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New York Power Authority

William A. Josiger
Resident Manager

September 15, 1987
JAS-87-090B
IP3-87-055Z

Docket No. 50-286
License No. DPR-64

Mr. William T. Russell
Regional Administrator
Region I
U.S. Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, PA 19406

Subject: NRC Bulletin No. 87-01:
Thinning Of Pipe Walls in Nuclear Power Plants

Dear Mr. Russell:

Attachments I and II to this letter provide the Authority's response to the subject bulletin. This response completes the actions required by Bulletin 87-01.

Should you or your staff have any further questions on this matter, please contact Mr. M. P. Cass of my staff.

Sincerely,

WA Josiger

William A. Josiger
Resident Manager
Indian Point Unit 3 Nuclear Power Plant

SUBSCRIBED AND SWORN TO
BEFORE ME THIS 15th DAY
OF September, 1987.

Ruthanne B Bowman

RUTHANNE B. BOWMAN
Notary Public, State of New York
No. 4651904, Westchester County
Commission Expires Oct. 31, 1989

WAJ:JAS:lg

cc: Document Control Desk (original)
U.S. Nuclear Regulatory Commission
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ATTACHMENT I

RESPONSE TO NRC BULLETIN NO. 87-01

Thinning of Pipe Walls in Nuclear Power Plants

New York Power Authority
Indian Point 3 Nuclear Power Plant
Docket No. 50-286

ATTACHMENT 1

NRC Bulletin No. 87-01: Thinning of Pipe Walls In Nuclear Power Plants

Action Item

1. Identify the codes or standards to which the piping was designed and fabricated.

Response

The Indian Point 3 plant is a Westinghouse four loop pressurized water reactor that began commercial operation in 1976. The design and fabrication of piping is in accordance with the requirements of the American National Standards Institute, code for pressure piping, ANSI B31.1, 1967 Edition. This includes all condensate, feedwater, steam and connected high energy piping systems fabricated of carbon steel.

Action Item

2. Describe the scope and extent of your programs for ensuring that pipe wall thicknesses are not reduced below the minimum allowable thickness. Include in the description the criteria that you have established for:

   a. selecting points at which to make thickness measurements
   b. determining how frequently to make thickness measurements
   c. selecting the methods used to make thickness measurements
   d. making replacement/repair decisions

Response

An informal inspection program to detect evidence of wall thinning at the Indian Point 3 plant has been in place since 1984. This inspection program was initiated due to increased industry concerns, particularly with two phase systems, as reported in industry documents such as INPO SOER 82-11, "Erosion of Steam Piping and Resultant Failure". The first of two inspections planned for the extraction steam and high pressure turbine exhaust (cross-under) systems was performed during the 1984 mid-cycle outage. During this inspection nineteen components (elbows and straight piping) were examined. The second inspection, performed between June 23 and July 12, 1985, examined an additional twenty-three components in the extraction team and high pressure turbine exhaust systems. Inspection points were selected based on piping geometry and engineering judgement. A computer enhanced ultrasonic examination system known as "P-SCAN", (Projection Image Scanning) was utilized on both occasions. P-SCAN performs erosion/corrosion thickness mapping based upon the ultrasonic pulse-echo technique.

Immediately after the Surry incident, the condensate and main feed systems were evaluated to determine those areas which would be potential "high risk" configurations for pipe erosion. This evaluation was based on preliminary information available in the first few days following the Surry event. Four components were inspected using manual ultrasonic techniques.

As a direct result of the Surry event and other industry reported failures in single phase systems, the Authority undertook an expanded inspection program during the 1987 refueling outage. Between May 25 and June 29, 1987, inspections were performed in the feedwater heater drain, moisture separator drain, reheater drain, main feedwater and extraction steam systems. Fifty-four components (eg: elbows and straight piping tees, reducers) were inspected using manual inspection ultrasonic techniques. The selection of all inspection areas was based on previous industry experience and the criteria provided in EPRI report NP-3944, April, 1985, "Erosion/Corrosion in Nuclear Power Plant Steam Piping" and EPRI final report on Single Phase Erosion/Corrosion". Additionally, results of earlier plant inspections and machinery history repairs were utilized.

No specific frequency for reinspection was determined for components inspected in 1984 and 1985. However, thickness measurements were compared to nominal wall thickness to determine what actions, if any, should be taken. Specific actions taken as a result of these inspections are discussed later in this report.

For components inspected in 1987 and thereafter, the frequency of inspection for components showing evidence of wear will be determined from the projected time to reach the code allowable minimum wall thickness. Measured wall thickness will be compared to the nominal wall thickness to determine if a component is undergoing wear. If wear is observed, an evaluation will be made in accordance with the guidelines of EPRI NP-3944 and other applicable documents. Reinspections will be scheduled so that thickness measurements are taken well in advance of the time projected (as determined by evaluation) to reach code allowable minimum wall thickness. If no wear is observed, reinspection decisions will be based on engineering judgement and the potential for erosion/corrosion as determined by engineering evaluation. Components inspected prior to 1987 will be similarly reviewed to determine reinspection schedules.

Thickness measurements performed since 1984 used ultrasonic inspection technique. The P-SCAN system used in 1984 and 1985 is an automated system that performs thickness measurements from the outside surface with a scanner. The size of the scanner is dependent on the curvature of the pipe to be scanned. The manual technique used in 1987 performs thickness measurements on the outside surface with a 1/4" diameter probe utilizing a grid format for each component. The ultrasonic technology involved in both methods is the same. The measurements obtained are repeatable and provide quantitative not results.

The basis for acceptance or rejection of a component is the calculated code minimum required design wall thickness, as defined in ANSI B31.1, 1967 Edition. If evaluation of the inspection data indicate that a component will reach code minimum allowable wall thickness within one operating cycle or expected operating period the questionable component will be repaired or replaced unless the results of an engineering evaluation shows that there is an acceptable margin for continued operation.

Action Item

3. For liquid-phase systems, state specifically whether the following factors have been considered in establishing your criteria for selecting points at which to monitor piping thickness (Items 2a):

   a. piping material (e.g., chromium content)
   b. piping configuration (e.g., fittings less than 10 pipe diameters apart)
   c. pH of water in the system (e.g., pH less than 10)
   d. system temperature (e.g., between 190 and 500° F)
   e. fluid bulk velocity (e.g., greater than 10 ft/s)
   f. oxygen content in the system (e.g., oxygen content less than 50 ppb)

Response

The criteria identified in the EPRI reports referenced in the response to item 2, were considered in the selection of components to be monitored for wall thinning. Specifically, for liquid phase systems the following factors were considered:

- piping with carbon steel material

- components separated by less than 10 pipe diameters

- pH less than 10.0

- temperature range between 190°F and 500°F

- fluid bulk velocity greater than 10 ft./sec.

- oxygen content less than 50 ppb.

Each factor is considered equally in the selection of components. For example, if bulk velocity was less than 10ft/sec, the component would not necessarily be excluded from the program.

Action Item

4. Chronologically list and summarize the results of all inspections that have been performed, which were specifically conducted for the purpose of identifying pipe wall thinning, whether or not

whether or not pipe wall thinning was discovered, and any other inspections where pipe wall thinning was discovered even though that was not the purpose of that inspection.

a. Briefly describe the inspection program and indicate whether it was specifically intended to measure wall thickness or whether wall thickness measurements were an incidental determination.

b. Describe what piping was examined and how (e.g., describe the inspection instrument(s), test method, reference thickness, location examined, means for locating measurement point(s) in subsequent inspection.

c. Report thickness measurement results and note those that were identified as unacceptable and why.

d. Describe actions already taken or planned for piping that has been found to have a nonconforming wall thickness. If you have performed a failure analysis, include the results of that analysis. Indicate whether the actions involve repair or replacement, including any change of materials.

Response

As noted previously, four inspections were performed since 1984 specifically to determine pipe wall thinning. For all inspections records are stored in the form of data summary sheets and detail sketches to enable relocation of inspection areas during subsequent inspections. Inspection results are given below and summarized in Attachment II.

In addition to the four wall thinning inspections, the Authority monitors crossunder piping for erosion. Since 1980 visual inspections have routinely been conducted to aid in identification and repair of erosion wear in crossunder piping. Several manways have been installed to aid access to inspections.

1984 MAINTENANCE OUTAGE

Nineteen components were inspected during the 1984 maintenance outage. This was performed with the P-SCAN system. The systems inspected include the extraction steam and high pressure turbine exhaust. Nine components were identified as exhibiting wear. Three of these components (18" 90^{o} Elbows) in the extraction steam system were replaced in conjunction with the Feedwater Heater Modification during the 1985 refueling outage. These elbows were projected to reach minimum allowable wall thickness within two years.

During normal operation in April, 1984, a leak developed at the 27"x10"x27" tee in the west high pressure turbine exhaust header for low pressure steam dump to condenser. Upon shutdown of the unit for the maintenance outage, two separate holes were identified in this localized area. The area was repaired and ultrasonic thickness measurements performed. This area was reinspected in 1985 and 1987. Similar joint configurations were also inspected. No further degradations have been noted.

1985 REFUELING OUTAGE

Inspections were performed on twenty-three components in the extraction and high pressure turbine exhaust systems. Thickness measurements were made using the automated P-SCAN system. Nine of the components inspected showed signs of wear. Subsequently these components have been evaluated and scheduled for reinspection.

DECEMBER 1986 - JANUARY 1987 ON-LINE INSPECTION

Four components were manually inspected with ultrasonic techniques in the condensate and main feedwater system shortly after the Surry incident. These components were judged to be susceptible to wear similar to that observed at Surry. No evidence of wear was identified.

1987 REFUELING OUTAGE

Manual ultrasonic inspection was performed on fifty-four components of the extraction steam, reheater drain, main feedwater, moisture separator drain and feedwater heater drain system. Twelve components in the extractions steam and five components in the reheater drain systems showed evidence of wall thinning. Two components (3" 90^{o} elbows) in the reheater drain system were replaced.

During performance of modifications to install moisture preseparating devices in the high pressure turbine exhaust, visual inspections were performed on the 28" extraction steam line to the #35 feedwater heaters. Wear was identified on three 28" 90^{o} elbows and were replaced.

Action Item

5. Describe any plans either for revising the present or for developing new or additional programs for monitoring pipe wall thickness.

Response

An ongoing erosion/corrosion inspection program is being developed at this time. To date, a review of all systems susceptible to erosion/corrosion has been completed. This review was based on the following selection criteria:

- system circulates water or steam
- system piping is carbon steel

- system temperature is greater than 190°F

The following systems have been selected for inclusion in the erosion/corrosion inspection program:

- Auxiliary Steam
- Condensate
- Main Steam
- Extraction Steam
- Feedwater Heater Drain
- Main Feedwater
- Reheater Drain
- Auxiliary Feedwater
- Moisture Separator Drain
- Steam Generator Blowdown

These systems will be reviewed in detail to determine the components most susceptible to erosion/corrosion. The selection criteria will be based on the parameters identified in EPRI reports on erosion/corrosion in nuclear plant piping systems, and other supporting information presented in reports of piping failures at other utilities. In addition, the Authority will use the EPRI "Chec" program to aid in selecting components susceptible to erosion/corrosion.

A sample of the most susceptible components in each system will be chosen and monitored for evidence of erosion/corrosion. The sample size to be monitored will include those components already showing evidence of wear from earlier inspections.

ATTACHMENT II

Summary of Erosion/Corrosion Inspections

New York Power Authority
Indian Point 3 Nuclear Power Plant
Docket No. 50-286

The table below lists those components showing evidence of wear, system and design parameters, and wall thickness (nominal versus lowest measured wall thickness) information. Actions already taken or planned for these components are noted in the remarks column.

Results of Inspection Performed between May 25 and June 29, 1987

Component Description	System	Pipe Material	Design Parameters Temp (F°)	Design Parameters Press. (psig)	Wall Thickness Nominal wall (in.)	Wall Thickness Lowest meas. (in.)	Remarks
90° elbow and piping in 12" extraction steam line to #36 FWH	Ext. Stm.	A-106, GR.B Sch.30	450	450	.330	.288	Scheduled for rein-spection
18"x12"x18" lateral in ext. stm line to #36 FWH's	Ext. Stm.	A-106, GR.B Sch.30	450	450	.330	.241	Scheduled for rein-spection
90° elbow and piping in 10" stm. dump line to cond	Turb. Exh.	A-53 seam-less Gr.B Sch.20	400	221	.375	.325	Scheduled for rein-spection
10"x4" reducer and piping in rehtr drn line to #36 Fdwtr htr	Rehtr. Drn	A-106,GR.B	600	1085	.337 (4" pipe) .594 (10" pipe)	.253 .579	Scheduled for rein-spection
6"x4" reducer and piping in rehtr drn to 36 fdwtr htrs	Rehtr. Drn	A-106,GR.B Sch.80	600	1085	.337 (4"pipe) .432 (6"pipe)	.200 .359	Scheduled for rein-spection
90° elbow & piping in 6" rehtr drn to 36 fedwtr htrs.	Rehtr. Drn	A-106,GR.B, Sch.80	600	1085	.432	.378	Scheduled for rein-spection

Results of Inspection Performed between May 25 and June 29, 1987 -con't

Component Description	System	Pipe Material	Design Parameters Temp (F°)	Press. (psig)	Wall Thickness Nominal wall (in.)	Lowest meas. (in.)	Remarks
90° elbow & piping in 12" ext. line to 36 fdwtr htrs.	Exh. Stm.	A-106,GR.B, Sch.30	450	450	.330	.245	Scheduled for rein-spection
18"x12"x18" in extr. line to 36 fdwtr. htrs.	Ext. Stm.	A-106,Gr.B, Sch.30	450	450	.438 (18" pipe) .330 (12" pipe)	.328 .252	Scheduled for rein-spection
28"x18" red-ucer in ext. stm line to 35 fdwtr htr	Ext. Stm.	A-53 seam-less GR.B Sch 20 (for 18" pipe) GR.C-55 class 2, .375" wall (28" pipe)	400	250	.312 (18" pipe) .375 (28" pipe)	.233 .386	Scheduled for rein-spection
45° elbow & and piping in 20" ext stm to 34B FWH	Ext. Stm.	A-53 seam-less Gr.B, Sch 10	400	full vacuum to 100 psig max	.250	.211	Scheduled for rein-spection
90° elbow in 8" Rehtr drn to 36 FWH	Rht. Drn	A-106,GR.B Sch. 80	600	1085	.500	.423	Scheduled for rein-spection
6"x4" reducer in rhtr drn to 36 FWH	Rht. Drn	A-106,GR.B Sch.80	600	1085	.432" 6"pipe .337 (4" pipe)	.375 .221	Scheduled for rein-spection

Results of Inspection Performed between May 25 and June 29 1987 - con't

Component Description	System	Pipe Material	Design Parameters Temp (F°)	Press. (psig)	Wall Thickness Nominal wall (in.)	Lowest meas. (in.)	Remarks
90° elbow in 3" vent chamber drn from rhtr to 36 FWH	Rht. Drn	A-106,GR.B Sch. 80	600	1085	.300	.235	Projected Min. Wall in 2 yrs Elbow repl'd
90° elbow in 3" vent chamber drn from rhtr to 36 FWH	Rht. Drn	A-106,GR.B Sch. 80	600	1085	.300	.236	Projected Min. Wall in 2 yrs Elbow repl'd

NOTE: Three 28" short radius 90° elbows in extraction steam line to #35 feedwater heaters were replaced in conjunction with preseparator modification during the 1987 refueling outage. Visual inspections had identified evidence of erosion/corrosion however, no ultrasonic inspections were performed.

Results of Inspections Performed between June 23 and July 12, 1985

Component Description	System	Pipe Material	Design Temp (F°)	Parameters Press. (psig)	Wall Thickness Nominal wall (in.)	Lowest meas. (in.)	Remarks
90° elbow & piping in 10" stm dmp line to cond	Turb Exh.	A-53 seamless GR.B Sch.20	400	221	.375	.280	Inspected in 1984, Scheduled for reinspection
45° elbow & piping in 20" ext stm to 34A FWH	Ext. Stm	A-53 seamless GR.B Sch.10	400°	full vacuum to 100 psig	.250	.201	Scheduled for reinspection.
90° elbow & piping in 28" ext. line to 33B FWH	Ext. Stm.	A-155 EFW GR.C-55, Sch.10	300	full vac- to 50 psig	.3125	.201	Scheduled for reinspection.
90° elbow & piping in 18" ext stm line to flash evap	Ext. Stm	A-53 seamless GR.B Sch.10	300	full vacuum to 50 psig	.250	.205	Scheduled for reinspection.
45° elbow & piping in 20" ext. stm line to 34C FWH	Ext. Stm.	A-53 seamless, GR.B Sch.10	400	full vacuum to 100 psig	.250	.201	Scheduled for reinspection.

Results of Inspection Performed between June 23 and July 12, 1985 -con't

Component Description	System	Pipe Material	Design Parameters Temp (F°)	Press. (psig)	Wall Thickness Nominal wall (in.)	Lowest meas. (in.)	Remarks
90° elbow & piping in 20" ext.stm line to 34A FWH	Ext. stm.	A-53 seam-less,GR.B Sch.10	400	full vac-umm to 100 psig	.250	.209	Scheduled for rein-spection.
90° elbow & piping in 20" ext.stm line to 33C FWH	Ext. stm.	A-53 seam-less,GR.B Sch.10	300	full vac-umm to 50 psig	.250	.209	Scheduled for rein-spection.
90° elbow & piping in 20" ext.stm line to 33A FWH	Ext. stm.	A-53 seam-less,GR.B Sch.10	300	full vac-umm to 50 psig	.250	.209	Scheduled for rein-spection.
45° elbow in 32" NW cross-under header	Turb. Exh		400	221	.500	.205	Area Clad-ed. Pitt-ing at localized areas. Visually reinspect-ed during 1987 Ref. Outage.

Results of Inspection Performed between October17 and October 27 1984

Component Description	System	Pipe Material	Design Parameters Temp (F°)	Press. (psig)	Wall Thickness Nominal wall (in.)	Lowest meas. (in.)	Remarks
90° elbow & piping in 10" line from west crossunder hdr to cond. (LP Stm. dmp.)	Turb Exh	A-53 seamless GR.B Sch.20	400	221	.375	.240	Inspected in 1985 & 1987
High press. turb. exh. piping (x-under)	Turb Exh		400	221	.500	.322	Visually insp'd during '87 ref. out.
90° elbow & piping in 18" ext line to 35C FWH	Ext Stm	A-53 seamless GR.B Sch.20	400	250	.312	.260	scheduled for reinsp
90° elbow in 18" ext line to 35C FWH (closest to FWH)	Ext Stm	A-53 seamless GR.B Sch.20	400	250	.312	.197	Predicted min. wall in less than 2 yrs replaced w/FWH in '85
90° elbow in 18" ext line to 35B FWH (closest to FWH)	Ext Stm	A-53 seamless GR.B Sch.20	400	250	.312	.189	Predicted min. wall in less than 2 yrs replaced w/FWH in '85
90° elbow and piping 18" ext line to 35B FWH.	Ext Stm	A-53 seamless GR.B Sch.20	400	250	.312	.252	Scheduled for reinspection.

Results of Inspection Performed between October 17 and October 27, 1984

Component Description	System	Pipe Material	Design Parameters Temp (F°)	Press. (psig)	Wall Thickness Nominal wall (in.)	Lowest meas. (in.)	Remarks
90° elbow in ext stm line to 35A FWH	Ext Stm	A-53 seamless GR.B Sch.20	400	250	.312	.181	Predicted min. wall in less than 2 yrs Replaced w/FWH in 1985
90° elbow & piping in 18" ext stm line to 35A FWH	Ext Stm	A-53 seamless Gr.B Sch.20	400	250	.312	.236	Scheduled for re-insp.
90° elbow in 12" ext line to 36A FWH	Ext Stm	A-106,GR.B Sch.30	450	450	.330	.246	Scheduled for re-insp.