results.

Response to GL item 1 for Model 44F Steam Generator

Item 1a — *Whether inspection records at the facility have been reviewed for indications of tube support plate signal anomalies from eddy current testing of the steam generator tubes that may be indicative of support plate damage or ligament cracking.*

No. Under current technology, eddy current is not performed for the support plates due to the quatrefoil broached hole design. Presently, the only available inspection is visual. Therefore, there are no eddy current testing records to review.

Item 1b — *Whether visual or video camera inspections on the secondary side of the steam generators have been performed at the facility to gain information on the condition of the steam generator internals (e.g., support plates, tube bundle wrappers, or other components).*

Steam generator video camera inspections have been performed in-bundle since the steam generators were replaced, and upper internal visual inspections since 1993. Inspections performed and results obtained are provided in Attachment II. The inspection summary for refueling outage (RFO-9) was submitted to the NRC as Attachment II to IPN-97-173, dated December 10, 1997.

Item 1c — *Whether degradation of steam generator internals has been detected at the facility, and how the degradation was assessed and dispositioned.*

No degradation of steam generator internals has been detected at the Indian Point Unit 3 station to-date.

Response to GL item 2 for Model 44F Steam Generator

Item 2 — If the addressee currently has no program in place to detect degradation of steam generator internals, discussion and justification of the plans and schedule for establishing such a program, or why no program is needed.

Based on the program in place to detect degradation previously described, this is not applicable to the Indian Point Unit 3 station.

Assessment of Steam Generator Information

The following safety concerns have been identified relative to the French steam generator, internals degradation experience. These are:

- Loss of tube support leading to steam generator tube wear and possible primary-to-secondary leakage or inadequate burst margins.
- More significant tube support plate deformation during a postulated LOCA +SSE event resulting in unacceptable steam generator tube collapse or secondary-to-primary in-leakage.
- The generation of a loose object in the secondary side of a steam generator which may result in tube wear or impacting and possibly primary-to-secondary leakage.

Based on a review of Table 1.0, the only degradation types that may occur domestically that may result in the loss of tube support plate integrity are: TSP flow hole/ligaments erosion-corrosion, TSP ligament cracking near the patch plates, and TSP ligament cracking in random areas. There are no observations of post chemical cleaning inspections discovering any significant material losses. There are no observations of any wrapper having dropped. There are no observations of TSP ligament cracking or thinning that is progressive and continuing. TSP ligament cracking or missing pieces of ligaments have been observed, but only in units with carbon steel TSPs with drilled round holes and flow holes. All utilities with Model D and E steam generators with carbon steel support plates inspect a significant percentage of steam generator tubes every outage with a bobbin probe, eddy current examination. If sections of the tube support plate are missing, this would be readily detectable due to a lack of eddy current response at the tube support plate elevation and actions can be taken to address the absence of the support. Future application of the voltage-based plugging criteria will also consider the presence of any missing ligaments. The alternate plugging criteria would not be applied at these locations.

It is expected that there is no increased susceptibility to ligament cracking near the wedge supports in the Model 44F steam generator designs. Existing calculations evaluating the effects of LOCA + SSE loadings on the tube bundle continue to apply in determining whether certain tubes should be excluded from application of the voltage-based plugging criteria or whether certain tubes should be removed from service in plants which do not currently apply such a criteria but which may have steam generator tubes experiencing cracking at the tube support plate intersections.

Another occurrence resulting from steam generator internals degradation that may affect a steam generator from performing its intended safety function is the potential for tube wear and primary-to-secondary leakage due to the generation of a loose object on the secondary side of the steam generator. This may occur due to erosion-corrosion of the moisture separators, tube support plate flow holes, or the occurrence of tube support plate ligament cracking. If primary-to-secondary leakage should occur due to tube wear from a loose object, the expected consequences would be bounded by a single tube rupture event and, therefore, would remain within the current licensing bases of a plant.

We believe that loose objects should be removed from the steam generator, whenever possible. Tubes observed to have visible damage should be eddy current inspected and plugged if found to be defective.

Since no steam generator internals degradation has been observed at Indian Point Unit 3 station, it is expected that steam generator internals degradation would be limited in extent such that the tubes will remain capable of sustaining the conditions of normal operation, including operational transients, design basis accidents, external events, and natural phenomena permitting the steam generator to perform its intended safety function. Eddy current inspection, foreign object search and retrieval (FOSAR) activities (during each refueling outage) and loose parts monitors should help to ensure the maintenance of tube integrity during subsequent plant operation.

The inspections performed during cycle 9 are also tentatively planned to be implemented at the next refueling on the remaining steam generators (31 & 32) to determine the condition of those generators. This tentative plan to be implemented at Indian Point's Unit 3 is to address the various types of steam generator secondary side internals degradation that may occur in Westinghouse designed steam generators. Changes may need to occur following the completion of a more detailed evaluation of these components, tentatively scheduled for May of 1998.

Reference

1. WCAP-15002, Rev. 1, "Evaluation of EDF Steam Generator Internals Degradation - Impact of Causal Factors on Westinghouse Series 51 Steam Generators"

ATTACHMENT II

DISCUSSION OF STEAM GENERATOR INSPECTIONS PERFORMED AND RESULTS OBTAINED

DISCUSSION OF STEAM GENERATOR INSPECTIONS PERFORMED AND RESULTS OBTAINED

1.0 Introduction

The four Steam Generators at Indian Point Unit 3 (IP3) were replaced in 1989 with Westinghouse model 44F units. These units have been constructed in accordance with the 1983 ASME Boiler and Pressure Vessel Code Section III, through the summer 1984 Addenda.

The first internal inspection of the model 44F units was implemented in November 1993, not only to examine for degradation from five years of service, but also to establish a baseline for comparison for future inspection.

The components examined consisted of the major internal components of the Steam Generator that are accessible via the secondary side manways. Those components are the Primary Separators, the Secondary Separators, the Feedring and the Feedring J. Nozzles. Additionally, the secondary side manways and studs were also examined for wear and degradation. The primary method of inspection was overall visual examination for gross or obvious abnormalities. Some thickness checks were also performed.

2.0 PRIMARY SEPARATORS

The Primary Separator inspection included a visual examination of the intermediate deck plate and deck supports, access ladders, chinning bar and deck plate drains, piping and all associated welds. A detailed visual inspection was performed on the swirl vanes noting structural integrity, flow hole blockage and erosion. A housing roundness check for selected swirl vanes was performed by use of calipers.

The condition of the Primary Separators in all four Steam Generators was found to be excellent. No abnormalities or degraded conditions were present. All quantitative data was within acceptable limits.

2.1 SECONDARY SEPARATORS

The inspection of the Secondary Separators included a visual inspection of the perforated plates, associated welds, jacking bolts, and the Secondary Separator central and compartment drains, specifically noting areas of erosion and perforated plates hole blockages.

The Secondary Separators for all four Steam Generators were found to be in excellent condition with no blockage present. All welds examined were intact and showed no evidence of degradation. The integrity of separator banks "A" through "H" in all four Steam Generators was found to be in excellent condition. All plates were a single unit with the exception of bank "F" in all found generators. The bank "F" plate was installed in two distinctive sections. One anomaly detected was an offset between the abutted plates ranging from approximately 1/16" in Steam Generators 31, 32, and 34 and 1/8" in Steam Generator 33. This does not present an adverse condition but shall be trended in the future for structural integrity.

2.2 FEEDRING AND J-NOZZLES

The Feedring and J-Nozzles inspection included a visual examination of the Feedring, Feedring supports, J-Nozzles, Feedwater Tee, Cover Deck Supports, access hatch welds, upper section of the Thermal Sleeve and all associated welds. Wall thickness measurements of selected samples of the Feedring piping, Feedwater Tee and designated J-Nozzles was performed.

The visual examinations performed in all four Steam Generators were satisfactory. All equipment was found to be in excellent condition. One point of interest found that in Steam Generators 32 and 33 the lower access plate area had a slight amount of sludge buildup in and around the Secondary Separator drain location.

The objective of the thickness readings was to provide baseline data for future inspections and for determination of any circumferential erosion/corrosion anomalies. This was achieved with all readings found to meet minimum wall thickness requirements. However, certain deviations to normal minimum pipe wall were noted. Areas on the reducers at the Feedwater Tee sections for Steam Generators 31, 32, and 33 were detected to be slightly below the component fabrication tolerances provided by Westinghouse. Also, one area of Steam Generator 32 Feedring piping was detected to be below the specified fabrication tolerances. The deviations were forwarded to Westinghouse, evaluated for structural integrity, and were determined to be satisfactory.

It is difficult to ascertain if all of the installed piping is within the specified fabrication thickness tolerances based on the measurements taken. Westinghouse did not provide as-built conditions of the associated piping and reducers. Therefore, comparison of measurements to fabrication dimensions proved to be difficult. It can be concluded, however, that these readings do not indicate any aggressive erosion condition. Those readings will provide a baseline comparison with any future inspection results.

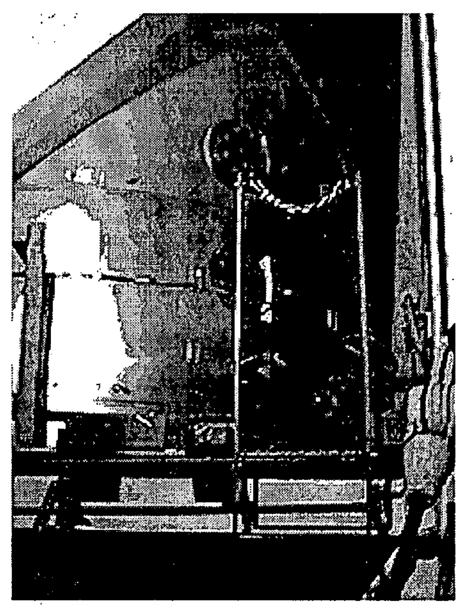
3.0 STEAM GENERATOR SECONDARY SIDE ACTIVITIES FOR REFUELING CYCLE-9

Handhole removal and installation, flow distribution baffle and tubesheet cleaning, FOS, and an In-Bundle Inspection (IBIS) were performed in steam generators 31, 32, 33, and 34. A Support Plate Inspection (SID) was planned for steam generators 33 and 34, but only completed in steam generator 34 due to equipment interferences encountered in steam generator 33. Subsequent to tubesheet cleaning in the first steam generator, 34, a cleanliness inspection was performed to characterized the existing sludge condition. This inspection was video taped.

In steam generator 33 and 34 the inspection port was removed and the "G" support plate inspected. This was an informational gathering inspection to collect data for an engineering assessment of the secondary side structural condition, including erosion, corrosion, and structural weld integrity. This assessment was not of an ISI non-destructive examination nature but a visual evaluation performed by Westinghouse Engineering. This inspection was performed to inspect the support plate for evidence of cracking as identified in NRC Information Notice 96-09 and supplement.

In steam generator 34 the steam drum was inspected. This was an informational gathering inspection to collect data for an engineering assessment of the secondary side structural condition, including erosion, corrosion, and structural weld integrity. This assessment was performed by a visual exam but was not of an ISI non-destructive examination nature. The visual inspections covered a number of areas; "G" support plate inspection through swirl vanes to look for evidence of support plate cracking at attachment points, AVB inspection through the swirl vanes to look for evidence of deposits, the transition cone to shell weld for evidence of pitting during wet lay up, inspection of the moisture separator for mechanical damage, inspection of selected J-nozzle and feedring welds, inspection of the upper wrapper supports, anti-rotation keys, and lower support keys for evidence of mechanical damage or gross cracking of the wrapper, and inspection of the wrapper weld seam for gross mechanical features. This inspection was video taped.

3.1 Visual Inspections at Handholes



Following tubesheet cleaning cleanliness, foreign object searches, and in-bundle inspections were performed on all steam generators using procedure NSD-FP-1997-7965 Revision 2, Remote Examination and Removal of Foreign Objects from Steam Generator Secondary Side, Indian Point 3. For the foreign object search, the annulus and tube lane were inspected. For the in-bundle inspection approximately every 5th column was inspected in each quadrant of the steam generator. Additional in-bundle inspections were performed in steam generator 34 to examine areas where eddy current examination indicated the locations of several potential foreign objects. These inspections were videotaped.

In steam generator 34 a support plate inspection was performed with SID (Support plate Inspection Device); the SID inspection planned for steam generator 33 was aborted when the SID would not fit properly. The SID inspection was performed using procedure NSD-FP-1997-7965 Revision 2, Remote Examination and Removal of Foreign Objects from Steam Generator Secondary Side, Indian Point 3. This inspection was videotaped.

During the eddy current inspection several tubes were identified as having potential loose parts. These were all located in steam generator 34 and were identified during the hot leg +Point probe inspection program. There were a total of 10 tubes in 5 specific areas. All five areas were examined by video probe and 4 of the 5 were identified as hard sludge deposits contacting the tube. The fifth, located in the hot leg near row 2 column 30 was a piece of wire. Following the removal of the object the tubes surrounding this location were inspected again with ECT and did not exhibit damage.

Retrieval of some other foreign objects was performed in steam generators 31, 32, 33, and 34. Some objects were not/could not be retrieved and a safety analysis (NSE 97-3-318-RCS) was performed to address operation without removal of the objects.

3.2 Visual Inspections through the Inspection Port

Procedure NSD-FP-1997-7966 Revision 1, Steam Generator Secondary Side Inspection, Indian Point 3, was used to perform the inspections of the upper, 6th, or "G" support plate. This was an informational gathering procedure to collect data for an engineering assessment of the secondary side structural condition, including erosion, corrosion, and structural weld integrity. This assessment was not of an ISI non-destructive examination nature but a visual evaluation performed by Westinghouse Engineering. A tubelane inspection was performed to assess sludge buildup on the "G" support plate. Additionally an in-bundle inspection was performed on selected columns corresponding to attachment points of the "G" plate to the wrapper. This in-bundle was performed to address concerns identified in NRC Information Notice 96-09 and supplement regarding support plate cracking in some foreign plants. No indications of cracking being present in the "G" support plate were observed. The inspection was videotaped.

3.2.1 Inspection Port / Top Tube Support Plate "G" Inspections:

Steam Generator No. 33:

This inspection was an assessment of the top support plate to provide an indication of sludge buildup or for anomalous conditions. This was an informational gathering inspection to collect data for an engineering assessment of the secondary side structural condition, including erosion, corrosion, and structural weld integrity. Entry was made through the steam generator lower shell upper inspection port and a video probe was traversed along the tube lane passing over the stay rod upper nut. This was a subjective examination with respect to sludge and will be compared to future inspections for evidence of heavy accumulation rates. In addition, the top support plate and its attachment to the wrapper were examined for gross cracking, missing segments, or anomalous conditions.

The initial examinations were in the tube lane region, which included scanning the top surface of the "G" tube support plate (top tube support plate), the tube support plate supports at each end of the tube lane, the bottom of the tube U-bends (Row 1), and looking into the tube rows. All support hardware reference numbers listed below are as specified in procedure NSD-FP-1997-7966 (page 25). This inspection was videotaped.

Wrapper/tube support plate support block #23 at the opposite end of the tube lane was assessed and no signs of deterioration were observed with the support wedges and their welds, and to the local tube support plate (limited views available).

Tube support plate /Tubelane: No sludge deposits were seen in the tubelane, other than what appeared to be a thin magnetite coating with a powdery surface. The flow holes (i.e., two rows of 90 flow holes within the Row 1 U-bend) all looked clear on the top side, and occasional limited views into a few flow holes revealed that original machining marks were still visible and there was no apparent sludge build-up. All viewed row 1 tubes and a few row 2 tubes looked clean, with very little if any scale buildup. The tubes observed showed no marks on their outer diameter surface that could result from tube support plate movement upward. Viewing of the stay rod and nut in the center of the tube lane revealed no apparent weld (3 welds) cracking.

At the inspection port end of the tubelane, tube bundle periphery, stamped letters in the tube support plate "G" top surface could be seen indicating a very thin, if any, magnetite coating at that position. All wrapper block #24 tube support plate support wedges looked clean and in good condition with no cracks observed in the welds (limited view available).

During a second pass through the tubelane to view the bottom of the Row 1- U-bends, all the tube surfaces looked to be clean and in good condition.

The final examinations were in-bundle along the tube columns out to the tube support plate-to-wrapper junctions. These inspections included scanning the top surface of the "G" tube support plate, and the tube support plate supports at each end of the tube columns inspected (hot leg and cold leg). Again, all support reference numbers listed below are as specified in Procedure NSD-FP-1997-7966 (page 25). Observations from the videotape are as follows:

This summary is for the upper "back-up bars" (the lower "back-up bars" could not be seen) which rest against the top surface of the tube support plate (without tube support plate welding) and prevent the tube support plate vertical movement. An assessment has been made of these back-up bars; the following observations were made for the <u>hot leg side</u> junctions at columns 91, 80, 63, 29, 10 and 1, and for the <u>cold leg side</u> junctions at columns 1, 10, 29, 63, and 80, as examined. All upper back-up bars appeared to be in good condition and are resting on the tube support plate top surface, with no observed cracks in the bar-to-wrapper welds (limited coverage). In addition, at these back-up bar locations, no gross cracking, missing segments, or anomalous conditions were observed in the tube support plate (limited views available).

This summary is for the wrapper-to-tube support plate wedge groups that bear against the backside of the wrapper anti-rotation keys (4) and the "U" shaped tapered block attachments (6 of 8 total). An assessment has been made of the upper portion (the lower portion could not be seen) of the wedges and their wrapper attachment welds; the following observations were made for the hot leg side junctions at columns 88, 65, 48, 20, and 4, and for the cold leg side junctions at columns 4, 20, 48, 65, and 88, as examined. All wrapper-to-tube support plate wedge groups (upper portion) appeared to be in good condition and bearing against the tube support plate top surface, with no observed cracks in the attachment welds (limited coverage). In addition, at these wedge group locations, no gross cracking, missing segments, or anomalous conditions were observed in the tube support plate (very limited views available).

For all the above assessments, the tube support plate was examined for the full traverse of the tube column from the wrapper to the tube lane. It was assessed that no gross tube support plate cracking, missing segments, or significant anomalous conditions were observed in the upper "G" tube support plate quatrefoil holes (limited views available - only those columns traversed and the top half of the tube support plate holes). For most of the tube support plate examined, a limited sludge/magnetite coating was present on the top surface and in the tube support plate tube holes. However, in a few locations as noted below, some tube scale was building up between the tube and tube support plate tube hole quatrefoil "lands." This tube scale seemed to be limited to the "land" locations and just above the "lands" on the tube, and in most cases has broken free of the "land" (scale was cracked). Where this tube hole scale existed, generally a little more sludge was present on the tube support plate top surface. These observations of slightly higher sludge concentrations were made for the hot leg side column 29, and for the cold leg side columns 4, 10, 48, 63, 65 and 80, as examined

Additional observations for the inspection port / top tube support plate "G" inspections are as follow:

No foreign objects were observed during the above inspection port inspections.

There were limited views available of the tube support plate at the wedge groups (contact points), where the highest tube support plate stresses exist, during the above inspection port inspections. It was recommended that the additional (optional) inspections of the tube support plate with a video probe from the primary separator entry points be performed in order to get a full picture of these bearing areas. See results of these additional (optional) inspections below (Section 3.3.1.5).

3.2.2 Inspection Port / Top Tube Support Plate "G" Inspections:

Steam Generator No. 34:

This inspection was identical to the inspection performed for the top support plate of SG 33 in section 3.2.1, and was to provide an indication of sludge buildup or for anomalous conditions. Entry was made through the steam generator 34 lower shell upper inspection port and a video probe was traversed along the tube lane passing over the stay rod upper nut. This was intended to be a subjective examination with respect to sludge and will be compared to future inspections for evidence of heavy accumulation rates. In addition, by using an in-bundle style guide tube, the top support plate and its attachment to the wrapper were examined for gross cracking, missing segments, or anomalous conditions.

SG 34 inspection port inspection produced results no different from those observed and reviewed by Westinghouse for SG 33. The SG 34 top tube support plate was inspected by video probe from the swirl vanes and the results of these additional inspection are described later in section 3.3.1.5.

3.3 Steam Drum Inspections

In support of normal maintenance and operation, as well as to address issues identified in the NRC Information Notice 96-09 and supplement, a steam drum and wrapper inspection plan was developed prior to the outage and performed using procedure NSD-FP-1997-7966 Revision 1, Steam Generator Secondary Side Inspection, Indian Point 3. This is an informational gathering procedure to collect data for an engineering assessment of the secondary side structural condition, including erosion, corrosion, and structural weld integrity. Entry to the steam drum was made through a temporary scaffold which was erected at the "B" or outboard manway. This scaffold, which was larger than the permanent scaffold on the reactor cavity side, allowed for staging of equipment and personnel.

Westinghouse NSD Engineering, under contract with NYPA, provided a review and assessment of the steam drum and support plate inspections. These information gathering were of the top support plate accessed through the transition cone inspection port (on steam generators 33 and 34), and of the complete steam drum including remote inspections of the wrapper supports (upper and lower), top tube support plate and supports, and the tube bundle U-bend region, all performed by manned entry into the secondary side of steam generator 34.

From the collective observations which follow, these steam generators, to the extent inspected during this outage by procedure NSD-FP-1997-7966, do not exhibit any advance degradation, and only exhibit the possible initiation of some deterioration modes that should be observed in the future to establish the rate of progression. These possible initiations of deterioration include:

Upper tube support plate "G" tube hole blockage in select areas that are only now beginning to show as scale build-up between the tube support plate quatrefoil hole lands and the tube.

Feedwater ring J-tube discharge impingement on the feedring pipe outer diameter surface and/or on the primary separator riser barrels, now observed as only a "washed" areas void of magnetite build-up and having no discernible depth of base material.

J-tube to feedwater ring inner diameter surface joint erosion-corrosion of the feedwater pipe base material, only identified during this outage as possibly starting for the J-tube closest to the feedwater nozzle and "T" section.

Sludge collection on the lower deck plate where washing off is prevented by the lower deck skirt attached at the periphery of the deck; now showing as a uniform sludge depth of approximately $^{1}/_{16}$ inch and a few local piles up to ½ inch deep.

3.3.1 <u>Steam Generator 34 Upper Steam Drum Inspections</u>

3.3.1.1 <u>Primary Separator/Swirl Vane Inspection:</u>

The criteria for this engineering assessment was to look for gross misplacement or misalignment, gross cracking of welds, discontinuities of weld surfaces, distinct corrosion or erosion patterns, excessive buildup of deposits, or other anomalous conditions.

Visual inspections of a random selection of primary separators and swirl vane assemblies were performed. The inspection results are reported in the Procedure NSD-FP-1997-7966 data package, and no internal deterioration of the primary separator units was observed. A Westinghouse engineer also viewed the interior of approximately 12 primary separators. He observed that all the primary separator swirl vane assemblies were intact, with the swirl vanes not showing any obvious signs of an erosion-corrosion condition. The swirl vane to riser barrel welds all appeared to be intact and showed no signs of erosion-corrosion attack. The riser barrels to which the swirl vanes are mounted, and the perforated riser barrels above the swirl vanes also appeared to be in good condition, with no obvious signs of initiation of erosion-corrosion of the inner diameter surfaces. The perforated riser barrel holes all appear to still be square edged and show no obvious signs of blockage. With an inspection by touch, the trailing edge of the perforated riser barrels and the leading edge of the primary separator orifice ring (primary separator exit pipe at the mid-deck) were confirmed to still have the original manufactured combination square and beveled cut edge, therefore indicating that no erosion-corrosion of these pipe sections is currently taking place. In summary, no deterioration of the primary separators was observed. During the remote inspections of the top tube support plate and AVB assemblies through the primary separators, although the video was not a formal inspection of the primary separator riser barrels, no evidence of deterioration of these riser barrels and swirl vanes and welds, was observed (limited view).

3.3.1.2 Transition Cone to Upper Shell Weld:

The criteria for this assessment are to look for pitting or gross cracks in this circumferential weld seam area. This was an informational gathering inspection to collect data for an engineering assessment of the secondary side structural condition, including erosion, corrosion, and structural weld integrity.

Westinghouse identified for the inspection team the location of the transition cone to upper shell circumferential weld seam, at approximately six (6) inches above the shell inner diameter surface slope transition. Inspections of this area at six different locations around the shell inner diameter surface did not identify a distinct weld seam. This is understandable because the weld inner diameter surface was ground nearly flush with the surrounding base material, and without surface preparation this surface may not exhibit any visible signs of the weld boundary. It can be concluded, that because the inspection was performed in the correct area, but was unable to visually identify the weld seam, that no large scale pitting or gross cracking in the weld exists.

3.3.1.3 Secondary Separator Inspection:

The criteria for this engineering assessment was to look for gross misplacement or misalignment, gross cracking of welds, discontinuities of weld surfaces, distinct corrosion or erosion patterns, excessive buildup of deposits, or other anomalous conditions.

Visual inspections of all eight secondary separator banks were performed The inspection results are reported in the Procedure NSD-FP-1997-7966 data package, and no deterioration of the secondary separator structures was observed. The Westinghouse engineer assessed the external condition of 6 of the 8 secondary separators visually. He observed that all the secondary separator structural welds were intact, with no obvious signs of weld cracking. This included the secondary assembly welds and the welds which attach the perforated plate assemblies to the separator banks (A - H). The secondary separator perforated plates attached to the separator bank entrances all appeared to show no signs of erosion-corrosion attack and the holes remain square cut. The perforated plate holes had very little to no sludge accumulation/blockage. The only exception to this is that the lowermost row of holes on the upper separator banks had initiation of flow hole blockage (~ 10%); this is a lower flow area. An attempt to view the secondary separator demister vanes through the perforated plate holes was difficult, but no internal sludge build-up was observed (limited views available). In summary, no deterioration of the secondary separators was observed.

3.3.1.4 J-Nozzle and Feedwater Ring Inspection:

The criteria for this engineering assessment was to look for gross misplacement of misalignment, gross cracking of welds, discontinuities of weld surfaces, distinct corrosion or erosion patterns, excessive buildup of deposits, or other anomalous conditions.

Remote video probe inspection was performed on five selected J-tubes to feedwater ring joint inner diameter surfaces in order to assess the interface condition of the feedring base metal and the J-tube inside edge. Inspection of the two J-tube to feedring joints closest to the feedwater nozzle and "T" section, i.e., J-tubes numbers 1 and 36, was inconclusive. Video inspection of these two J-tube joints indicates possible initiation of erosion-corrosion at these joints. The level of erosion-corrosion, if present, is not significant at this time and should not pose a concern for feedring through-wall wastage for a number of cycles. However, these J-tubes will be re-inspected at a later outage to determine if erosion-corrosion is progressing and at what rate. The other three J-tube to feedring joints inspected, J-tubes numbers 9, 18, and 28, did not show any sign of erosion-corrosion. The joints all have square-cut edges on the feedring inner diameter surface and acceptable fit-ups with the J-tubes. All five J-tubes inspected have square cut leading edges showing no apparent damage to the J-tube material.

All inspected feedwater pipe weld seams internal to the feedring, and inspected by video probe insertion through J-tubes numbered 1 and 36, do not show any signs of deterioration. No weld feedwater ring backing rings were observed (as expected), thus, the potential for loose parts originating from the interior of the feedring is remote. All feedring inner diameter surface pipe welds appear to have a smooth finished look with no signs of significant weld or feedring base metal erosion-corrosion. However, some flow induced surface scouring patterns were faintly visible in this video tape inspection of the feedring inner diameter surfaces.

Viewed from the outside, the feedring and J-Tubes looked to be in good condition. No J-tubes were found to be loose (as expected) and there were no apparent signs of any flow-induced erosion-corrosion holes through the feedring (as expected). The only observation identified at this time is the effect that the J-tube discharge is having as it impinges the feedring and the primary separator riser barrels. It was observed for some (approximately 30%) of the 36 J-tubes, the discharge flow is impinging on (in a glancing manner) the feedring outer diameter pipe surface. This impingement was distinctly observed for J-tubes numbers 20, 22 and 26. This impingement has washed the local pipe surface clean of all magnetite allowing the flow to directly impinge on the feedring base metal. At this time the smoothed surface of the washed feedring does not appear to have any base material loss. If any material loss due to erosion-corrosion action has occurred, it is estimated to be limited to approximately 1-3 mils depth. By feel (tactile), no erosion-corrosion material loss could be detected on the feedring outer diameter surface.

Other J-tubes' discharge flow appears to be impinging on the primary separator riser barrels. This impingement has washed the local riser barrel pipe surface partially clean of the magnetite coating, allowing the flow to directly impinge on some of the riser barrel base metal. At this time the smoothed surface of the washed riser barrel does not appear to have any base material loss. By feel (tactile), no erosion-corrosion material loss could be detected on the riser barrel outer diameter surfaces.

3.3.1.5 <u>Top Support Plate Ligament Cracking Inspection:</u>

The intent of this engineering assessment was to examine the top tube support plate "G" for evidence of gross cracking or missing segments at certain areas, in particular where the tube support plate is attached to the wrapper adjacent to the wrapper longitudinal seam. The remote video inspection performed was insertion of a video probe down the 25 most outward located primary separator riser barrels around the complete periphery of the mid-deck plate. Of these 25 attempts, 21 probe insertions made it to the top support plate periphery. The other 4 attempts inspected the AVBs only and did not proceed to the tube support plate for concern of jamming the probe. The video quality at the tube support plate was very good.

For the 21 areas inspected, no signs of tube support plate cracking were observed. All tube support plate areas examined showed fully intact quatrefoil tube hole ligaments, there were no missing tube support plate sections, tube support plate surfaces were clean of significant sludge deposits, all machined edges were square and well defined, and the tube holes observed (limited) exhibited no apparent flow blockage. In addition, to the extent inspected, all wrapper to tube support plate supports, i.e., wedge groups and back-up bars (vertical supports) showed no deterioration in the form of crack welds or loose hardware. The only exception to this was an approximate ½" of wedge side weld appeared to have separated from the shell, but the wedge was fully captured by the top weld and tube support plate. This inspection was complimented by the inspection port - top support plate inspections (Procedure NSD-FP-1997-7966 - Section 9.0, also see above) that also resulted in similar observations.

3.3.1.6 AVB Visual Inspection:

The intent of this engineering assessment was to examine the top of the Anti-Vibration Bars (AVBs) for evidence of gross misplacement and missing parts. Quantification of AVB-to-Tube wear or anomalies in the tube bundle are addressed by the eddy current examination. The remote video inspection performed was insertion of a video probe down the 25 most outward located primary separator riser barrels around the complete periphery of the mid-deck plate. Of these 25 attempts, 13 probe insertions made it to the AVBs, the others missed the AVBs and preceded to the top support plate periphery. The video quality at the AVBs was fair to good.

For the 13 areas inspected, there was no evidence of gross misplacement and missing parts. For those portions of the AVBs observed, the AVB assemblies were intact and preceded into the tube bundle with an apparent tight fit-up, and all AVB assemblies were captured by the retaining ring, i.e., all attachment welds were in-place and no cracked welds were observed.

3.3.1.7 Upper Wrapper Support Inspections:

The upper end of the wrapper (near the top support plate, "G") is supported vertically by eight (8) "U" shaped tapered blocks which are welded to the wrapper and bear against the transition cone. These supports allow the wrapper to expand vertically upward relative to the shell. There is no guidance or anti-rotation function associated with these supports.

The intent of this engineering assessment was to examine the upper wrapper support block for evidence of gross misplacement, gross cracking of the weld, and gross cracking of the wrapper in the area of attachment. This was an informational gathering inspection to collect data for an engineering assessment of the secondary side structural condition, including erosion, corrosion, and structural weld integrity. The transition cone will be examined in the area of the block for gross scoring or spalling.

For the eight (8) areas inspected, all upper wrapper "U" shaped tapered blocks were clearly viewed by the inspections video probe with good detail shown. For all 8 tapered support blocks, there was no evidence of gross misalignment, and no evidence of any deterioration of the block or shell bearing surfaces. The backside (wrapper outer diameter side) of the support block welds were observed from the wrapper/shell annulus. These welds appeared to have a straight uniform gap in some cases, to a ragged gap with scale deposits in other cases. However, for all cases, the weld appeared to be the unimproved backside of the root pass of a penetration weld. In all eight case the upper wrapper "U" shaped tapered blocks appeared to be in acceptable condition with no signs of deterioration.

3.3.1.8 Upper Wrapper Support Anti-rotation Keys and Wedges:

The upper end of the wrapper (near the top support plate, "G") has four (4) tapered wedges which bear on anti-rotation keys which are affixed to the steam generator shell. These keys do not permit rotation of the wrapper but allow vertical expansion and contraction of the wrapper relative to the shell.

The intent of this engineering assessment was to examine the upper wrapper anti-rotation wedges for evidence of gross misplacement, gross cracking of the weld, and gross cracking of the wrapper in the area of attachment. This was an informational gathering inspection to collect data for an engineering assessment of the secondary side structural condition, including erosion, corrosion, and structural weld integrity. The transition cone was examined in the area of the key for gross cracking of the weld or gross deformation of the key.

For the four (4) areas inspected, all upper wrapper wedges which bear on anti-rotation keys were clearly viewed by the inspections video probe with good detail shown. For all 4 wedges, there was no evidence of gross misalignment, and no evidence of any deterioration of the wedge or shell anti-rotation keys. The backside (wrapper outer diameter side) of the support wedge block welds were observed from the wrapper/shell annulus. This weld appeared to have a straight uniform gap in some cases, to a ragged gap with scale deposits in other cases. However, for all cases, the weld appeared to be the unimproved backside of the root pass of a penetration weld. In all four cases the upper wrapper wedges appeared to be in acceptable condition with no signs of deterioration. The transition cone has been examined in the area of the keys and no gross cracking of the weld or gross deformation of the key was observed.

3.3.1.9 Lower Wrapper Support Keys:

The lower end of the wrapper (nearest the first support plate above the flow distribution baffle) is supported vertically by six (6) - 12 inch long blocks which are welded to the wrapper and bear against the shell via two - 2.25 inch diameter jacking studs. A 1.75 inch thick horizontally oriented key on the shell fits into a groove in these blocks, fixing the wrapper vertically. There is no anti-rotation function associated with these supports.

The intent of this engineering assessment was to examine the lower wrapper support block for evidence of gross misplacement, gross cracking of the weld, and gross cracking of the wrapper in the area of attachment. This was an informational gathering inspection to collect data for an engineering assessment of the secondary side structural condition, including erosion, corrosion, and structural weld integrity. The shell was examined in the area of the block for gross deformation of the key. The inspection was performed by lowering a video probe down through the shell-wrapper annulus.

This inspection covered all six (6) of the lower wrapper support keys. It showed that there appears to be no evidence of gross misplacement or gross deformation of these support assemblies. All wrapper jacking bolts observed, were in good condition and remain in contact with the shell indicating that the wrapper-to-support block junctions have not deformed. No cracks in the wrapper plate around the support blocks were observed (best effort basis). Viewing of the wrapper plate was limited and partially obscured by the weld backing bar (360° around the support block). In addition, all six of the shell keys were observed to be in-place and properly positioned in the wrapper blocks. The shell key welds (to the shell pressure boundary) were intact in all cases, with no deformation and no cracks observed in these welds.

3.3.1.10 Wrapper Weld Seam:

Three separate attempts were made by to find and identify the wrapper vertical weld seam. This was an informational gathering inspection to collect data for an engineering assessment of the secondary side structural condition, including erosion, corrosion, and structural weld integrity. This weld seam could not be distinctly identified in either of four anticipated locations, approximately 15° to either side and either end of the tubelane. During each of the inspection attempts, the remote observers were unable to visually identify this weld seam, which is likely to have been ground smooth to the wrapper outer diameter surface and obscured by the magnetite film on the wrapper. However, by the process of searching for the wrapper weld seam, no observation was made of any gross cracking or pitting of the wrapper outer diameter that could be indicative of the possible loss of integrity present in this weld seam.

Conclusion

The results of steam generator 33 & 34 secondary side visual inspections indicated that there was no evidence of sludge build up on the quatrefoil design tube support plates and no evidence of support plate degradation, wrapper support block and structural degradation. In fact no active damage mechanisms have been identified.

A similar inspection scope is planned for the next refueling outage for steam generators 31 & 32.

ATTACHMENT I

RESPONSE TO GENERIC LETTER 97-06
FOR INDIAN POINT 3