TECHNICAL EVALUATION REPORT ON
RESPONSE FROM
PENNSYLVANIA POWER & LIGHT COMPANY
TO GENERIC LETTER 88-01
PERTAINING TO THE
SUSQUEHANNA STEAM ELECTRIC STATION, UNIT 2

VIKING SYSTEMS INTERNATIONAL

Johnstown, Ohio Pittsburgh, Pennsylvania Washington, D.C.

FINAL

TECHNICAL EVALUATION REPORT ON RESPONSE FROM PENNSYLVANIA POWER & LIGHT COMPANY TO GENERIC LETTER 88-01 PERTAINING TO THE SUSQUEHANNA STEAM ELECTRIC STATION, UNIT 2

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ABSTRACT

This report contains an evaluation of the licensee (Pennsylvania Power & Light Company) submittal for Susquehanna Steam Electric Station, Unit 2 which was submitted in response to the NRC Generic Letter 88-01 in which Pennsylvania Power was requested to: (1) Furnish their current plans relating to piping replacement and other measures to mitigate IGSCC, inspection, repair, and leakage detection. (2) Indicate whether they plan to follow the NRC Staff positions, or propose alternative measures. Pennsylvania Power's plans are evaluated in Section 2 of this report in terms of compliance to NRC Staff positions. Pennsylvania Power presented an alternative position to that of the NRC Staff position on Reporting of Flaws. That position is evaluated in Section 3 of this report.

SUMMARY

The Licensee, Pennsylvania Power & Light Company, submitted a response to the NRC Generic Letter 88-01. Pennsylvania Power's response pertaining to the austenitic stainless steel piping in the Susquehanna Steam Electric Station, Unit 2 (a BWR nuclear power plant) was evaluated in terms of: (1) Their previous and planned actions to mitigate IGSCC to provide assurance of continued long-term service. (2) Their Inservice Inspection (ISI) Program. (3) Their Technical Specifications pertaining to ISI and their plans to ensure that leakage detection will be in conformance with the NRC Staff position. (4) Their plans to notify the NRC of significant flaws identified (or changes in the condition of the welds previously known to be cracked) during inspection and evaluation of such flaws.

Pennsylvania Power endorses 12 of the 13 NRC Staff positions which are outlined in Generic Letter 88-01, although they applied provisions to three (i.e., Materials, Crack Characterization and Repair Criteria, and Leakage Detection). Their position on leakage detection (with their attached provision) is much less restrictive than the NRC Staff position on restricting the rate of increase of unidentified leakage. An alternative position on Reporting Requirements would allow excessive delays in reporting of flaws.

As a result of previous mitigating actions most welds in the austenitic stainless steel systems at Susquehanna, Unit 2 are IGSCC Categories A and B. They have 31 non-resistant welds classified as IGSCC Category D welds. Some of these should be classified as IGSCC Category G. No additional mitigating treatments are planned except to repair welds, as needed, using procedures which comply with the NRC Staff position.

Inspection plans are in compliance with the NRC Staff positions on schedules, methods and personnel, and sample expansion. In addition, Pennsylvania Power agreed to submit an amendment to their Technical Specification on ISI as requested in Generic Letter 88-01.

CONTENTS

1. INTRODUCTION

Intergranular stress corrosion cracking (IGSCC) near weldments in Boiling Water Reactor (BWR) piping has been occurring for almost 20 years. Substantial efforts in research and development have been sponsored by the BWR Owners Group for IGSCC Research, and the results of this program, along with other related work by vendors, consulting firms and confirmatory research sponsored by the NRC, have permitted the development of NRC Staff positions regarding the IGSCC problems. The technical basis for NRC Staff positions is detailed in Reference 1, and further background is provided in Reference 2.

The results of these research and development programs prompted the NRC to issue Generic Letter 88-01 (see Reference 3) requesting all licensees of BWR's and holders of construction permits to:

(1) Furnish their current plans relating to piping replacement, inspection, repair, and leakage detection.

(2) Indicate whether they:
    (a) Plan to follow the staff positions, or
    (b) Propose alternative measures.

Specifically, Generic Letter 88-01 stated that an acceptable licensee response would include the following items:

(1) Current plans regarding pipe replacement and/or other measures taken or to be taken to mitigate IGSCC and provide assurance of continued long-term piping integrity and reliability.

(2) An inservice inspection (ISI) program to be implemented at the next refueling outage for austenitic stainless steel piping.

(3) A change to the Technical Specifications to include a statement

in the section on ISI that the inservice inspection program for piping will be in conformance with the staff positions on schedule, methods and personnel.

(4) Confirmation of plans to ensure that the Technical Specification related to leakage detection will be in conformance with the NRC Staff position on leak detection.

(5) Plans to notify the NRC, in accordance with 10CFR50.55a(o), of any flaws identified that do not meet IWB-3500 criteria of Section XI of the ASME Code for continued operation without evaluation, or a change found in the condition of the welds previously known to be cracked, and an evaluation of the flaws for continued used operation and/or repair plans.

This report contains a technical evaluation of the response which Pennsylvania Power and Light Company (called either Pennsylvania Power or PP&L in this report) submitted in response to the NRC Generic Letter 88-01 pertaining to the Susquehanna Steam Electric Station, Unit 2 (hereafter called Susquehanna 2 or SSES).

2. EVALUATION OF RESPONSE TO GENERIC LETTER 88-01

This evaluation consisted of a review of the response to NRC Generic Letter 88-01 of January 25, 1988 by Pennsylvania Power pertaining to Susquehanna 2 to determine if their performance and plans are in conformance with the NRC Staff positions or if proposed alternatives are acceptable. Proposed inspection schedules and amendments to the Technical Specification were included in the review.

2.1 Documents Evaluated

Review was conducted on the information pertaining to Susquehanna 2 provided by the Licensee in the following document:

(1) "Susquehanna Steam Electric Station, Response to Generic Letter 88-01," Docket Nos. 50-387 and 50-388, Pennsylvania Power and Light Company, Two North Ninth Street, Allentown Pennsylvania 18101, August 10, 1988.

(2) "Susquehanna Steam Electric Station,. Additional Response to Generic Letter 88-01," Pennsylvania Power and Light Company, Two North Ninth Street, Allentown, Pennsylvania 18101, August 18, 1989.

(3) "Susquehanna Steam Electric Station, Units 1 and 2, Final Response to Request for Additional Information - Response to Generic Letter 88-01," Pennsylvania Power and Light Company, Two North Ninth Street, Allentown,. Pennsylvania 18101, October 2, 1989.

Hereafter, in this report, these documents will be referred to as Pennsylvania Power Submittals No. 1, No. 2, and No. 3, respectively, and collectively, as the Pennsylvania Power Submittals.

2.2 Review of Pennsylvania Power's Responses to Staff Positions and Implementation of Those Positions

Generic Letter 88-01 outlines 13 NRC Staff positions pertaining to (1) materials, (2) processes, (3) water chemistry, (4) weld overlay, (5) partial replacement, (6) stress improvement of cracked weldments, (7) clamping devices, (8) crack evaluation and repair criteria, (9) inspection methods and personnel, (10) inspection

schedules, (11) sample expansion, (12) leak detection, and (13) reporting requirements. Generic Letter 88-01 states that the licensee should indicate in their submittal whether they endorse these NRC Staff positions or propose alternative positions. Pennsylvania Power Submittal No. 3 addresses each of these items, and that response is summarized in Table 1 of this report.

Note that Pennsylvania Power indicated acceptance of twelve of the thirteen NRC Staff positions, although they applied provisions to three items, i.e., those pertaining to Materials, Crack Evaluation and Repair Criteria, and Leak Detection which are discussed later in this report. Pennsylvania Power proposed an alternative position on Reporting of Flaws. This position is also discussed later in this report.

2.3 Review of Classification of Welds, Previous Mitigating Actions, and Previous Inspections

Pennsylvania Power Submittal No. 1 does not provide a list of welds at Susquehanna 2 that are within the scope of Generic Letter 88-01; however, they did provide summaries of the materials, mitigating treatments, and IGSCC classifications of welds which are discussed below.

A list of welds is contained in Pennsylvania Power Submittal No. 3 which lists IGSCC classifications, material compositions, mitigating treatments, past inspections, and plans for future inspections. These items are discussed in the following sections.

2.3.1 PP&L's Position on Materials (per Pennsylvania Power Submittal No. 1)

Pennsylvania Power Submittal No. 1 states that there are

Table 1

Summary of PP&L's Responses to Staff Positions

Staff Position	PP&L Accepts NRC Staff Position	PP&L Has/Will Applied In Past	PP&L Has/Will Consider for Future Use
1. Materials	yes(a)	yes(a)	yes(a)
2. Processes	yes	yes	yes
3. Water Chemistry	no(b)	no(b)	no(b)
4. Weld Overlay	yes(c)	no	yes(c)
5. Partial Replacement	yes(c)	no	yes(c)
6. Stress Improvement of Cracked Weldments	yes(c)	no	yes(c)
7. Clamping Devices	yes(c)	no	yes(c)
8. Crack Evaluation and Repair Criteria	yes(a)	no	yes(a)
9. Inspection Method and Personnel	yes	no	yes
10. Inspection Schedule	yes	no	yes
11. Sample Expansion	yes	no	yes
12. Leak Detection	yes(a)	yes(d)	yes(a)
13. Reporting Requirements	no(d)	no(d)	no(d)

(a) Provisions applied, see text for discussion.

(b) HWC is not used, but its implementation is periodically re-evaluated.

(c) No IGSCC has been found that required repair, but PP&L will determine the most appropriate method considering NUREG 0313, Revision 2 when required.

(d) Alternative position presented. See text for discussion.

13 Inconel 182 and Inconel 600 austenitic nickel based weldments at Susquehanna 2 and that these welds will be included in their inspection plans. Another statement pertaining to materials is:

> "Low carbon weld metal with less than 7.5% ferrite (as deposited). The SSES (Susquehanna) units were constructed using low carbon weld material with a specified minimum delta ferrite of 5.0%, consistent with the practice at the time. PP&L is confident that the low carbon weld metal used at SSES has sufficient ferrite percentage to be resistant to IGSCC. A review of a representative sample of low carbon weld material certifications for SSES showed a minimum percent ferrite ranging from 5.5% to 12%, with most above 7.5%. Most BWR's have used the minimum 5% ferrite content weld materials and of all the HAZ cracking observed in BWR's, no cracks have initiated in or penetrated the weld metal. Given these considerations, PP&L's inspection program will continue to consider the low carbon weld material used at SSES as resistant."

2.3.2 Stress Improvement

Pennsylvania Power Submittal No. 1 contains the following statement:

> "Prior to commercial operation, SSES, Unit 2 had IHSI (Induction Heating Improvement Process) performed on 113 welds. All of these welds are included in inspection programs as Category B from NUREG 0313, Rev. 2."

2.3.3 IGSCC Classification of Welds and Mitigating Treatments

A summary of the IGSCC classifications of welds and the mitigating treatments are contained in Table 2 of this report. Note that the number of IGSCC Category D welds and IGSCC Category G is different in Pennsylvania Power Submittal No. 2 than they are in Pennsylvania Power Submittal No. 3. In part these differences are explained in the following statement from Pennsylvania Power Submittal No. 3:

> "Unit 1 IGSCC Category D currently contains 32 welds - 36 welds were previously reported in IGSCC Category D. Review of the welds included in Category D yielded four welds which conformed to the NRC staff position on materials for IGSCC Category A; therefore, these welds were deleted from Category D and included in Category A." Similarly, Unit 2 Category D was revised from 33 to 31 welds."

Additional explanation is found in Pennsylvania Power Submittal No. 1 which states:

> There are ... 22 weldments in Unit 2 that are non-resistant with no stress improvement and have not been examined in accordance with the inspection method and personnel referenced in NUREG 0313, Rev. 2. These weldments will be inspected during (the) units next refueling outage. Presuming that no defects are found and all weldments are inspectable, these weldments will be included into our programs as Category D."

Since Pennsylvania Power is planning inspections of the 22 IGSCC Category G welds during the next refueling outage, they are considering these welds as IGSCC Category D for purposes of tabulation, and this practice is accepted in this report for purposes of evaluation of their inspection

Table 2

Summary of IGSCC Classifications and
Mitigating Treatments at Susquehanna 2

Per Pennsylvania Power Submittal No. 1

IGSCC Classification	A	B	C	D	E	F	G
Number of Welds	*	113	0	11	0	0	22

* Number not disclosed

Per Pennsylvania Power Submittal No. 2

IGSCC Categ	No. of Welds	No. with Res. Matl.	Number with Indicated Treatment			
			SHT	CRC	SHT+IHSI	IHSI
A	187	145	20	10	12	0
B	113	0	0		0	113
C	0	–	–	–	–	–
D	31	0	0	0	0	0
E	0	–	–	–	–	–
F	0	–	–	–	–	–
G	0	–	–	–	–	–
Totals	331	145	20	10	12	113

program.

2.3.4 Previous Inspection Programs

As mentioned above, Pennsylvania Power Submittal No. 3 contains a list of welds which includes information concerning which welds that have been inspected and plans for future inspections. This information is summarized in Table 3 of this report. It should be noted that all inspections performed after 1985 were performed using methods and personnel qualified under the NRC/EPRI/BWROG Coordination program as upgraded in September, 1985.

2.3.5 Evaluation and Recommendations

It is recommended that Pennsylvania Power's provision concerning materials (i.e., that pertaining to ferrite content of low carbon welds) should be accepted since the carbon content of those welds are < 0.035 as recommended in Generic Letter 88-01 and NUREG 0313, Revision 2.

Pennsylvania Power has replaced (or originally used) resistant materials in 145 welds. In addition, they applied corrosion resistant cladding to 10 welds and solution heat treating to 32 welds (12 of which were subsequently treated with IHSI). Thus, a total of 187 welds have been correctly classified as IGSCC Category A.

A total of 113 welds which contain non-resistant material have been treated with IHSI (all before commercial operation). These welds are correctly classified as IGSCC Category B welds.

Table 3

Summary of Inspection Schedules for Susquehanna 2

IGSCC Categ.	No. in Categ.	No. Inspected[a] or Scheduled 86	89	Later	Required by Generic Letter 88-01
A	187	8	10	38	25% every 10 years (at least 12% in 6 years)
B	113	12	15	47	50% every 10 years (at least 25% in 6 years)
C	0	-	-	-	All within the next 2 refueling cycles, then all every 10 years (at least 50% in 6 years)
D	31	2	7	31	All every 2 refueling cycles
E	0	-	-	-	50% next refueling cycle, then all every 2 refueling cycles
F	0	-	-	-	All every refueling outage
G	0		-	-	All next refueling cycle

Note:

a. Inspections in 1986 and later were conducted using methods and personnel qualified under NRC/EPRI/BWROG Coordination Plan as upgraded in September, 1985.

The remaining 31 welds have been classified as IGSCC Category D welds. Twenty-two of these were incorrectly classified (they have not been properly inspected so they should be classified as IGSCC Category G welds), but these welds are scheduled for inspection during the next refueling outage, after which (assuming no flaws are found) the classifications will be correct. Thus, it is recommended that the error should not be corrected at this time.

2.4 Current Plans for Mitigating Actions

2.4.1 Summary of Plans

The only plans for future mitigating actions at Susquehanna 2 consist of evaluation of hydrogen water chemistry and repairs of cracked weldments. These actions are discussed in greater detail in the following sections.

2.4.2 Water Chemistry Control

Pennsylvania Power Submittal No. 1 contains the following statement concerning water chemistry control:

> "Presently, PP&L has no plans to implement hydrogen water chemistry at SSES. We are following industry experience in this area and periodically re-evaluate our position."

2.4.3 Weld Repairs

Pennsylvania Power Submittal No. 1 contains the following statement concerning weld overlay reinforcement, partial replacement, stress improvement of cracked weldments, and clamping devices:

"There are no weldments at SSES that were repaired due to IGSCC. When necessary to perform repairs, PP&L will determine the most appropriate method considering the criteria in NUREG 0313, Rev. 2."

2.4.4 Evaluation of Conformance to Staff Positions and Recommendation

Since (a) mitigating treatments have already been applied to most welds at Susquehanna 2, (b) an ISI program which complies to NRC Staff positions (as discussed below) will be employed, and (c) any needed repairs will be performed using a procedure that complies with the NRC Staff position, acceptance of the Pennsylvania Power position is recommended.

2.5 Plans for Future Inspections

2.5.1 Summary of Inspection Schedules

Pennsylvania Power Submittal No. 1 states:

"SSES has weldments which fall into the inspection schedules for Category A, B, & D. Our inspection program presently complies with these schedules except for the Category D frequency. PP&L presently inspects these type of weldments at a frequency of 100% every 6 years while NUREG 0313, Rev. 2 requires 100% every two refueling outages. SSES inspection schedules will be adjusted prior to the next refueling outages to reflect this requirement."

"There are 22 weldments in Unit 2 ... that are nonresistant with no stress improvement and have not

been examined in accordance with the inspection method and personnel referenced in NUREG 0313, Rev. 2. These weldments will be inspected during each unit's next refueling outage. Presuming that no defects are found and all weldments are inspectable, these weldments will be included into our programs as Category D."

Pennsylvania Power Submittal No. 1 also contains the following information pertaining to inspection schedules:

Category A: Inspection schedules presently are in the ASME Section XI inspection programs and presently meet the required inspection schedule of 25% in 10 years and at least 12% in 6 years.

Category B: Inspection schedules will meet the requirement of 50% in 10 years and at least 25% in 6 years. 56 weldments out of 111 are scheduled for inspection.

Category D: Inspection schedules will meet the requirement of all weldments every two refueling cycles.

As previously mentioned, Pennsylvania Submittal No. 3 contains schedules for previous and future inspection plans that are summarized in Table 3 of this report. Recall that all inspections performed after 1985 were conducted using methods and personnel qualified under NRC/EPRI/BWROG Coordination plan as upgraded in September, 1985, so credit should be allowed for those inspections. Note that with that allowance, the schedules planned by Pennsylvania Power satisfy the schedule requirements as delineated in Generic Letter 88-01.

2.5.2 Method and Personnel

Pennsylvania Power Submittal No. 1 contains the following statement:

> "The inspection programs established for SSES presently incorporate the detailed volumetric procedures, equipment and examination personnel qualified by a formal program approved by the NRC as outlined in NUREG 0313, Revision 2."

As previously mentioned, Pennsylvania Submittal No. 3 also contains assurance that inspection methods and personnel used at Susquehanna 2 will conform with the NRC Staff position.

2.5.3 Sample Expansion

Pennsylvania Power's position on Sample Expansion will be in compliance with the NRC Staff position. Specifically, Pennsylvania Power Submittal No. 1 states:

> "The present sample expansion method for SSES meets the requirements of NUREG 0313, Revision 2. However, the current procedure does not explicitly conform to the NUREG requirements. This procedure will be revised by October 31, 1988 to comply with the NUREG."

2.5.4 Plans for Uninspectable Welds

There are no uninspectable welds listed for Susquehanna 2.

2.5.5 Evaluation and Recommendations

Acceptance of Pennsylvania Power's position on inspections is recommended since it conforms to the NRC Staff position as delineated in NUREG 0313, Revision 2 and Generic Letter 88-01.

2.6 Changes in the Technical Specification Concerning ISI

2.6.1 Summary of Pennsylvania Power's Position

Pennsylvania Power Submittal No. 1 states that a change to the Technical Specifications on ISI will be made. Specifically, their submittal contains the following statement:

> "PP&L will add a statement to the Technical specifications in the section on ISI that the Inservice Inspection Program for piping covered by the scope of Generic Letter 88-01 will be in conformance with the staff positions on schedule, methods and personnel, and sample expansion. This addition to Technical Specifications will be submitted before the next scheduled refueling outage."

2.6.2 Evaluation and Recommendation

Since the required change to the Technical Specification concerning ISI is promised by Pennsylvania Power, acceptance of Pennsylvania Power's position is tentatively recommended, pending actual receipt of the promised change.

2.7 Confirmation of Leak Detection in the Technical Specification

2.7.1 Pennsylvania Power's Position

Pennsylvania Power Submittal No. 1 states that the existing Technical Specifications are in conformance with the NRC Staff position on leakage with the exception of the following differences:

> "SSES Technical Specification for each unit limits the increase in unidentified leakage to two GPM within any four hour period. The specification also allows 4 hours to identify the source of leakage increase as not being service sensitive Type 304 or 316 austenitic stainless steel. PP&L feels this criteria is reasonable and is sufficiently restrictive to meet the intent of NUREG 0313, Rev. 2."

> "SSES Technical Specifications for each unit do not allow any time for repair of an inoperable leak detection channel. PP&L will investigate a revision to the Specification to allow a time period to repair an inoperable sump leak detection system prior to initiating a shutdown. The exact time period would be determined by evaluation and justified. The time period would be less than or equal to the 24 hour recommended maximum."

Pennsylvania Power Submittal No. 2 contains additional information concerning leakage detection which is reproduced in Table 4 of this report and the following notes pertaining to Items 1, 2(a), 2(b) of Table 4.

Table 4

Licensee Positions on Leakage Detection[a]

Position	Already Contained in TS	TS will be Changed to Include	Alternate[a] Position Proposed
1. Conforms with Position C of Regulatory Guide 1.45	yes[a]	-	-
2. Plant shutdown should be initiated when:			
(a) within any period of 24 hours or less, an increase is indicated in the rate of unidentified leakage in excess of 2 gpm, or	-	-	yes[a]
(b) the total unidentified leakage attains a rate of 5 gpm.	-	-	yes[a]
3. Leakage monitored at four hour intervals or less.	yes	-	-
4. Unidentified leakage includes all except:			
(a) leakage into closed systems, or	yes	-	-
(b) leakage into the containment atmosphere from sources that are located, do not interfere with monitoring systems, or not from throughwall crack.	yes	-	-
5. Provisions for shutdown within 24 hours due to inoperable measurement instruments in plants with Category D, E, F, or G welds.	yes	-	-

(a) See text for notes.

Item 1

"The drywell floor drain sump, all drywell drain piping, and all instrumentation used to monitor drywell floor drain sump are qualified to operate following an OBE. The drywell equipment drain tank, drywell equipment drain tank level instrumentation, and drywell floor drain sump pumps are not qualified to operate following an OBE."

"Credit will be taken for monitoring unidentified leakage following an OBE thru the use of the drywell floor drain sump level monitoring system. The proper functioning of at least one leakage detection system following an SSE is provided by the design of the air borne radioactivity monitoring system."

Item 2(a)

"Our Technical Specifications currently stipulate that the increase in unidentified leakage be limited to 2 GPM within any 4-hour period. Changing the limits to a 2 GPM increase within any 24-hour period is significantly more restrictive and would require a Technical Specification change. We feel that the present Technical Specification is reasonable and achievable with our present leakage detection system. The significant tightening of allowable leakage rate increases would pose a substantial threat to SSES availability with no improvement in our break detection capability."

"The Technical Specification also allows 4 hours to identify the source of leakage increase as not service sensitive, Type 304 or 316 austenitic stainless steel. It is our opinion that 4 hours is a reasonable

period for corrective action (e.g. backseating valves) and should not be deleted from the Technical Specifications."

Item 2(b)

"The Technical Specifications limit the total unidentified leakage to 5 GPM which is in agreement with Position 2(b); however, it also allows 4 hours to reduce the leakage rate before initiating a shutdown. It is our opinion that 4 hours is a reasonable period for corrective action and should not be deleted from the Technical Specifications."

2.7.2 Evaluation and Recommendation

The Susquehanna Technical Specifications on leakage detection conform with the NRC Staff position on conformance with Regulatory Guide 1.45 (with certain qualifications), frequency of leakage monitoring, definition of unidentified leakage, and requirements for shutdown for inoperable monitoring instruments. Thus, acceptance of Pennsylvania Power's positions on these items is recommended.

Pennsylvania Power's claim that the Technical Specification is sufficiently restrictive (by limiting the increase of unidentified leakage to 2 gpm per four hour period) is not justified. This is considerably less restrictive than the standard for the industry (as determined by the NRC Staff and delineated in Generic Letter 88-01) of 2 gpm per 24 hour period). Thus, rejection of this portion of Pennsylvania Power's position is recommended. Pennsylvania Power should amend the Susquehanna Technical Specification to conform with the position of the NRC Staff on the rate of increase

of unidentified leakage as delineated in Generic Letter 88-01.

Pennsylvania Power claims that the provision in the Technical Specification that allows a four hour period to identify the source of leakage when the total leakage exceeds 5 gpm or the rate of increase exceeds 2 gpm is reasonable. This position is also a deviation from the NRC Staff position as delineated in Generic Letter 88-01, but its inclusion does not compromise safety or the intent of the NRC Staff position on leakage detection. Thus, acceptance of this provision is recommended.

2.8 Crack Evaluation

2.8.1 Pennsylvania Power's Position

Pennsylvania Power Submittal No. 1 states that a criteria manual has been developed to evaluate and disposition flaws found during ISI. They further stated that the manual contains evaluation diagrams which can determine if a discovered flaw requires immediate repair or if continued operation without repair is justified. The diagrams, which were attached to the submittal, were based on the following:

> Methods and criteria for crack evaluation follow the rules of Paragraph IWB-3640 of Section XI of the 1986 Edition of the ASME Boiler and Pressure Vessel Code.
>
> Crack growth rate (inches per hour) is determined using linear elastic solutions for K_I and the following expressions:

For welds treated with IHSI

$$da/dt = 3.590 \times 10^{-8} K_I^{2.161}$$

For welds not treated with IHSI

$$da/dt = 3.217 \times 10^{-8} K_I^{2.12}$$

The methods incorporate the following assumptions:

The residual stress for non-IHSI welds is in accordance with NUREG 0313, Rev. 2 for welds for which $t > 1"$ and linear for welds for which $t < 1"$.

For non-IHSI welds, flaws are 360 degree, part-through circumferential flaws at the I.D. surface. For IHSI welds, a constant flaw aspect ratio is maintained.

2.8.2 Evaluation and Recommendation

The approach advanced by Pennsylvania Power differs from that proposed in Generic Letter 88-01 in the following respects:

(1) The equation used for crack growth rate for welds that have been treated with IHSI is that proposed by the NRC Staff, but for welds not treated with IHSI, an equation is used that gives about 20% lower crack growth rates.

(2) The assumed residual stress distribution differs from that given in Generic Letter 88-01.

Although not reproduced in this report, justification for

those differences is contained in Pennsylvania Power Submittal No. 2. The justification is-based on a report by EPRI Report NP-46-SR which summarizes methods and bases used by the Task Group for Piping Flaw Evaluation to develop allowable flaw sizes for Section XI, IWB-3640 of the ASME Code.

Since there is documented justification for the technical approach contained in Pennsylvania Power's position, acceptance of that position is recommended.

3. ALTERNATIVE POSITION

3.1 Plans for Notification of the NRC of Flaws and Evaluation of Flaws

3.1.1 Pennsylvania Power's Position

Pennsylvania Power plans to comply with the NRC Staff position on notification. Specifically, their submittal states:

> "PP&L will notify the NRC Senior Resident Inspector within 30 days if detected IGSCC cracks do not meet the IWB-3500 criteria of Section XI of the Code for continued operation without evaluation or if a change is found in the condition of welds previously known to be cracked. The evaluation of the cracks for continued operation and/or the repair plans will be submitted as part of the Outage Summary Report. If an alternate continued service evaluation (other than that provided for ... (in) this letter) is performed on such cracks, PP&L will obtain NRC approval of the alternate evaluation procedures and acceptance criteria (ref. IWB-3640) prior to resumption of operation."

3.1.2 Evaluation and Recommendation

Pennsylvania Power's position on reporting of flaws is not acceptable because it does not provide timely notification. Thus their position should be modified to conform with the NRC Staff position which is delineated as follows in Generic Letter 88-01:

> "... notify the NRC of any flaws identified that do not meet IWB-3500 criteria of Section XI of the Code for continued operation without evaluation, or a change found in the condition of the welds previously known to be cracked ..."
>
> "If any cracks are identified that do not meet the criteria for continued operation without evaluation given in Section XI of the Code, NRC approval of flaw evaluations and/or repairs in accordance with IWB 3640 and IWA 4130 is required before resumption of operation."

4. CONCLUSIONS AND RECOMMENDATIONS

Pennsylvania Power endorsed twelve of the thirteen NRC Staff positions as delineated in Generic Letter 88-01 (i.e., those pertaining to Materials, Processes, Water Chemistry, Weld Overlay, Stress Improvement of Cracked Weldments, Clamping Devices, Partial Replacement, Crack Evaluation and Repair Criteria, Inspection Methods and Personnel, Inspection Schedule, Sample Expansion, and Leakage Detection; however, they applied some provisions to their endorsement of Materials, Crack Evaluation and Repair Criteria, and Leakage Detection. They presented an unacceptable alternative position on reporting of flaws which is discussed in Section 3 of this report.

Concerning Crack Evaluation and Repair Criteria. They use an approach for IHSI treated welds that is similar to that recommended in NUREG 0313, Revision 2, but they assume a linear distribution for residual stress for welds for which t < 1 inch. They also use an expression for crack growth rate for non-IHSI welds that gives about 20% lower growth rate. They presented data justifying this approach.

A detailed (weld-by-weld) list of welds that were assigned IGSCC classifications and a list of welds that will be (or have been) inspected was provided by Pennsylvania Power. Extensive mitigating treatments have been applied so that most welds are either IGSCC Category A or IGSCC Category B (treated with IHSI before commericial operation). Thirty-one non-resistant welds remain (classified as IGSCC Category D). Although 22 of the non-resistant welds should be classified as IGSCC Category G welds rather than IGSCC Category G welds, no action is required because they are scheduled for inspection during the next refueling outage.

No additional mitigating actions are planned except for weld repairs (as needed) using an appropriate repair procedure (per recommendations of NUREG 0313, Revision 2).

Inspection plans (including inspection schedules, methods and personnel, plans for inaccessible welds, and sample expansion) comply with the NRC Staff positions. In addition, Pennsylvania Power agreed to change the Technical Specification concerning ISI, and they stated that a proposed amendment would be submitted before the next scheduled refueling outage.

Pennsylvania Power stated that the Technical Specification concerning leakage is already in compliance with the NRC Staff position except for following differences. One difference concerns the restriction on the increase of unidentified leakage. They restrict the increase to 2 gpm per 4-hour period, and they declined to change this requirement

even though it is much less restrictive than the 2 gpm per 24-hour requirement established by the NRC Staff. Another difference is that they allow a four hour period (prior to initiating shutdown) to identify the source of leakage (i.e. whether or not it is leakage from service sensitive Type 304 or 316 stainless steel) when the increase of unidentified leakage exceeds 2 gpm or when the total leakage exceeds 5 gpm.

As a result of this technical evaluation, the following recommendations are made:

(1) Acceptance of Pennsylvania Power's classification of welds provided that inspections of previously uninspected, nonresistant welds are performed during the next refueling outage as currently scheduled.

(2) Acceptance of Pennsylvania Power's inspection plans including their plans for inspection schedules, methods and personnel, and sample expansion.

(3) Tentative acceptance of Pennsylvania Power's position on changing the Technical Specification concerning ISI, pending receipt of the promised amendment to the Technical Specification.

(4) Rejection of Pennsylvania Power's position concerning limiting the rate of increase of unidentified leakage. Pennsylvania Power should amend the Technical Specification to state that plant shutdown should be initiated for inspection and corrective action when, within any period of 24 hours or less (rather than 4 hours), any leakage detection system indicates an increase in rate of unidentified leakage in excess of 2 gpm or its equivalent.

(5) Acceptance of other portions of Pennsylvania Power's position on leakage detection.

(6) Rejection of Pennsylvania Power's position on Reporting of Flaws. Pennsylvania Power should change their position to conform with the NRC Staff position as discussed in Section 3 of this report.

(7) Acceptance of the Pennsylvania Power's provision to the NRC Staff position on Crack Evaluation and Repair Criteria.

(8) Acceptance of the remaining portions of the Pennsylvania Power Submittal.

5. REFERENCES

1. "Technical report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping," NUREG 0313, Revision 2, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, January, 1988.

2. "Investigation and Evaluation of Stress-Corrosion Cracking in Piping of Light Water Reactor Plants," NUREG 0531, U. S. Nuclear Regulatory Commission, February, 1979.

3. "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping," Generic Letter 88-01, U.S. Nuclear Regulatory Commission, January 25, 1988.