123 Main Street
White Plains, New York 10601
914 681 6200

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New York Power Authority

May 9, 1985
JPN-85-42

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

Attention: Mr. Domenic B. Vassallo, Chief
Operating Reactors Branch No. 2
Division of Licensing

Subject: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
Intergranular Stress Corrosion
Cracking (IGSCC) Inspections

References:
1. USNRC Generic Letter No. 84-11, "Inspections of BWR Stainless Steel Piping", dated April 19, 1984.
2. NYPA letter, J.P. Bayne to D.B. Vassallo, dated April 26, 1985 (JPN-85-35).
3. NYPA letter, J.P. Bayne to D.B. Vassallo, dated April 26, 1985 (JPN-85-34).

Dear Sir:

In accordance with Generic Letter No. 84-11 (Reference 1), the Authority developed and implemented a program of inspection for IGSCC (Intergranular Stress Corrosion Cracking) at our FitzPatrick plant.

The Authority has prepared a report to describe the inspections conducted during our recent (March-April) refueling outage (Attachment No. 1). This report supplements the preliminary summary (Reference 2) and weld inspection data packages (Reference 3) to further clarify the extent and results of these inspections. The report also responds to verbal questions developed by the NRC staff.

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New analyses have been performed for weld numbers 12-4, 12-17, and 28-112 to justify continued plant operation without repair. Flaw analyses and overlay design reports are provided in Attachment 2.

If you have any questions, please contact Mr. J. A. Gray, Jr. of my staff.

Very truly yours,

John C. Brons
Senior Vice President
Nuclear Generation

Encls.

cc: Office of the Resident Inspector (with enclosure)
U.S. Nuclear Regulatory Commission
P.O. Box 136
Lycoming, New York 13093

Mr. Robert McBrearty (with enclosure)
U.S. Nuclear Regulatory Commission
Region I
631 Park Avenue
King of Prussia, PA

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ATTACHMENT NO. 1 TO JPN-85-42

Additional Information on Intergranular Stress Corrosion Cracking Inspections during March-April 1985 Outage

New York Power Authority
James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333

1.0 Introduction

As required by Generic Letter No. 84-11 (Reference 1), a program of inspection of the stainless steel piping at the James A. FitzPatrick (JAF) plant for Intergranular Stress Corrosion Cracking (IGSCC) has been implemented. In Reference 2, the Authority reported the results of inspections performed on the Reactor Recirculation and Residual Heat Removal (RHR) systems in conjunction with the application of Induction Heating Stress Improvement (IHSI) on that piping.

As discussed in Reference 4, the inspections performed in association with IHSI, together with those performed during the current refueling outage, are considered in meeting the requirements of Generic Letter No. 84-11. Table 1 is a revised version of the table included with Reference 3, updated to show the actual inspections performed.

2.0 Reinspection of Unrepaired Cracked Welds

Each of the unrepaired cracked welds were reinspected. Reference 5 transmitted the ultrasonic test data for these examinations. The fracture mechanics analysis of these welds, based on 1985 inspection are enclosed in Attachment 2. Table 2 details the results of these recent inspections.

Each unrepaired cracked weld was examined by both Ebasco and Kraftwerk Union (KWU) inspectors. The majority of these inspectors were the same individuals utilized during the October 1984 outage. All the examiners used were certified in IGSCC detection, and those that performed evaluation were also certified in sizing at the EPRI/J.A. Jones NDE Center. Differences did exist in examination techniques, due mainly to improvements in data processing and in the incorporation of recommendations developed through the EPRI based IGSCC sizing qualification and certification program. Reference 3 detailed the various techniques used by both the Ebasco and KWU inspectors in the 1984 inspections.

In the current inspections, an attempt was made to standardize the examination methodology in order to minimize procedural variations in the results obtained by the different inspection agencies. Flaw length was evaluated to 10% of the highest amplitude signal or to background noise. The recording level utilized by KWU, for the evaluation of flaw circumferential length, was determined as follows:

> During calibration the peaked-up signal from a 10% notch was adjusted electronically to an amplitude of 80% full screen height. **This is the reference level.**
>
> A gain setting of 14 decibels (dB) (more than 2 times) greater than the reference level is utilized during scanning or detection examinations.

An indication signal, regardless of transducer type or angle used, is adjusted to the reference level for evaluation. The recording level is 10% of this adjusted signal height or 8% of full screen height (FSH). Indication signals which are below this level, or which are lost in background noise, are considered below the recording level.

It should be noted that the evaluation of any signal detected required a necessary amplitude, in terms of return of sufficient energy, to be noted and analyzed. Below 8% of the screen height, the background noise effectively prevents signal analysis for the majority of indications. However, if the background is unusually low, and/or the indication signal can be clearly distinguished, then such a signal is followed to an even lower amplitude. The recording level used by KWU is that lowest level which will provide an acceptable tolerance of echo height reproducibility between examinations.

The recording level utilized by Ebasco for detection of flaws is 20% of the Distance Amplitude Curve (DAC). The primary reference reflector signal, 3/4 T side drilled hole (SDH), is maximized and marked without any adjustment. Scanning is performed utilizing an additional 8 dB. When a reflector is detected, it is evaluated at the reference level.

For sizing the criteria for through wall dimensioning and circumferential length, the primary reference levels were also set at 80% of FSH. Various techniques were used including WSY-70,52° shear, 50°, refracted longitudinal wave, high angle longitudinal wave and SUS-I and SLIC-40. During the evaluations, the indication signals were sized to 10% of reference level or until they were undistinguishable from background noise level.

A summary of the inspection methodology and comparative results for each unrepaired weld is provided below and in Table 2.

Weld 12-4

An IGSCC indication was reported in October 1984 by both Ebasco and KWU at approximately 9" clockwise (CW) from top dead center. The indication was evaluated as 1.18" long circumferentially and 7.5% through wall.

This indication was again detected in 1985 at 9" CW by both Ebasco and KWU, and was evaluated by KWU as 1.10" long and 7% of wall. Note that the earlier reported length of 2.5" was due to misinterpretation of the data sheet.

Weld 12-17

Inspection by Ebasco during the 1985 outage revealed an indication at 13" CW. Evaluation of this indication by KWU revealed a circumferential length of 1.6" and a depth of less than 10% through wall. The previously reported length of 2.9" was erroneous, and could not be supported by examination data.

This indication was again detected in March 1985, by both Ebasco and KWU at the same location. KWU initially reported this indication's location only and did not evaluate for size, since it was 2 dB below their recording level. Re-analysis of their P-Scan computer data for this weld, at a level 16 dB below that of the 10% notch, revealed this indication to be approximately 1.4" long and less than 10% of wall.

Weld 22-22

An IGSCC indication was reported by Ebasco during the Summer 1983 outage at 1.8" CW, 1.9" long and 20% through wall. Manual re-examination after IHSI in March 1985 confirmed the existence of this indication, but it was evaluated as geometric by KWU. Re-examination with P-Scan in March 1985 revealed numerous short and relatively shallow indications of IGSCC, many of which had been previously evaluated as geometric indications by both Ebasco and KWU. Summation of the lengths of the separate indications detected resulted in an effective length of 51.5" (or 75% of circumference), with the maximum depths of these indications ranging from 10% to 27% through wall.

Weld 28-48

Indications were detected during the March 1984 outage at 22" CW, and were evaluated by Ebasco as 1.25" long and 14% through wall. Evaluation by KWU resulted in a depth of 10% wall and a length of 1.5". Re-examination by both Ebasco and KWU revealed indication signals at 22" CW to be due to counterbore and weld root.

Weld 28-53

The 1984 inspection detected an indication 25" counter clockwise (CCW) reported to be 0.5" long by both Ebasco and KWU, and evaluated as less than 5% of through wall by KWU. Re-examination by Ebasco in March 1985 detected numerous indications, including one at 25" CCW, however, no through wall dimension nor verification of IGSCC could be obtained. KWU reported the presence of this indication, although signal amplitude was 2 dB below the recording level of 14 dB less than 10% notch signal. No through wall depth was detected; circumferential length was estimated at 0.4". It should be noted that KWU observed an 8 dB drop in signal amplitude from this indication between the pre- and post-IHSI examinations, less than a week apart, during the October 1984 outage.

Weld 28-112

An indication was detected at 7.5" CW and sized at 0.5" long and 12.5% through wall by Ebasco in October 1984. KWU evaluated this indication as 0.5" long and 17% through wall. The length was determined by following the indication to an amplitude level 6 dB below the maximum signal of this indication after adjusting to 80% of full screen height.

During the March 1985 outage, this indication was followed to a level 18 dB below the maximum signal after adjustment to the 10% notch level. This level was approximately 10% of full screen height.

This more sensitive technique resulted in a reported length of 4.72" (roughly 6 to 10.5" CW). Significantly, however, the through wall dimension was determined to be 16% by both KWU and Ebasco. This strongly suggests that the increase in length was due to increased sensitivity in ultrasonic technique, not crack growth.

Weld 28-113

This weld had an indication reported at 6.5" CW by Ebasco personnel during the October 1984 outage. Evaluation by KWU resulted in a circumferential length of 0.5" and a depth of 10% of wall.

Ebasco again detected this indication during the March 1985 inspection but could not confirm the existence of IGSCC. KWU's re-examination utilizing P-Scan revealed the indication to be due to shear wave reflection from counterbore, not a CE 2 (crack tip) signal as previously reported. This indication is considered to be geometric in nature.

3.0 Flaw Analysis

Attachment 2 is a fracture mechanics analysis of flaws detected and sized during the March 1985 inspections. The indications reported in welds 12-4, 12-17, 28-53 and 28-112 have been evaluated by Structural Integrity Associates for their impact on the recirculation piping structural integrity. It should be noted that, with the exception of 28-112, the results of re-examinations do not alter the conclusions of the previous analysis.

The apparent increase in flaw length in weld 28-112 has been considered in the attached fracture mechanics analysis. As stated in Reference 3, this difference in crack length should be attributed to improved, more sensitive inspection methodology, not crack growth. All theoretical and empirical evidence available to date indicates that circumferential crack growth (even assuming no beneficial effect due to the IHSI performed on this joint) of four inches in less than six months of normal operation is extremely improbable. Gerber has reported an effective conservative crack growth rate which would bound the crack length at x + 2 inches after 4000 hours of operation (approximately six months). This growth rate includes nucleation of new cracks. Without new crack nucleation, the growth rate is further reduced. Even the bounding growth rate is approximately one-half of the observed ISI estimated change in length, suggesting the the reported change is not likely to be due to real IGSCC. Further, circumferential growth at this rate, with no growth through the pipe wall is even more unlikely. Such rates of growth have never been reported. This analysis indicates that this

flaw, even with the apparent increase in length, will not impact the structural design margin of the piping during the next operating cycle.

The re-examinations of welds 28-48 and 28-113 showed that IGSCC does not exist. However, conservatively assuming that the indications previously called IGSCC still exist, the previous analysis performed indicates that the piping structural margin would not be impacted.

4.0 Examination of Weld Overlays

In conjunction with the performance of weld overlay repairs, liquid penetrant examinations were performed on the first and last layers. Additionally, an ultrasonic inspection for lack of bond between the first layer and the pipe OD surface was also performed.

Re-examination of the five joints repaired by overlays in October 1984, in accordance with Generic Letter 84-11 was not performed during the current outage. A qualified procedure has not been developed which could be demonstrated reliable in detecting flaws at the overlay-to-pipe OD interface. The Authority has actively pursued the development of these techniques with EPRI, J.A. Jones and other commercial inspection agencies. The Authority plans to continue its efforts in developing reliable overlay inspection techniques as well as closely following the work of EPRI and the inspection vendors. Inspection of the overlay repairs will be performed, if feasible, to provide justification of multi-cycle life, if such use is compatible with the Authority's long-term approach to the problem of IGSCC.

Finally, integrity of the weld overlays was verified via the Class 1 hydrostatic pressure test performed at the end of the recent outage.

5.0 Personnel Qualifications

As required by Generic Letter #84-11, all Level 2 and 3 UT examiners employed in detection and sizing of IGSCC were qualified to the requirements specified in IE Bulletin No. 83-02 (Reference 6).

6.0 Drywell Leakage Detection System - Technical Specifications

Reference 7 transmitted an application for an amendment to the JAF technical specifications regarding drywell leakage detection. The changes proposed by this application meet the requirements of Attachment 1 to Reference 2, and ensure the discovery of unidentified leakage that may be caused by through wall cracks developed in austenitic stainless steel piping.

7.0 Future Inspections

Based on the Authority's activities detailed above, no additional inspections are planned until the next refueling outage, tentatively scheduled for Winter 1986.

8.0 References

1. USNRC Generic Letter No. 84-11, "Inspections of BWR Stainless Steel Piping", dated April 19, 1984.

2. NYPA letter, C. A. McNeill, Jr. to D. B. Vassallo, dated October 21, 1984 (JAFP-84-0979) regarding Recirculation System Weld Joints. Includes: fracture mechanics evaluation of ultrasonic indications for five welds; summary of recirculation system weld inspections performed to date; weld overlay reports; weld overlay thickness; ultrasonic test data and polar plots for riser and safe-end welds; and, simplified recirculation system isometeric drawings.

3. NYPA letter, C. A. McNeill, Jr. to D. B. Vassallo, dated October 25, 1984 (JAFP-84-1001) regarding Recirculation System Welds - September 1984 Outage.

4. NYPA letter, C. A. McNeill, Jr. to D. B. Vassallo, dated January 15, 1985 (JPN-85-02) regarding Inspections for IGSCC during February 1985 Refueling Outage.

5. NYPA letter, J. P. Bayne to D. B. Vassallo, dated April 26, 1985 (JPN-85-34).

6. USNRC IE Bulletin No. 83-02, "Stress Corrosion Cracking in Large-Diameter Stainless Steel Recirculation System Piping at BWR Plants."

7. NYPA letter, J. P. Bayne to D. B. Vassallo, dated October 9, 1984 (JPN-84-64) regarding Proposed Changes to the Technical Specifications Related to Reactor Coolant Leakage Detection.

TABLE NO. 1
SUMMARY OF IGSCC INSPECTION
DURING 1985 OUTAGE

RECIRCULATION SYSTEM

Re-inspected Welds (#)	"New" Inspected Welds	Joint Type	Remarks - Results
28-02-2-48		28" Pipe to Safe-end	Re-examination of unrepaired IGSCC
	28-02-2-50	28" Pipe to Elbow	no IGSCC indications
28-02-2-53		28" Elbow to Valve	Re-examination of unrepaired IGSCC
	28-02-2-108	28" Pipe to Elbow	no IGSCC indications
28-02-2-112		28" Elbow to Valve	Re-examination of unrepaired IGSCC
28-02-2-113		28" Pipe to Valve	Re-examination of unrepaired IGSCC

RESIDUAL HEAT REMOVAL

	28-10-130	Valve to Tee	Bimetallic/no IGSCC,no indications
	28-10-131	Valve to Valve	Bimetallic/no IGSCC,no indications
	24-10-132	Valve to Pipe	Bimetallic/no IGSCC,no indications
24-10-142		Valve to Tee	Bimetallic/no IGSCC,no indications
20-10-119		Elbow to Pipe	no IGSCC indications
	20-10-141	Pipe to Saddle	no IGSCC indications

REACTOR WATER CLEAN-UP

6-12-14A		Pipe to Saddle	no IGSCC indications
	6-12-141B	Pipe to Valve	Bimetallic/no IGSCC,no indications

TABLE NO. 1 (cont'd)
SUMMARY OF IGSCC INSPECTION
DURING 1985 OUTAGE

RECIRCULATION SYSTEM

Re-inspected Welds (#)	"New" Inspected Welds	Joint Type	Remarks - Results
	4-02-2-42	4" bypass piping	no IGSCC indications
	4-02-2-43	4" bypass piping	no IGSCC indications
	4-02-2-44	4" bypass piping	no IGSCC indications
	4-02-2-45	4" bypass piping	no IGSCC indications
	4-02-2-46	4" bypass piping	no IGSCC indications
4-02-2-98		4" bypass piping	no IGSCC indications
4-02-2-99		4" bypass piping	no IGSCC indications
	4-02-2-100	4" bypass piping	no IGSCC indications
	4-02-2-101	4" bypass piping	no IGSCC indications
	4-02-2-102	4" bypass piping	no IGSCC indications
12-02-2-1		12" Pipe to Safe-end	no IGSCC indications
12-02-2-7		12" Pipe to Safe-end	no IGSCC indications
12-02-2-58		12" Pipe to Safe-end	no IGSCC indications
12-02-2-75		12" Pipe to Safe-end	no IGSCC indications
12-02-2-81		12" Pipe to Safe-end	no IGSCC indications
12-02-2-4		12" Pipe to Sweepolet	Re-examination of unrepaired IGSCC
12-02-2-17		12" Pipe to Safe-end	Re-examination of unrepaired IGSCC
~~12~~-02-2-22 22"		12" Pipe to Endcap	Re-examination of unrepaired IGSCC

TABLE NO. 1 (cont'd)
SUMMARY OF IGSCC INSPECTION
DURING 1985 OUTAGE

CORE SPRAY

Re-inspected Welds (#)	"New" Inspected Welds	Joint Type	Remarks - Results
	10-14-494	Pipe to Elbow	no IGSCC indications
10-14-495		Pipe to Elbow	no IGSCC indications
10-14-496		Elbow to Elbow	no IGSCC indications
10-14-497		Pipe to Elbow	no IGSCC indications
10-14-498	10-14-501	Pipe to Elbow	no IGSCC indications

TABLE NO. 2
SUMMARY OF RE-INSPECTION OF UNREPAIRED CRACKED WELDS
DURING 1985 OUTAGE

Welds (#)	Loop	Weld Location	Length	Depth	Corrective Action	Remarks
12-4	A	Pipe to Sweepolet	1.1"	7%	Verification of Previous Analysis	
12-17	A	Pipe to Safe-end	1.4"	10%	Verification of Previous Analysis	Indication detected below recording level, no CE1 signal detected
28-48	A	Pipe to Safe-end				Indications previously reported determined to be due to weld root
22-22	A	Pipe to Endcap	51.5"	27%	Repair by weld overlay	Intermittent indications of various lengths; depths ranging from 10% to 27%
28-53	A	Elbow to Valve	0.4"	5%	Verification of previous analysis	Indications detected below recording level
28-112	B	Elbow to Valve	4.72"	16%	Re-analysis	
28-113	B	Valve to Pipe				Indication previously reported determined to be due to weld counter bore. No CE2 signal detected.