Public Service
Electric and Gas
Company

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Gentlemen:

RESPONSE TO NRC BULLETIN 87-01
SALEM GENERATING STATION
UNIT NOS. 1 AND 2
HOPE CREEK GENERATING STATION
DOCKET NOS. 50-272, 50-311 AND 50-354

Public Service Electric and Gas Company (PSE&G) has received the subject NRC Bulletin regarding the thinning of pipe walls in condensate, feedwater, steam and connected high-energy single-phase and two-phase carbon steel piping systems, including all safety-related piping systems. The information requested by this Bulletin as related to the Salem and Hope Creek Generating Stations is provided in the enclosure to this letter.

Should you have any questions on this transmittal, please do not hesitate to contact us.

Sincerely,

C A McNeill Jr / JTB

Enclosure

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USNRC Licensing Project Manager - Hope Creek

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ENCLOSURE

RESPONSE TO NRC BULLETIN 87-01
SALEM GENERATING STATION, UNIT NOS. 1 AND 2
HOPE CREEK GENERATING STATION
DOCKET NOS. 50-272, 50-311, 50-354

The responses to each of the questions indicated in NRC Bulletin 87-01, Thinning of Pipe Walls in Nuclear Power Plants with regard to programs for monitoring the wall thickness of pipes in condensate, feedwater, steam, and connected high-energy piping systems, including all safety-related and non-safety-related piping systems fabricated of carbon steel are addressed in the following:

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

The following are the codes used for design, fabrication and installation of the subject piping for Salem and Hope Creek:

Salem Generating Station

Non-nuclear piping	ANSI B31.1 1967 Edition
Nuclear piping	ANSI B31.1 1967 Edition (Design)
	ANSI B31.7 1968 Edition (Material)
	ANSI B31.7 1969 through 1970 Edition (Construction)

Hope Creek Generating Station

Non-nuclear piping	ANSI B31.1 1973 through 1974 Addenda
Nuclear piping	ASME Section III, 1974 through Winter 1974 Addenda (Design and Material)
	ASME Section III, 1977 through Winter 1977 Addenda (Construction)

2. Describe the scope and extent of your program 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

Although a program was in effect for two phase flow at Salem and Hope Creek, no systematic recurring wall thickness inspections of single phase piping were performed prior to the Surry event. The program scope for evaluation of single phase high energy piping erosion/corrosion and review of the existing two phase erosion program will consist of a systematic review of the following systems as a minimum.

Systems Included in Review

Salem Generating Station

Single Phase	Condensate (after second stage of feedwater heating) Feedwater Heater Drains Heater Drain Pump Discharge
Two Phase	Bleed Steam Steam Generator Blowdown MSR Drains

Hope Creek Generating Station

Single Phase	Condensate Feedwater Heater Drains High Pressure Core Injection Reactor Isolation Core Injection
Two Phase	Extraction Steam Main Steam Drains

The program is formatted using the recommendations of the NUMARC Technical Subcommittee Working Group on Piping Erosion/Corrosion dated June 2, 1987 and related NRC comments dated June 12, 1987.

Actual inspection point selection will be determined through engineering evaluation and the EPRI generated CHEC computer diagnostic program. Plant piping isometrics, chemistry data, piping design specifications and plant walkdowns will be utilized. The frequency of inspections will be determined following review of the program field measurements. Factors which will affect inspection frequency are:

- Comparison of the measured wall thickness to design wall thickness and code minimum wall thickness requirements.

- Materials of construction compared with operating conditions biased by a wear rate, based on the difference between design wall thickness and measured wall thickness over the existing service time.

- Geometry of the system compared with operating conditions.

- Maintenance history and/or replacements.

- Accessibility to the area for both inspection teams and operating personnel, and location with respect to safety system equipment.

Non-destructive examination methods will be consistent with the degradation to be expected. Presently, straight beam ultrasonic techniques are planned to be utilized. Automated data collection methods are being addressed. It is not anticipated that radiographic techniques for measuring wall thickness will be utilized.

Repair/replacement decisions will be based on existing non-conformance practices which require an engineering evaluation. Typical items to be addressed for this decision process are:

- Measured wall thickness compared to design wall thickness and code minimum wall thickness allowable adjusted for service history and required future service.

- Materials of construction compared with operating conditions.

- Material availability.

- Code requirements and type of defect being addressed.

- Repair economic factors versus replacement economic factors.

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 (Item 2a):

   a. piping material
   b. piping configuration
   c. pH of water in the system
   d. system temperature
   e. fluid bulk velocity
   f. oxygen content in the system

For single phase systems, the following factors are included in determining inspection point selection and frequency:

Design Conditions	Operating Conditions
Piping material	System fluid pH and type of water treatment
Piping configuration	System operating temperature
Fluid bulk velocity	Oxygen content of fluid

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

   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.

Chronologically, the wall thickness inspections that have been performed at Salem and Hope Creek are as follows:

Salem Generating Station

Salem Unit 1, Bleed Steam Erosion Baseline Survey, November 1982 and April 1986 (Attachment 1)

Salem Unit 2, Bleed Steam Erosion Baseline Survey, November 1984 (Attachment 2)

Salem Unit 1, No. 5 Bleed Steam Erosion Occurrence Data, September 1986 (Attachment 3)

Salem Unit 2, No. 5 Bleed Steam Erosion Survey, October 1986 (Attachment 4)

Salem Unit 2, Surry Failure Evaluation (initial), December 1986 (Attachment 5)

Salem Unit 1, Feedwater Inspection (responding to findings in Salem Unit 2), April through June 1987 (Attachment 6)

Hope Creek Generating Station

Extraction Steam Erosion Baseline Survey, March 1984 (Attachment 7)

Based on engineering review, the inspection programs for single phase and two phase erosion detail specific areas in the subject piping which are most subject to corrision. The inspections listed above were performed solely to indicate wall thicknesses. Straight beam ultrasonic techniques were utilized.

The piping which was inspected is indicated on the Attachments. The general locations for inspections are marked on inspection sketches which are available for review upon request. A grid network, varying in spacing was utilized. The minimum wall thickness measured, when compared with adjacent measurements, will determine the severity of erosion and acceptability/unacceptability for use.

The wall thickness of the inspected piping is detailed on the Attachments. The only unacceptable determination was found on the Salem Unit 1 and 2 Steam Generator Feedwater Pump recirculation piping downstream of the control valve and flow restricting orifices during the inspection of feedwater and condensate systems performed subsequent to the Surry incident. This piping was designed to the feedwater piping specification but is not exposed to feedwater system pressure if the manual isolation valve, which is located downstream, remains open to the condenser. Following the inspection, Engineering Safety Evaluations (MT-86-204 (Salem Unit 1) and MT-87-005 (Salem Unit 2)) were immediately performed to determine whether continued use of this piping could be permitted. The results of the safety evaluations permitted the use of this piping to the next refueling outage based on the normal operating conditions on this piping with the manual isolation valve open. Administrative controls have been placed on the manual isolation (BF-31) valves prohibiting closure with the plant in operational or standby modes.

Erosion of the main feedwater pump recirculation piping downstream of the control valves and flow orifices is caused by flashing of high energy liquid in A106 grade B piping.

The affected piping is scheduled to be replaced during the next scheduled refueling outages commencing in October 1987 (Salem Unit 1) and April 1988 (Salem Unit 2). The replacement material is to be A335 Chromium Molybdenum piping.

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

The single phase wall thickness inspection program and existing two phase wall thickness inspection program are being enhanced as a result of industry working group recommendations (NUMARC) and PSE&G engineering evaluations. Future enhancements will be based on technological improvements in data acquisition and operating experiences.

Attachment No. 1
Salem Generating Station Unit No. 1

Bleed Steam Erosion Inspection Program

Ref: S-C-G100-MSE-152
S-C-G100-MFD-281, Rev. 1
S-C-MP00-MGS-001 SPS-17

Inspection Location	Code Minimum Wall	Baseline Data*	Review Data**
BSH-13-7 (No. 3 Bleed)	.250	.401 to .409	.395 to .435
BSH-13-4 (No. 3 Bleed)	.250	.409 to .418	.415 to .430
BSH-14-7 (No. 4 Bleed)	.188	.453 to .469	.460 to .485
BSH-14-8 (No. 4 Bleed)	.188	.415 to .427	.420 to .440
BSH-14-9 (No. 4 Bleed)	.188	.402 to .420	.400 to .445
Bleed Steam to MSR's	.280	.457 to .468	.445 to .465

* Baseline data taken November 24, 1982 (Krautkramer - Branson Model CL-204, 1/4" Transducer)

** Review data taken April 25, 1986 (Nortec Not-120, 1/4" Transducer)

All dimensions in inches.

Attachment No. 2
Salem Generating Station Unit No. 2

Bleed Steam Erosion Inspection Program

Ref: S-C-G100-MSE-152
S-C-G100-MFD-281, Rev. 2
S-C-MP00-MGS-0001 SPS-17

Inspection Location	Code Minimum Wall	Baseline Data	Review Data
44" (Crossunder along L Line)*	.375	.950 to 1.80	(4th refueling)
44" (Crossunder along G Line)*	.375	.1.0 to 1.80	(4th refueling)
44" (Crossunder along M Line)*	.375	.995 to 1.80	(4th refueling)
BSH-23-7 (No. 3 Bleed)	.250	.400 to .450	(4th refueling)
BSH-23-4 (No. 3 Bleed)	.250	.390 to .425	(4th refueling)
BSH-24-7 (No. 4 Bleed)	.188	.390 to .410	(4th refueling)
BSH-24-8 (No. 4 Bleed)	.188	.410 to .440	(4th refueling)
BSH-24-9 (No. 4 Bleed)	.188	.390 to .430	(4th refueling)

* Note visual inspections performed every refueling of crossunders and turning vanes.

All dimensions in inches.

Attachment No. 3
Salem Generating Station Unit No. 1

Bleed Steam Erosion Occurrence Data

Ref: SPE-86-0330
DCR-1SM-0118
PSE&G Research Lab. Report Nos. 69520 and 69545
S-C-MP00-MGS-0001 Section SPS-17

Piece Mark Location No.	Code Minimum Wall	Wall Thickness
1SBS-15-3 (No. 5 Bleed, North)	.165	.045 to .300
1SBS-15-3A (No. 5 Bleed, South)	.165	.100 to .400

Measuresurements taken using Nortec Model Not-120 with a 1/4" inch transducer.
Original material ASTM A106 Grade B.

Piping replaced with ASTM A335 grade P-11 per DCR 1SM-0118, September 1986.

All dimensions in inches.

Attachment No. 4
Salem Generating Station   Unit No. 2

No. 5 Bleed Steam erosion inspection (at crossunders)

Ref: Deficiency Report No. SMD-M86-0587
DCR 2SM-00142
S-C-MP00-MGS-0001   SPS-17

Inspection Location	Code Minimum Wall	Measured Wall Thickness
25-B525-A	.165	.178 to .595
25-B525-3A	.165	.194 to .594
North crossunder (adjacent to spool 1A)	.375	.992 to 1.066
South crossunder (adjacent to spool 3A)	.375	.998 to 1.066

Original material ASTM-A106 grade B.
Inspections Mode using Krautkramer - Branson Model No. DM-2, October 25, 1986.

Piping replaced using ASTM-A335 grade P-11 per DCR 2SM-0142, October 1986.

All dimensions in inches.

Attachment No. 5
Salem Generating Station Unit 2

Surry occurrence review at Salem, Initial Inspection Data

Ref: System Engineer to Salem ISI Supervisor memo dated December 16, 1986
PSE&G NDE reports with work order No. 86-12-16-076-6
S-C-MP00-MGS-0001 SPS-16, SPS-17, SPS-19

Inspection Location	Code Minimum Wall		Wall Thickness	
21 SGFP suction 90° elbow (A)	.480		.670 to .900	
21 SGFP suction 90° elbow (B)	.480		.640 to .680	
22 SGFP suction 90° elbow (A)	.480		.700 to .830	
22 SGFP suction 90° elbow (B)	.480		.500 to .580	
SGFP common suction T	.520		1.060 to 1.260	
SGFP common suction 90° elbow	.520		.750 to .900	
Heater drain to SGFP suction T	.360		.920 to 1.190	
24 inch T from 25 heater	.480		.985 to 1.160	
21 heater drain pump discharge elbow (A)	.360		.360 to .440	
21 heater drain pump discharge elbow (B)	.360		.380 to .430	
22 heater drain pump discharge (A)	.360		.380 to .460	
22 heater drain pump discharge (B)	.360		.360 to .420	
23 heater drain pump discharge elbow (A)	.360		.370 to .475	
23 heater drain pump discharge elbow (B)	.360		.350 to .400	Note 1
23 condensate pump discharge elbow (A)	.360		.480 to .540	
23 condensate pump discharge elbow (B)	.360		.520 to .560	
24 net common feed elbow	.480		1.760 to 1.860	
11 BF19 valve discharge spool	.720		.720 to 1.360	
12 BF19 valve discharge spool	.720		.730 to 1.380	
13 BF19 valve discharge spool	.720		.730 to 1.440	
14 BF19 valve discharge spool	.720		.700 to 1.340	Note 2
21 BF32 valve discharge spool	.512/.322	Note 5	.330 to .540	
22 BF32 valve discharge spool	.512/.322	Note 5	.280 to .550	Note 3
25 B & C heater feed water T	.480		.880 to 1.190	

Note 1 Acceptable for use based upon paragraph 102.2.4 of ANSI B31.1, 1967 per original design.
Note 2 .700 area is isolated spot. General wall thickness is not less than .740 inches.
Note 3 .280 defect is isolated spot located by scan. General thinning is not less than .345 inches. Administrative controls have been placed on BF-31 valves and replacement is scheduled for the fourth refueling outage.
Note 4 All data taken between December 16-18, 1986 using Nortec Not-120 equipment.
Note 5 Design wall thickness violation per SPS-16. Minimum wall required with administrative control on isolation valve is .322.

(All dimensions in inches.)

Attachment No. 6
Salem Generating Station   Unit No. 1

Steam Generator Feed Pump Recirculation
Piping Downstream of Flow Orifice

Location	Code Minimum Wall	Inspection 1	Inspection 2	Inspection 2
FWR-4	Notes 1 and 2	.340 to .575	.330 to .570	.325 to .585
FWR-12	Notes 1 and 2	.425 to .525	.440 to .520	.425 to .525
12 BF31 Elbow	Notes 1 and 2	.235 to .450	.235 to .470	.235 to .460
12 NE Bend	Note 2	N/A	.280 to .480	.280 to .480

Notes:

1 Minimum wall thickness, piping isolatable from main condenser, .393 inches.
2 Minimum wall thickness, piping non-isolatable from main condenser, .247 inches.
3 Original material ASTM A106 grade B.

Inspection 1: April 22, 1987   Krautkramer - Branson - Model CL 204 w/high temperature probe

Inspection 2: May 21, 1987   Krautkramer - Branson - Model CL 204 w/high temperature probe

Inspection 3: June 22, 1987   Krautkramer - Branson - Model CL 204 w/high temperature probe

Piping scheduled for replacement, 4th refueling outage, October/November 1987.

All dimensions in inches.

Attachment No. 7
Hope Creek Generating Station   Unit No. 1

Extraction Steam Erosion Inspection Program

Ref: Letter from Chief Project Engineer - Hope Creek to
General Manager - Hope Creek Operations dated January 16, 1984.

Description	Piece Mark Location	Design Wall Thickness	Baseline Dat*	Review Data
Crossunder	6-2500	.438	.495 to .522	(1st refueling)
Crossunder	6-2501	.438	.502 to .513	(1st refueling)
No. 5A Ext.	6-2514	.438	.552 to .573	(1st refueling)
No. 5A Ext.	6-2516	.438	.557 to .576	(1st refueling)
No. 5A Ext.	6-2517	.438	.555 to .572	(1st refueling)
No. 5A Ext.	6-2518	.438	.592 to .609	(1st refueling)
No. 5B Ext.	6-2504	.438	.553 to .572	(1st refueling)
No. 5B Ext.	6-2512-A	.438	.538 to .557	(1st refueling)
No. 5B Ext.	6-2512-B	.438	.595 to .620	(1st refueling)
No. 5B Ext.	6-2513-A	.438	.528 to .542	(1st refueling)
No. 5B Ext.	6-2513-B	.438	.541 to .558	(1st refueling)
Crossaround	6-7678	.438	.475 to .498	(1st refueling)
No. 5C Ext.	6-2510	.438	.574 to .587	(1st refueling)
No. 5C Ext.	6-2511	.438	.564 to .587	(1st refueling)
No. 6A Ext.	6-4701	.438	.576 to .592	(1st refueling)
No. 6A Ext.	6-4702-A	.438	.588 to .604	(1st refueling)
No. 6A Ext.	6-4702-B	.438	.595 to .605	(1st refueling)
No. 6A Ext.	6-4704-A	.438	.564 to .602	(1st refueling)
No. 6B Ext.	6-4692	.438	.575 to .594	(1st refueling)
No. 6B Ext.	6-4695	.438	.548 to .565	(1st refueling)
No. 6B Ext.	6-4696	.438	.615 to .625	(1st refueling)
No. 6B Ext.	6-4697-A	.438	.556 to .574	(1st refueling)
No. 6C Ext.	6-4713	.438	.564 to .574	(1st refueling)
No. 6C Ext.	6-4714-A	.438	.564 to .579	(1st refueling)
No. 6C Ext.	6-4714-B	.438	.586 to .608	(1st refueling)
No. 6C Ext.	6-4716-A	.438	.562 to .574	(1st refueling)

*Baseline data taken December, 1983 with Krautkramer - Branson Model CL-204 equipment.

All dimensions in inches.

Attachment No. 7
Hope Creek Generating Station   Unit No. 1

Extraction Steam Erosion Inspection Program

Ref: Letter from Chief Project Engineer - Hope Creek to
General Manager - Hope Creek Operations dated January 16, 1984.

Description	Piece Mark Location	Design Wall Thickness	Baseline Dat*	Review Data
Crossunder	6-2500	.438	.495 to .522	(1st refueling)
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No. 5A Ext.	6-2514	.438	.552 to .573	(1st refueling)
No. 5A Ext.	6-2516	.438	.557 to .576	(1st refueling)
No. 5A Ext.	6-2517	.438	.555 to .572	(1st refueling)
No. 5A Ext.	6-2518	.438	.592 to .609	(1st refueling)
No. 5B Ext.	6-2504	.438	.553 to .572	(1st refueling)
No. 5B Ext.	6-2512-A	.438	.538 to .557	(1st refueling)
No. 5B Ext.	6-2512-B	.438	.595 to .620	(1st refueling)
No. 5B Ext.	6-2513-A	.438	.528 to .542	(1st refueling)
No. 5B Ext.	6-2513-B	.438	.541 to .558	(1st refueling)
Crossaround	6-7678	.438	.475 to .498	(1st refueling)
No. 5C Ext.	6-2510	.438	.574 to .587	(1st refueling)
No. 5C Ext.	6-2511	.438	.564 to .587	(1st refueling)
No. 6A Ext.	6-4701	.438	.576 to .592	(1st refueling)
No. 6A Ext.	6-4702-A	.438	.588 to .604	(1st refueling)
No. 6A Ext.	6-4702-B	.438	.595 to .605	(1st refueling)
No. 6A Ext.	6-4704-A	.438	.564 to .602	(1st refueling)
No. 6B Ext.	6-4692	.438	.575 to .594	(1st refueling)
No. 6B Ext.	6-4695	.438	.548 to .565	(1st refueling)
No. 6B Ext.	6-4696	.438	.615 to .625	(1st refueling)
No. 6B Ext.	6-4697-A	.438	.556 to .574	(1st refueling)
No. 6C Ext.	6-4713	.438	.564 to .574	(1st refueling)
No. 6C Ext.	6-4714-A	.438	.564 to .579	(1st refueling)
No. 6C Ext.	6-4714-B	.438	.586 to .608	(1st refueling)
No. 6C Ext.	6-4716-A	.438	.562 to .574	(1st refueling)

*Baseline data taken December, 1983 with Krautkramer - Branson Model CL-204 equipment.

All dimensions in inches.