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REON

SACRAMENTO PLANT

REPORT NO. RN-DR-0083

REPAIRS OF DISCREPANT STEAM GENERATING SYSTEM
LIQUID LINES

NERVA PROGRAM

CONTRACT SNP-1

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REPAIRS OF DISCREPANT STEAM GENERATING SYSTEM
LIQUID LINES

ROCKET ENGINE OPERATIONS - NUCLEAR

NERVA PROGRAM

CONTRACT SNP-1

CLASSIFICATION CATEGORY

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R. E. Branstrom
CLASSIFYING OFFICER

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ABSTRACT

In the process of accomplishing a water system modification to the Steam Generating System, a discrepant weld was discovered in the supply line undergoing modification. As a result it was decided that random checks should be accomplished on other welds to ensure the same discrepant condition did not exist throughout the system. The checks indicated that in many cases, welding was not to specification and was inferior to the extent that remedial action was necessary. Radiographic inspection revealed the discrepant welds which were subsequently repaired and accepted in accordance with standard procedures and specifications.

C. M. Rice
Program Manager
REON

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I. INTRODUCTION

The Steam Generating System (SGS), composed of three, chemical, steam generators, is located at NERVA Test Operations (NTO) and is part of the Nuclear Exhaust System (NES). The generators were built by the Thiokol Chemical Corporation for Aerojet-General Corporation. In addition to the three generators which are installed as a system there exists a fourth generator which is a spare. The generators are referred to by serial number as S/N 0016, S/N 0017, S/N 0018, and S/N 0019.

II. DISCUSSION

While accomplishing a water system modification, unrelated to the subject of this report, a weld discrepancy was noticed in a 90-degree flanged elbow of a water supply line. The discrepancy consisted of lack of penetration, no evidence of root spacing, and lack of inert gas purge, as evidenced by oxidation on the inside of the pipe. It was decided that a random check of other weldments should be accomplished in the event other discrepancies existed which could eventually cause an SGS malfunction. Field Action Request No. 107 was issued, authorizing NTO (Pan Am) to radiographically inspect 42 fluid line weldments of steam generator S/N 0016. Table 1 shows the results of the radiographic inspection and the types of defects encountered. A review of Table 1 shows that 43% of the welds were rejected. Records of REON Contract Administration show that the original purchase order placed with Thiokol required that all accessible welds be radiographically inspected and that control and acceptance of the welds were to be in accordance with ASME Boiler Code Sections VIII and IX.

Since steam generator S/N 0016 was scheduled to be used for injector development tests under Experimental Test Plan IV, proof tests of the fluid lines were accomplished as an interim qualification measure.

The fluid lines were successfully proof tested to 1.5 times the design operating pressure for ten cycles and the injector tests were continued to completion.

As a result of the high percentage of rejects in the 42 welds initially inspected on S/N 0016, the investigation was expanded to 79 weldments on each of the four generators. The original 42 welds inspected on S/N 0016 were re-inspected as part of this investigation. The various fluid lines and weld numbers are shown in Figure 1 for identification. The results of the radiographic inspection are presented in Table 2 for S/N 0016; Table 3 for S/N 0017, Table 4 for S/N 0018, and Table 5 for S/N 0019. Forty percent of all welds inspected were rejected in compliance with accept-reject requirements of ASME Boiler Code Section VIII and IX. The inspection was accomplished with all piping in place and revealed that the most common discrepancy was lack of penetration. A microphotograph of a cross-section of one of the welds is shown in Figure 2 and shows approximately 70% penetration and only one weld pass. Because of poor welding techniques, a suck-back condition and drop-through were also prevalent. Figures 3 and 4 show a typical suckback condition. Figure 5 shows a typical drop-through condition.

III. DISPOSITION

All propellant and water lines were removed for further detailed inspection and repair. Those lines that were not replaced in their entirety were radiographically inspected under laboratory conditions with the final disposition indicated in Table 6. Of those welds radiographed in the laboratory, 50% were rejected. Of the 50% rejected 95% required cutting and rewelding. The symbols used in Table 6 under DISPOSITION are as follows:

- C & R - The weld was completely cut out, weld preparation performed, and the line rewelded to the original as-built dimensions.
- Grind - The weld was ground as required to make it acceptable.
- W. I. - Where lack of penetration occurred, the inner diameter of the weld was ground and a weld pass was made to provide full penetration.

All radiographic records of the SGS liquid lines will be kept on file at the Pan Am Laboratory at NRDS.

The rework and acceptance of the SGS liquid lines was accomplished in accordance with the following procedures and specification:

Welding Specification	Pan Am 51-001
Welders Certification	Pan Am 51-001
Weld procedures	Pan Am 51-001
Radiography of Fusion Welds	NTO-QCS-105
Liquid Penetrant Examination i.e.,	
Root Pass Examination	NTO-QCS-107
Cleanliness Specification (Pipe)	NTO-QCS-112
Lox - Level E	
Propane - Level H	
Water - Level H	
Examination Requirements	NTO-QCS-110

IV. RESULTS AND CONCLUSION

The reworked and replaced lines successfully passed radiographic inspection and hydrostatic testing to 1.5 times the normal working pressure. The lines were then cleaned to the appropriate level of cleanliness for the particular line service in accordance with specification NTO-QCS-112, and were concluded to be acceptable for the intended service.

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WELD NO.	TYPE OF FLUID LINE	DISPOSITION		TYPE OF DEFECT	LOCATION Figure 1
		ACCEPT	REJECT		
1	Water	X			See sheet 1
2	Water	X			See sheet 1
3	Water	X			See sheet 1
4	Water	X			See sheet 1
5	Water	X			See sheet 1
6	LOX	X			See sheet 6
7	Propane	X			See sheet 4
8	Water		X	Lack of Fusion	See sheet 8
9	Water	X			See sheet 17
10	Water	X			See sheet 17
11	Water		X	Lack of Penetration	See sheet 17
12	Water	X			See sheet 17
13	Water	X			See sheet 17
14	Water		X	Lack of Penetration	See sheet 17
15	Propane		X	Lack of Penetration	See sheet 7
16	Propane	X			See sheet 7
17	Propane		X	Lack of Penetration	See sheet 7
18	Propane		X	Lack of Penetration	See sheet 7
19	LOX			Did not Record	See sheet 6
20	Water		X	Lack of Penetration	See sheet 5
21	Water	X			See sheet 5
22	Propane		X	Drop Through (Weld)	See sheet 5
23	Propane		X	Lack of Penetration	See sheet 5
24	Propane		X	Lack of Penetration	See sheet 5
25	LOX	X			See sheet 4
26	LOX	X			See sheet 4
27	LOX	X			See sheet 4
28	Propane	X			See sheet 4
29	Propane		X	Porosity, Slag, Lack of Fusion	See sheet 4
30	Propane		X	Porosity	See sheet 4
31	LOX	X			See sheet 6

Table 1. Radiographic Inspection of S/N 0016 Fluid Lines
(Sheet 1 of 2)

WELD NO.	TYPE OF FLUID LINE	DISPOSITION		TYPE OF DEFECT	LOCATION Figure 1
		ACCEPT	REJECT		
32	LOX	X			See sheet 6
33	LOX	X			See sheet 6
34	LOX		X	Lack of Penetration	See sheet 6
35	Water		X	Lack of Penetration	See sheet 8
36	Water	X			See sheet 8
37	Water		X	Excessive Suckback	See sheet 8
38	Water		X	Lack of Penetration	See sheet 1
39	Water	X			See sheet 8
40	Water	X			See sheet 8
41	Water		X	Lack of Fusion	See sheet 8
42	Water		X	Lack of Penetration	See sheet 8

Table 1. Radiographic Inspection of S/N 0016 Fluid Lines
(Sheet 2 of 2)

WELD NO.	DISPOSITION		SYSTEM	REMARKS
	ACCEPT	REJECT		
1	X		Water	
2	X		Water	
3	X		Water	
4	X		Water	
5	X		Water	
6	X		LOX	
7	X		Propane	
8		X	Water	Lack of Fusion
9	X		Water	
10	X		Water	
11		X	Water	Lack of Penetration
12	X		Water	
13	X		Water	
14		X	Water	Lack of Penetration
15		X	Propane	Lack of Penetration
16	X		Propane	
17		X	Propane	Lack of Penetration
18		X	Propane	Lack of Penetration
19		X	LOX	Lack of Penetration
20		X	Water	Lack of Penetration
21	X		Water	
22		X	Propane	Excessive Drop Through
23		X	Propane	Lack of Penetration
24		X	Propane	Lack of Penetration
25	X		LOX	
26	X		LOX	
27	X		LOX	
28	X		Propane	
29		X	Propane	Porosity, Slag, L. F.
30		X	Propane	Porosity
31	X		LOX	
32	X		LOX	

Table 2. Radiographic Interpretation for Steam Generator
S/N 0016 (Sheet 1 of 3)

WELD NO.	DISPOSITION		SYSTEM	REMARKS
	ACCEPT	REJECT		
33	X		LOX	
34		X	LOX	Lack of Penetration
35		X	Water	Lack of Penetration
36	X		Water	
37		X	Water	Excess Suckback
38		X	Water	Lack of Penetration
39	X		Water	
40	X		Water	
41		X	Water	Lack of Fusion
42		X	Water	Lack of Penetration
43		X	Water	Lack of Penetration
44		X	Water	Excessive Suckback
45		X	Water	Lack of Penetration
46	X		Water	
47	X		Water	
48		X	Water	Excessive Suckback
49	X		Water	
50	X		Water	
51	X		Water	
52	X		Water	
53		X	Water	Lack of Penetration
54		X	Water	Lack of Penetration
55		X	Water	Lack of Penetration
56	X		Water	
57			Water	Not Radiographed
58			Water	Not Radiographed
59			Water	Not Radiographed
60			Water	Not Radiographed
61	Replaced		Water	
62	Replaced		Water	
63			GN ₂	Not Radiographed

Table 2. Radiographic Interpretation for Steam Generator
S/N 0016 (Sheet 2 of 3)

WELD NO.	DISPOSITION		SYSTEM	REMARKS
	ACCEPT	REJECT		
64			GN ₂	Not Radiographed
65			GN ₂	Not Radiographed
66			GN ₂	Not Radiographed
67			GN ₂	Not Radiographed
68			GN ₂	Not Radiographed
69			GN ₂	Not Radiographed
70		X	Water	Lack of Penetration
71		X	Water	Lack of Penetration
72		X	Water	Lack of Penetration
73		X	Water	Lack of Penetration
74		X	Water	Gross Suckback
75	X		Water	
76		X	Water	Gross Suckback
77		X	Water	Gross Suckback
78	X		Water	
79		X	Water	Lack of Penetration

Table 2. Radiographic Interpretation for Steam Generator
S/N 0016 (Sheet 3 of 3)

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WELD NO.	DISPOSITION		SYSTEM	REMARKS
	ACCEPT	REJECT		
1		X	Water	Drop through, Lack of Fusion
2	X		Water	
3	X		Water	
4		X	Water	Drop through, Lack of Fusion
5		X	Water	Drop through, Lack of Fusion
6	X		LOX	
7		X	Propane	Slag, Lack of Fusion
8	X		Water	
9	X		Water	
10		X	Water	Lack of Penetration
11		X	Water	Lack of Penetration
12		X	Water	Lack of Penetration
13		X	Water	Lack of Penetration
14		X	Water	Lack of Penetration
15		X	Propane	Slag, Lack of Fusion
16		X	Propane	Slag, Lack of Fusion
17		X	Propane	Lack of Penetration
18		X	Propane	Lack of Penetration
19		X	LOX	Lack of Penetration
20	X		Water	
21	X		Water	
22		X	Propane	Lack of Fusion
23		X	Propane	Lack of Penetration
24		X	Propane	Lack of Penetration
25	X		LOX	
26	X		LOX	
27		X	LOX	Lack of Fusion
28		X	Propane	Slag, Lack of Fusion
29		X	Propane	Lack of Penetration

Table 3. Radiographic Interpretation for Steam Generator
S/N 0017 (Sheet 1 of 3)

WELD NO.	DISPOSITION		SYSTEM	REMARKS
	ACCEPT	REJECT		
30		X	Propane	Slag, Porosity
31	X		LOX	
32		X	LOX	Lack of Penetration
33	X		LOX	
34		X	LOX	Lack of Penetration
35		X	Water	Lack of Penetration
36		X	Water	Gross Suckback
37	X		Water	
38		X	Water	Lack of Penetration
39		X	Water	Lack of Fusion
40	X		Water	
41	X		Water	
42		X	Water	Lack of Penetration
43	X		Water	
44		X	Water	Lack of Penetration
45		X	Water	Excessive Suckback
46		X	Water	Excessive Suckback
47		X	Water	Lack of Penetration
48		X	Water	Lack of Penetration
49	X		Water	
50	X		Water	
51		X	Water	Excessive Suckback
52		X	Water	Excessive Suckback
53	X		Water	
54		X	Water	Lack of Penetration
55	X		Water	
56	X		Water	
57			Water	Not Radiographed
58			Water	Not Radiographed
59			Water	Not Radiographed
60			Water	Not Radiographed

Table 3. Radiographic Interpretation for Steam Generator
S/N 0017 (Sheet 2 of 3)

WELD NO.	DISPOSITION		SYSTEM	REMARKS
	ACCEPT	REJECT		
61	Replaced		Water	
62	Replaced		Water	
63			GN ₂	Not Radiographed
64			GN ₂	Not Radiographed
65			GN ₂	Not Radiographed
66			GN ₂	Not Radiographed
67			GN ₂	Not Radiographed
68			GN ₂	Not Radiographed
69			GN ₂	Not Radiographed
70	X		Water	
71	X		Water	
72	X		Water	
73	X		Water	
74	X		Water	
75	X		Water	
76	X		Water	
77	X		Water	
78	X		Water	
79		X	Water	Lack of Penetration

Table 3. Radiographic Interpretation for Steam Generator
S/N 0017 (Sheet 3 of 3)

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WELD NO.	DISPOSITION		SYSTEM	REMARKS
	ACCEPT	REJECT		
1		X	Water	Lack of Penetration
2	X		Water	
3	X		Water	
4		X	Water	Lack of Penetration
5		X	Water	Lack of Penetration
6	X		LOX	
7		X	Propane	Slag, Lack of Fusion
8	X		Water	
9	X		Water	
10		X	Water	Lack of Penetration
11		X	Water	Lack of Penetration
12		X	Water	Lack of Penetration
13		X	Water	Lack of Penetration
14	Omit		Water	
15		X	Propane	Lack of Fusion
16		X	Propane	Lack of Fusion
17		X	Propane	Lack of Penetration
18		X	Propane	Lack of Penetration
19		X	LOX	Lack of Penetration
20	X		Water	
21	X		Water	
22		X	Propane	Slag, Lack of Fusion
23		X	Propane	Burn through, Lack of Fusion
24		X	Propane	Lack of Fusion
25	X		LOX	
26		X	LOX	Lack of Fusion
27		X	LOX	Lack of Fusion
28	X		Propane	
29		X	Propane	Gross Slag
30		X	Propane	Gross Slag

Table 4. Radiographic Interpretation for Steam Generator
S/N 0018 (Sheet 1 of 3)

WELD NO.	DISPOSITION		SYSTEM	REMARKS
	ACCEPT	REJECT		
31	X		LOX	
32	X		LOX	
33		X	LOX	Lack of Fusion
34		X	LOX	Gross Suckback
35		X	Water	Lack of Penetration
36		X	Water	Lack of Penetration
37		X	Water	Lack of Penetration
38		X	Water	Lack of Penetration
39	X		Water	
40	X		Water	
41	X		Water	
42		X	Water	Lack of Penetration
43	X		Water	
44		X	Water	Drop through and Burn through
45		X	Water	Lack of Penetration
46		X	Water	Burn through and Drop through
47	X		Water	
48	X		Water	
49		X	Water	Lack of Penetration
50		X	Water	Excessive Suckback
51		X	Water	Drop through and Burn through
52		X	Water	Burn through and Drop through
53	X		Water	
54		X	Water	Lack of Penetration
55		X	Water	Lack of Penetration
56	X		Water	
57			Water	Not Radiographed
58			Water	Not Radiographed
59			Water	Not Radiographed

Table 4. Radiographic Interpretation for Steam Generator
S/N 0018 (Sheet 2 of 3)

WELD NO.	DISPOSITION		SYSTEM	REMARKS
	ACCEPT	REJECT		
60			Water	Not Radiographed
61	Replaced		Water	
62	Replaced		Water	
63			GN ₂	Not Radiographed
64			GN ₂	Not Radiographed
65			GN ₂	Not Radiographed
66			GN ₂	Not Radiographed
67			GN ₂	Not Radiographed
68			GN ₂	Not Radiographed
69			GN ₂	Not Radiographed
70		X	Water	Lack of Penetration
71	X		Water	
72		X	Water	Lack of Penetration
73		X	Water	Lack of Penetration
74		X	Water	Lack of Penetration
75	X		Water	
76	X		Water	
77	X		Water	
78	X		Water	
79		X	Water	Lack of Penetration

Table 4. Radiographic Interpretation for Steam Generator
S/N 0018 (Sheet 3 of 3)

BLANK

WELD NO.	DISPOSITION		SYSTEM	REMARKS
	ACCEPT	REJECT		
1		X	Water	Lack of Penetration
2		X	Water	Lack of Penetration
3	X		Water	
4		X	Water	Lack of Penetration
5		X	Water	Lack of Penetration
6	X		LOX	
7			Propane	
8	X		Water	
9	Replaced		Water	
10	Replaced		Water	
11	Replaced		Water	
12	Replaced		Water	
13	Replaced		Water	
14	Replaced		Water	
15	Replaced		Propane	
16	Replaced		Propane	
17	Replaced		Propane	
18	Replaced		Propane	
19	Replaced		LOX	
20		X	Water	Lack of Penetration
21	X		Water	
22		X	Propane	Lack of Penetration
23		X	Propane	Lack of Penetration
24		X	Propane	Lack of Penetration
25	X		LOX	
26		X	LOX	Burn through
27		X	LOX	Lack of Penetration and Burn through
28	Replaced		Propane	
29	Replaced		Propane	

Table 5. Radiographic Interpretation for Steam Generator
S/N 0019 (sheet 1 of 3)

WELD NO.	DISPOSITION		SYSTEM	REMARKS
	ACCEPT	REJECT		
30	Replaced		Propane	
31	X		LOX	
32	X		LOX	
33	X		LOX	
34	Replaced		LOX	
35		X	Water	Lack of Penetration
36	X		Water	
37		X	Water	Lack of Fusion
38		X	Water	Lack of Penetration
39	Replaced		Water	
40	Replaced		Water	
41	Replaced		Water	
42	Replaced		Water	
43	X		Water	
44	X		Water	
45	X		Water	
46	X		Water	
47	X		Water	
48	X		Water	
49	X		Water	
50	X		Water	
51	X		Water	
52	X		Water	
53	X		Water	
54		X	Same	Lack of Fusion
55		X	Water	Lack of Penetration
56	X		Water	
57			Water	Not Radiographed
58			Water	Not Radiographed
59			Water	Not Radiographed

Table 5. Radiographic Interpretation for Steam Generator
S/N 0019 (Sheet 2 of 3)

WELD NO.	DISPOSITION		SYSTEM	REMARKS
	ACCEPT	REJECT		
60	Replaced Replaced		Water	Not Radiographed
61				
62				
63			GN ₂	Not Radiographed
64			GN ₂	Not Radiographed
65			GN ₂	Not Radiographed
66			GN ₂	Not Radiographed
67			GN ₂	Not Radiographed
68			GN ₂	Not Radiographed
69		X	GN ₂	Not Radiographed
70			Water	Lack of Penetration
71	X		Water	
72	X		Water	
73			Water	
74	X		Water	
75	X		Water	
76	X		Water	
77	X		Water	
78	X	X	Water	
79			Water	Lack of Penetration

Table 5. Radiographic Interpretation for Steam Generator
S/N 0019 (Sheet 3 of 3)

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PART	WELD NO.	MODULE S/N 0016					MODULE S/N 0017					MODULE S/N 0018					MODULE S/N 0019				
		Orig. A	R	Disposi-	Repair A	R	Orig. A	R	Disposi-	Repair A	R	Orig. A	R	Disposi-	Repair A	R	Orig. A	R	Disposi-	Repair A	R
Water Outlet 901631	1	X						X	C&R	X			X	C&R	X			X	C&R	X	
	2		X	C&R	X		X					X					X	X	Grind	X	
	3		X	C&R	X		X					X					X				
	4		X	C&R	X			X	C&R	X			X	C&R	X			X	C&R	X	
	5		X	C&R	X			X	C&R	X			X	C&R	X			X	C&R	X	
	70		X	C&R	X		X						X	C&R	X			X	Grind	X	
	71		X	C&R	X		X					X					X				
	72		X	C&R	X		X						X	C&R	X		X	X			
	73		X	C&R	X		X						X	C&R	X		X	X			
	74		X	C&R	X		X						X	C&R	X		X	X			
	75		X	C&R	X		X					X					X	X			
	76		X	C&R	X		X					X					X	X			
	77		X	C&R	X		X					X					X	X			
	78	X					X					X					X	X			
	79		X	Grind	X			X	W. I.	X		X					X	X	W. I.	X	
	38		X	C&R	X			X	C&R	X			X	C&R	X			X	C&R	X	
LOX Inlet 901630	25	X					X					X					X				
	26		X	C&R	X		X						X	C&R	X			X	Grind	X	
	27	X					X						X	C&R	X			X	C&R	X	
	6	X					X					X					X	X			
	31	X					X					X					X	X			
	32	X						X	C&R	X		X					X	X			
Water Elbow 910008	33		X	C&R	X			X	C&R	X			X	C&R	X			X			
	20		X	C&R	X		X					X						X	Grind	X	
	21	X					X					X					X				
Water Inter- face 901633	8		X	C&R	X		X					X					X				
	35		X	C&R	X			X	C&R	X			X	C&R	X			X	C&R	X	
	36	X					X		C&R	X			X	C&R	X		X				
	37		X	C&R	X		X						X	C&R	X			X	C&R	X	

Table 6. Repair of Steam Generator Piping (Sheet 1 of 2)

PART	WELD NO.	MODULE S/N 0016					MODULE S/N 0017					MODULE S/N 0018					MODULE S/N 0019				
		Orig. A	R	Disposi- tion	Repair A	R	Orig. A	R	Disposi- tion	Repair A	R	Orig. A	R	Disposi- tion	Repair A	R	Orig. A	R	Disposi- tion	Repair A	R
Propane Inlet 901628	22	X						X	C&R	X			X	C&R	X			X	C&R	X	
	23		X	C&R	X			X	C&R	X			X	C&R	X			X	C&R	X	
	24		X	C&R	X			X	C&R	X			X	C&R	X			X	C&R	X	
Water Inlet 901629	43		X	C&R	X		X					X					X				
	44		X	C&R	X			X	C&R	X			X	C&R	X		X				
	45		X	C&R	X			X	C&R	X			X	C&R	X		X				
	46	X						X	C&R	X							X				
	47	X						X	C&R	X							X				
	48		X					X	C&R	X		X					X				
	49	X					X						X	C&R	X		X				
	50	X					X						X	C&R	X		X				
	51	X						X	C&R	X			X	C&R	X		X				
	52	X						X	C&R	X			X	C&R	X		X				
	53		X	C&R	X							X					X				
	54		X	C&R	X			X	C&R	X			X	C&R	X		X	X	Grind	X	
	55		X	C&R	X			X					X	C&R	X		X	X	Grind	X	
	56	X					X					X					X				

Table 6. Repair of Steam Generator Piping, (Sheet 2 of 2)

Figure 1. Weld Numbers for Identifying Radiographs (Sheet 1 of 9)

Figure 1. Weld Numbers for Identifying Radiographs (Sheet 2 of 9)

PLENUM WATER COOLANT INLET

WATER COOLANT MANIFOLD

Figure 1. Weld Numbers for Identifying Radiographs (Sheet 3 of 9)

LOX INLET
P/N 901630

PROPANE INLET
P/N 901669

Figure 1. Weld Numbers for Identifying Radiographs (Sheet 4 of 9)

WATER ELBOW
P/N 910008

PROPANE INLET
P/N 901628

Figure 1. Weld Numbers for Identifying Radiographs (Sheet 5 of 9)

LOX INTERFACE
P/N 901632

LOX LINE TO MANIFOLD

Figure 1. Weld Numbers for Identifying Radiographs (Sheet 6 of 9)

WATER INLET TO INJECTION LINE
P/N 901636

PROPANE LINE TO MANIFOLD
P/N 901635

Figure 1. Weld Numbers for Identifying Radiographs (Sheet 7 of 9)

WATER INTERFACE

P/N 901633

WATER INLET - MANIFOLD TO CC

Figure 1. Weld Numbers for Identifying Radiographs (Sheet 8 of 9)

GN₂ MANIFOLD

Figure 1. Weld Numbers for Identifying Radiographs (Sheet 9 of 9)

BLANK

Figure 2. Microphotograph Showing Lack of Penetration and Only One Weld Pass

BLANK

Figure 3. Photograph of Typical Suckback

BLANK

Figure 4. Microphotograph Showing Multiple Weld Passes But Typical Suckback

BLANK

Figure 5. Photograph Showing Typical Drop-Through (Sheet 1 of 2)

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Figure 5. Photograph Showing Typical Drop-Through (Sheet 2 of 2)