TEST REPORT

Experimental Verification
of the
Presray Reactor Cavity Liner Seal
for the
Yankee Nuclear Power Station

Prepared for:

YANKEE ATOMIC ELECTRIC COMPANY

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0	Original

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1.0 INTRODUCTION

This report documents the results of testing the Presray T-Slot Seal used in the annulus between the shield tank cavity and the reactor vessel flange during refueling at the Yankee Nuclear Power Station to contain the water in the refueling cavity.

The test was conducted to satisfy a requirement of NRC I. E. Bulletin 84-03 by demonstrating that the Presray T-Slot Seal will not undergo gross failure during use in the refueling cavity. Gross failure is interpreted as the pushing through of the seal between the reactor pressure vessel (RPV) and the refueling shield tank cavity wall or incurring a leakage rate above the cavity filling pumps capacity. This bulletin was issued by the NRC as a result of an event that occurred during a recent refueling at Connecticut Yankee. In particular, the seal between the RPV and the refueling cavity did not retain its integrity during refueling and the cavity water drained into the containment.

Testing was performed at a location approximately 4 miles from Impell's SER office. The testing area was established inside a local machine shop and utilized shop air, water and electricity. Testing was performed by Impell personnel with Yankee Atomic personnel in attendance. The Impell personnel involved with the project are identified in Appendix F of this report. Testing was initiated on 4/22/85 and concluded 4/29/85. This report includes the objectives of the testing, a description of the Presray Seal tested, test methods, equipment, procedures and instrumentation. The test results are evaluated and conclusions are presented.

2.0 TEST OBJECTIVE

The objective of this testing program was to evaluate the integrity of the Presray T-Slot Seal in terms of:

1. Failure limit/factor of safety
2. Push through resistance/water pressure vs. seal displacement
3. Bladder pressure effects/worst case determination
4. Leakage rate vs. water head
5. Temperature effects
6. Creep effects
7. Gap width/height offset effects

3.0 PRESRAY PR-2598 BLADDER SEAL

A Presray PR-2598 T-Slot Seal was provided by Yankee Atomic to be used for the testing program. The seal came from plant stock and had been scheduled for use in an upcoming outage. The seal was molded of Presray's 60 durometer EPDM Compound E-603. A typical cross-section of the seal is shown on Figure No. 1.

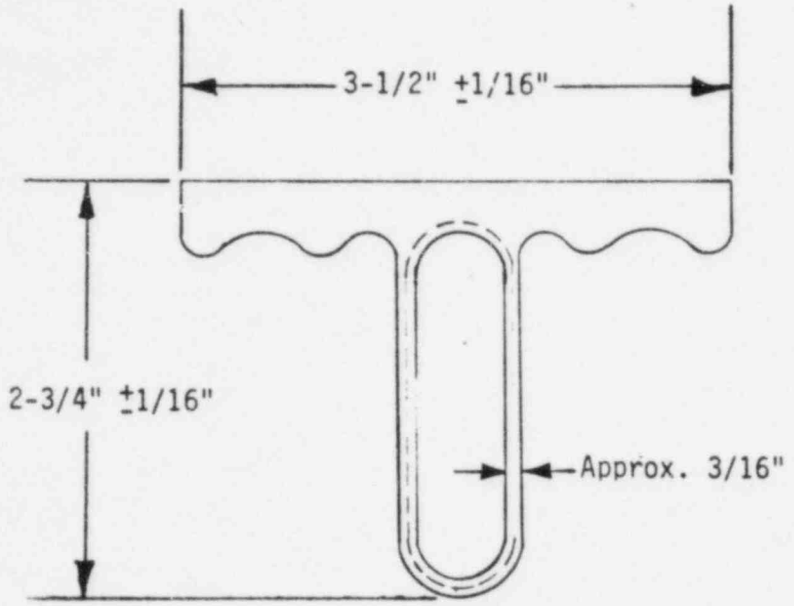


Figure No. 1 - Presray PR-2598, E603 Seal

The seal was identified by stamped markings from Presray as follows:

Mfg. Date	Mfg. No.	Ser. No
4-Q-82	PR-2598-1	SN-19051-1

To prepare for insertion into the test apparatus, the seal was first cut into three foot sections. A thin rubber innertube matching the internal dimension of the seal bladder was inserted into each seal and its air tap drawn through a pre-drilled hole in the bottom of the seal.

The ends of the seal were then sealed using a thin rubber fabric to provide a smooth surface to contact the plexiglass end plates of the test cell. The thin covers expanded with the bladder during inflation and contracted with the seal as it pushed into the gap during loading. The plexiglass end covers prevented the rubber fabric from expanding in the longitudinal direction.

Additionally, three small electrical conductors were bonded to the top of the seal for the level indicator system. The final seal configuration prior to insertion into the test cell is shown on Figure No. 2.

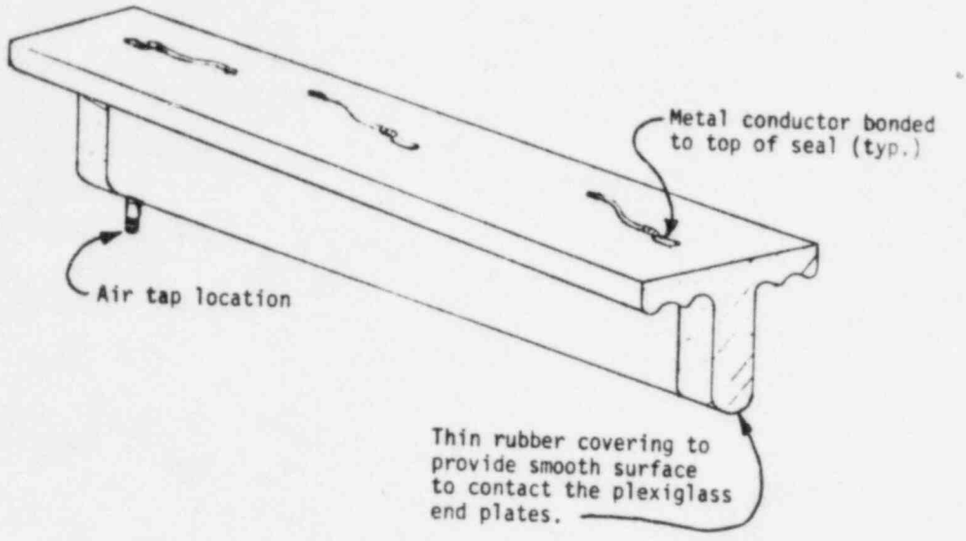


Figure No. 2 - Modified Seal, Ready for Testing

4.0 METHODS, TEST EQUIPMENT, TEST PROCEDURES & INSTRUMENTATION

This section describes the method in which the testing was performed and provides an overview of the methods, equipment, procedures, and instrumentation used during testing.

4.1 Methods

In order to best simulate the loading conditions found during refueling, the test cell was designed to induce loading on the Presray seal by using water pressure. Water pressure would best reproduce the distributed forces and water lubrication effects found in the seal installation. The test apparatus was therefore designed to impose a water pressure boundary around the top half of the seal while maintaining proper longitudinal end sealing and avoiding adverse end effects. The air bladder pressure, water pressure, and temperature was adjustable and regulated by an air, a water pressure, and a temperature control system, respectively. Gap conditions were adjustable and a collection trough provided measurement of any leakage through the seal. Seal displacement and creep was monitored by the displacement measurement system. The test apparatus and supportive systems are detailed and illustrated in section 4.3.

4.2 Test Matrix

A test matrix was established that encompassed the key parameters governing the seal installation at Yankee Nuclear Power Station. The matrix contained the seventeen individual tests listed on Table 4.1. The water head for all tests was regulated from 0 to a maximum of 300 ft. in intervals of 5-10 psi. At each pressure interval, displacement and leakage readings were taken. The displacement readings provided the method of comparison between the individual tests. Bladder pressure effects, creep and gross failure were also of interest to evaluate seal performance. The installed gap width was varied to determine seal sensitivity and three high temperature tests simulating loss of the shutdown cooling system were performed. Two additional tests for lubrication effects and "seal not set" were also evaluated.

CAVITY SEAL TEST MATRIX

Test No.	Bladder Pressure	Head of Water 5-10 psi incr	Leakage Readings	Displacement Readings	Water Temperature	Annulus Gap Size	Air Bladder Pressure Loss	Creep Effects	Failure Test
1	0 psi	0-300 ft.	X	X	70	Normal		X	
2	30 psi	0-300 ft.	X	X	70	Normal	X	X	X or worst case
3	50 psi	0-300 ft.	X	X	70	Normal	X	X	of tests 1,2,3
4	0 psi	0-300 ft.	X	X	70	Max. 1		X	
5	30 psi	0-300 ft.	X	X	70	Max. 1	X	X	X or worst case
6	50 psi	0-300 ft.	X	X	70	Max. 1	X	X	of tests 4,5,6
7	0 psi	0-300 ft.	X	X	70	Max. 1 & offset		X	
8	30 psi	0-300 ft.	X	X	70	Max. 1 & offset	X	X	X or worst case
9	50 psi	0-300 ft.	X	X	70	Max. 1 & offset	X	X	of tests 7,8,9
10	0 psi	0-300 ft.	X	X	70	Max. 2 & offset		X	
11	30 psi	0-300 ft.	X	X	70	Max. 2 & offset	X	X	X or worst case
12	50 psi	0-300 ft.	X	X	70	Max. 2 & offset	X	X	of tests 10,11,12
13	0 psi	0-300 ft.	X	X	150	Normal	---	X	
14	30 psi	0-300 ft.	X	X	150	Normal	---	X	X or worst case
15	50 psi	0-300 ft.	X	X	150	Normal	---	X	of tests 13,14,15
16	30 psi	0-300 ft.	X	X	70	Normal w/grease	---	X	----
17	30 psi	0-300 ft.	X	X	70	Seal not seated	---	X	----

Gap dimensions are as follows:

1. Normal = 15/16 in.
2. Max. 1 = 1-1/16 in.
3. Max. 2 = 1-3/16 in.
4. Offset = + 1/4 in.

Table 4.1 - Test Matrix

4.3 Test Equipment

The test equipment consisted of a test cell with supportive air, leakage, hydraulic, temperature and displacement measurement systems. A brief description and diagram of each system, as used in the experiment is detailed below.

4.3.1 Test Cell

The test cell provided the pressure boundary and support structure for the seal. The internal dimensions duplicated the RPV/Cavity Liner gap at the Yankee Nuclear Power Station. The simulated RPV and cavity liner support blocks were curved at a radii of 74-1/4" and 75-3/16" respectively to simulate the actual configuration at full scale. The RPV-cavity gap was varied from 15/16 to 1-3/16 inches. Testing was also conducted with elevations of the RPV flange and cavity liner offset by 1/4". The 1-3/16" gap and 1/4" offset tests were chosen as upper bound values to examine the effects of large gaps and offsets an seal performance. These conditions were therefore special cases and in no way represented actual conditions. Figure No. 3 shows a detailed cross section of this interface. The test cell structure is 3 ft. long x 9-1/2 in. wide x 1-1/2 ft. high. Internally, the test cell was divided into two sections with the upper half capable of being pressurized. Plexiglass end covers and portholes were provided to allow visual inspection of the seal behavior and leakage. The test cell is shown in Figure No. 4.

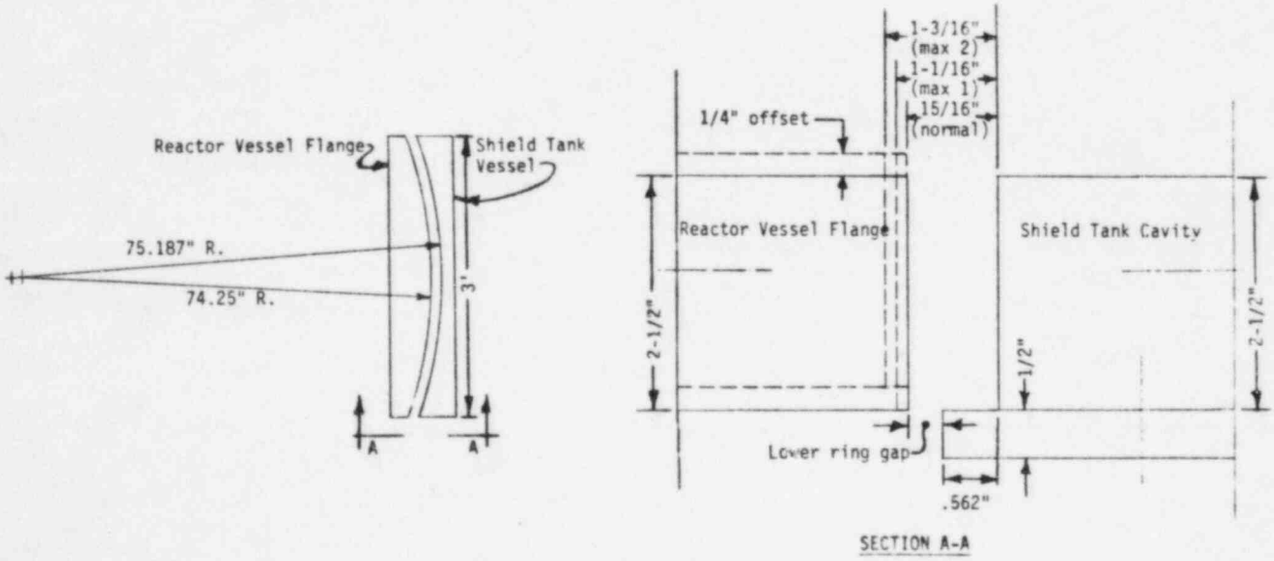


Figure No. 3 - RPV Cavity Liner Interface

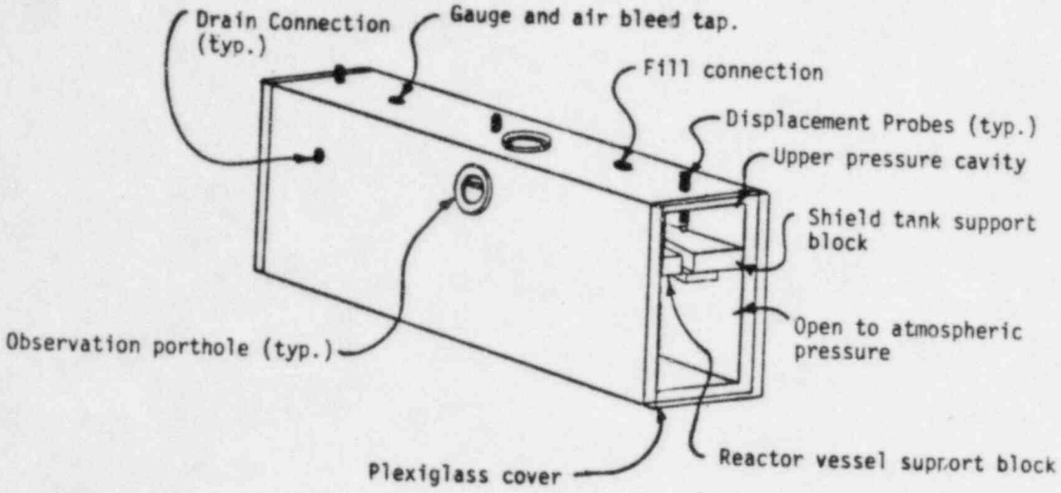


Figure No. 4 - Test Cell

4.3.2 Air System

The air system maintained constant air bladder pressure during testing. The system consisted of an air supply, test gauge, and air lines with an air connection at the seal as shown in Figure No. 5.

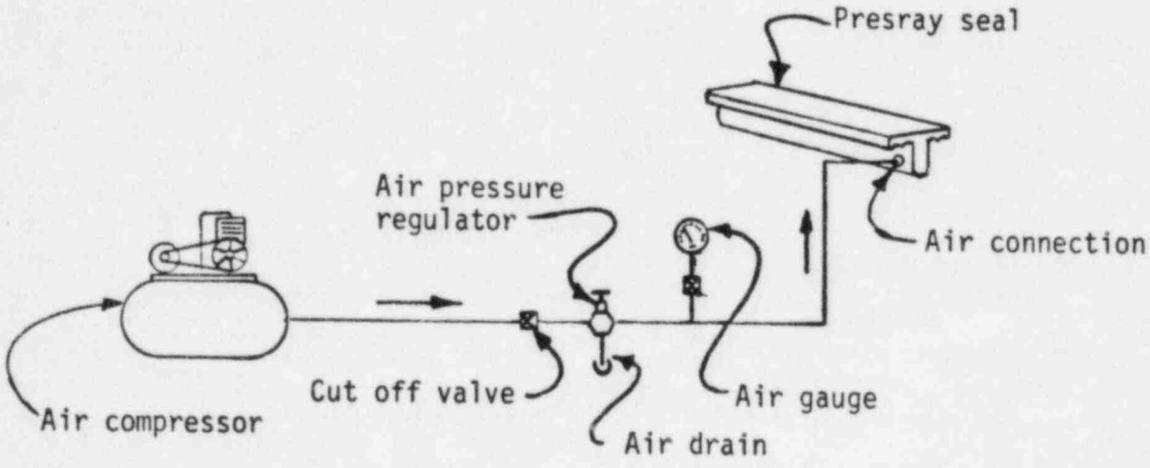


Figure No. 5 - Air System

4.3.3 Water Pressure System

The water pressure system provided water to the upper portion of the test cell and maintained a given pressure as desired. The system consisted of a reservoir, water pump, filter system, pressure regulator with bypass, test gauge, fill lines and drainage hoses arranged as shown on Figure No. 6.

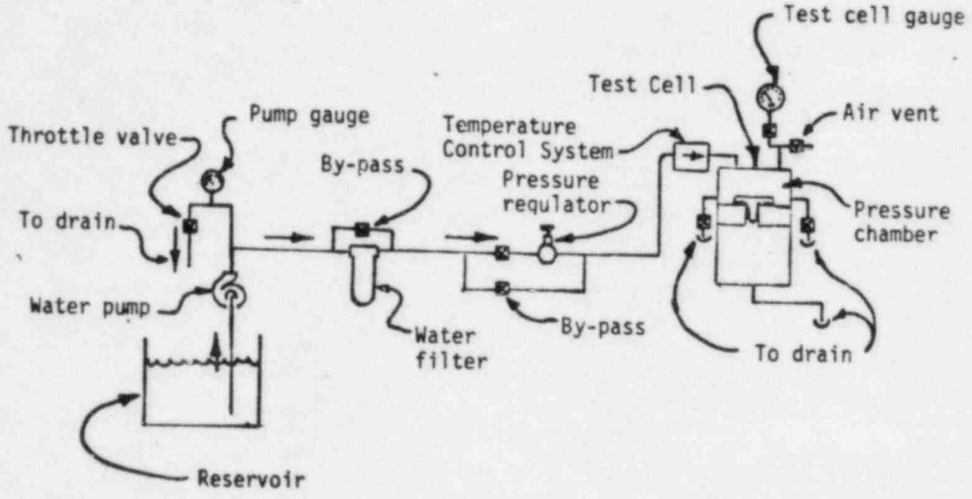


Figure No. 6 - Water Pressure System

4.3.4 Temperature Control System

The temperature control system recirculated water from the upper portion of the test cell through a water heater and returned it to the test cell. The temperature control system is capable of maintaining a test cell temperature of 150°F. The system consisted of a temperature control unit with a thermo-couple, a six element heater, and a recirculating pump as shown in Figure No. 7.

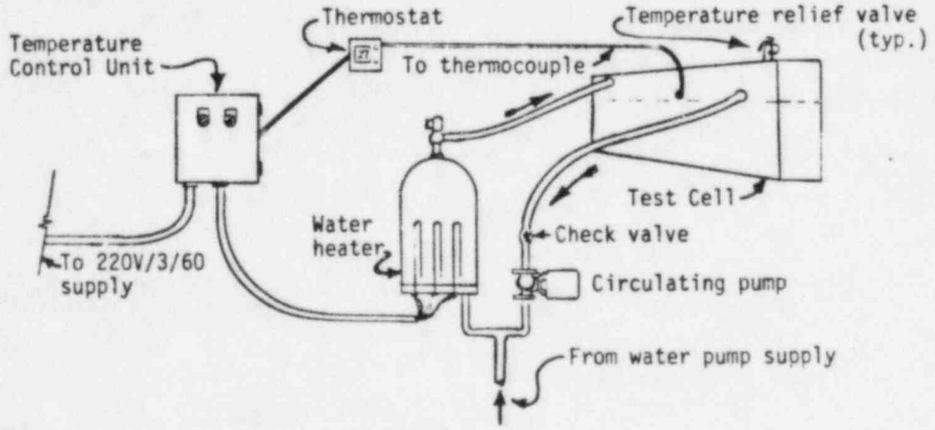


Figure No. 7 - Temperature Control System

4.3.5 Displacement Measurement System

The displacement measurement system was designed to measure the midpoint seal elevation through the pressure boundary as the seal was loaded. The system is shown on Figure No 8. Consisting of three displacement probes, dial indicators, and an electrical level indicator device, the system provided elevations to + or - .001 inch at three longitudinal locations on the seal.

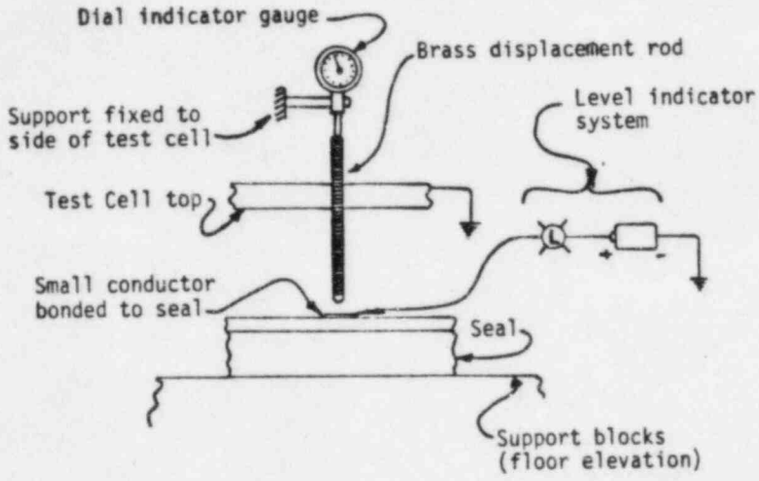


Figure No. 8 - Displacement Measurement System

4.3.6 Leakage Measurement System

The leakage measurement system consisted of a 2 ft. long trough placed beneath the seal which drained into a graduated beaker. The leakage rate determined with this apparatus was then converted into a rate representing the entire annular seal. The system is shown on Figure No. 9.

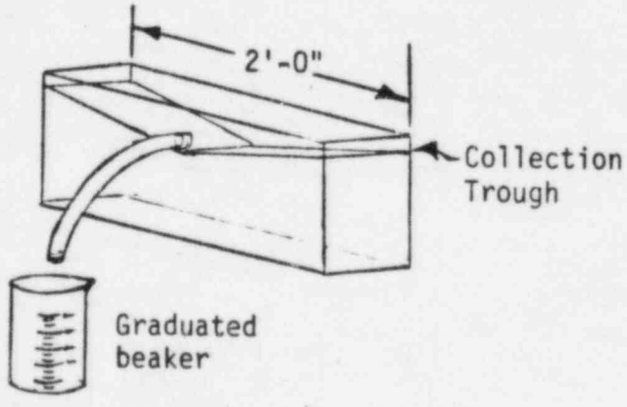


Figure No. 9 - Leakage Measurement System

4.4 Test Procedures

The testing procedures followed the steps as outlined in section 5.0 of Test Specification 0570-035-01, Rev. 0, contained in Appendix E of this report. The procedures detail the equipment set up, test preparation, measurements, and precautions used during testing.

4.5 Instrumentation

The instruments used during testing are listed on the instrumentation identification sheet found in Appendix C. The sheet details the function, size and range of each instrument used in the testing.

The pressure and temperature gauges were calibrated within the accuracy of each gauge. The displacement readout gauges were calibrated to within $\pm$ .005 inches. The graduated beaker used to measure leakage rate was precalibrated to + 5 ml. The applicable calibration certificates traceable to the National Bureau of Standards (NBS) are located in Appendix C. No ASTM standards were applicable.

5.0 RESULTS

Under the installation tolerances for the seal configuration at Yankee, gross failure by push through was not accomplished within the pressures obtained by the test appartus (12X design head). The seal exhibited a substantial resistance to push through.

Leakage was measured throughout the testing and found to be very minor in scope. In most instances the leakage was nonexistent.

At the higher pressures the seal was prevented from a push through failure by the lower plate on the cavity liner side. The seal would compress into the gap and lodge against the lower plate preventing leakage from occurring as well as a gross push through failure.

The individual effects of the variation in test parameters are examined for the seal and are detailed on the following pages.

5.1 Push Through Resistance

For the normal operating and installation parameters (25 ft. water head, 30 psi bladder, and normal annulus gap), the seal exhibited a displacement into the gap by a nominal .004 in. At 6 times the design head, the displacement increased to approximately 1/4 inches and the seal was almost touching the lower ledge of the cavity liner flange. At 12 times the design head, the seal still exhibited sufficient resistance to prevent failure by push through as it was compressed into the lower ring gap at the lower ledge of the cavity wall. Figure No. 10 below shows seal behavior as described above.

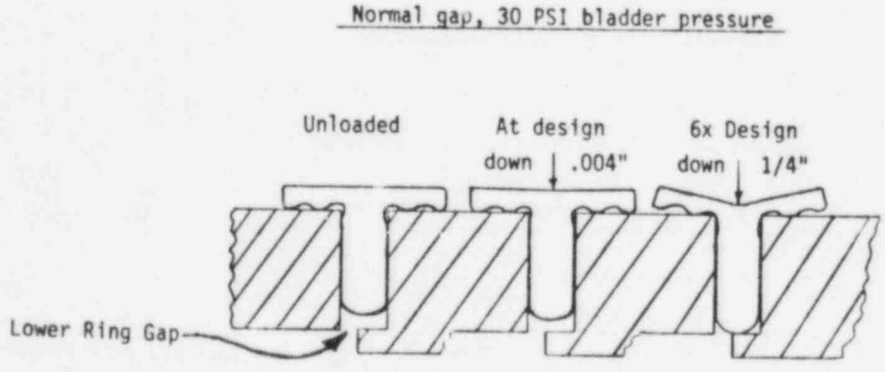


Figure No. 10 - Seal Behavior Under Loading

5.2 Gap Width and Offset Heights

The installation tolerances for the Yankee gap configuration provided a nominal gap width of 15/16" + 1/16". Tests were conducted at 15/16" (normal gap) and a conservative 1-1/16" (Max. 1) and two of the tests are compared in Figure No. 11. As would be expected, the wider gap produced higher displacement for equal water pressures. The amount of the difference however was neglible with displacement readings within 3/16" as shown.

The 1/4" offset tests also reflected very little variation in performance versus tests without the height difference. As shown in Figure 11, the recorded displacement difference between test 4 (Max. 1) and test 7 (Max 1 with 1/4" offset) was insignificant, being less than 1/16".

The 1 3/16" gap with 1/4" offset tests provided insight into the sensitivity of the seal design. Although recording predictability more displacement as shown in Figure No. 11 (Max. 2 w/offset), the seal maintained its integrity to values well beyond normal conditions. Although not shown, test No. 11 (Max. 2 w/offset-30 psi bladder) maintained its integrity to values exceeding nine times the normal water pressure before the test was terminated due to test cell pressure limitations.

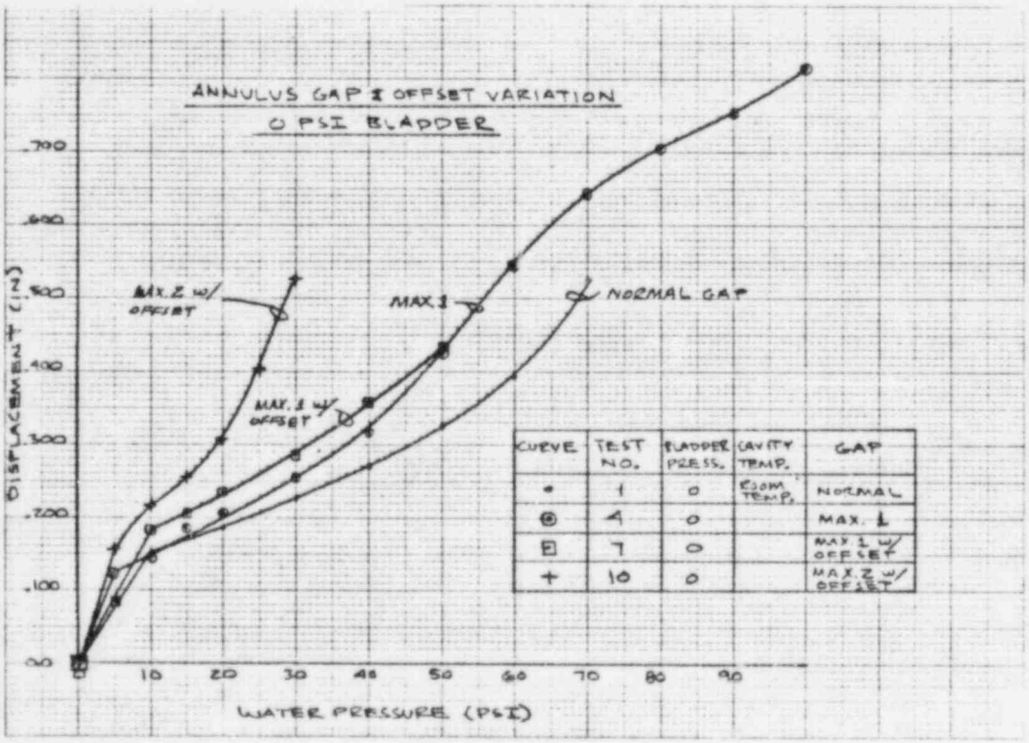


Figure No. 11 - Gap Width and Offset Effects

5.3 Bladder Pressure

As can be expected higher bladder pressure provides increased resistance to seal displacement into the annulus gap. This effect can be seen on Figure 12. This figure shows seal displacement as a function water pressure, for various bladder pressures.

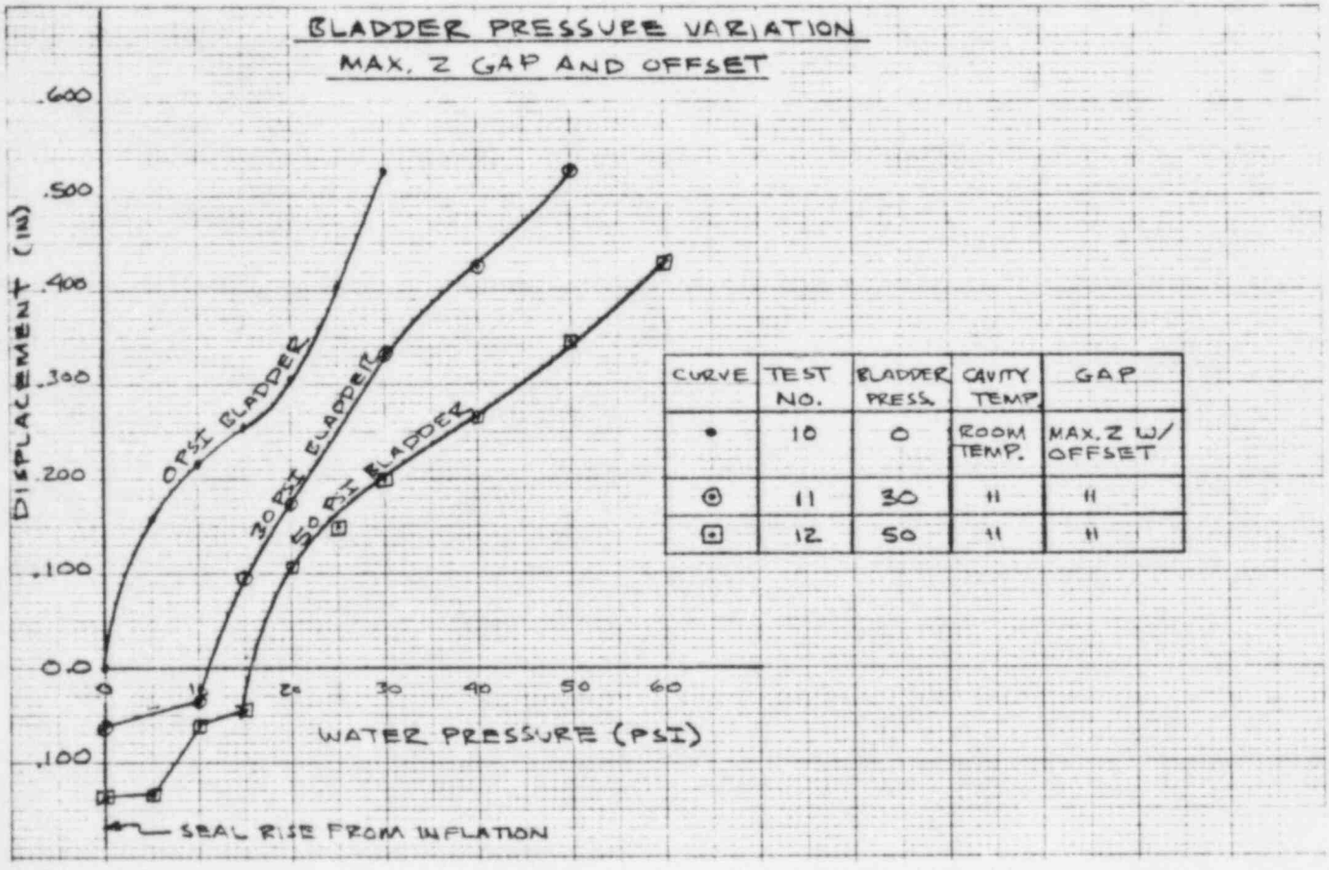


Figure No. 12 - Bladder Pressure Effects

5.4 Leakage Rate

Seal leakage along a 2 ft. section of seal was measured for all 17 tests. The results are shown in Table 5.1 as well as Figure No. 13. As can be seen from Table 5.1, the seal provided excellent resistance to leakage with the majority of the test points reflecting no leakage at all.

Excessive leakage was only observed when the seal was unpressurized and not seated prior to filling the test cell with water. To accomodate this condition, the tests conducted at 0 psi bladder pressure were initiated by inflating the bladder to a pressure of 10 psi or less and increasing the water pressure to approximately 5 psi. It is important to note that no leakage occured at the design head for any test while the bladder was inflated (Test 2, 3, 5, 6, 8, 9, 11, 12, 14-17).

TOTAL ADJUSTED SEAL LEAKAGE *
(GPM**)

Water Pressure (psi)	Test No.																
	Normal Gap			Max 1 Gap			Max 1 Gap w/offset			Max 2 Gap w/offset			Normal Gap at 150°F			Normal Gap w/Grease	seal not seated
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
5	0	0	0	.9	0	0	0	0	0	0	0	0	2.1	0	0	0	0
10	2.9	0	0	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0
15	-	0	~0	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	~0	~0	0	0	0	0	0	5.2	0	~0	0	~0	0	0	0
30	.3	0	~0	21.3	1.9	1.2	2.6	0	0	.55	.94	~0	0	0	0	0	-
40	0	~0	0	10.3	5.2	1.3	0	0	.63	-	0	0	0	0	0	0	-
50	3.1	0	0	3.1	0	0	~0	.9	-	0	0	0	0	0	0	-	-

* Total Adjusted Seal Leakage = Measured leakage amount x 19.6
** ~0 <3000 drops/min.

Table No. 5.1 - Seal Leakage

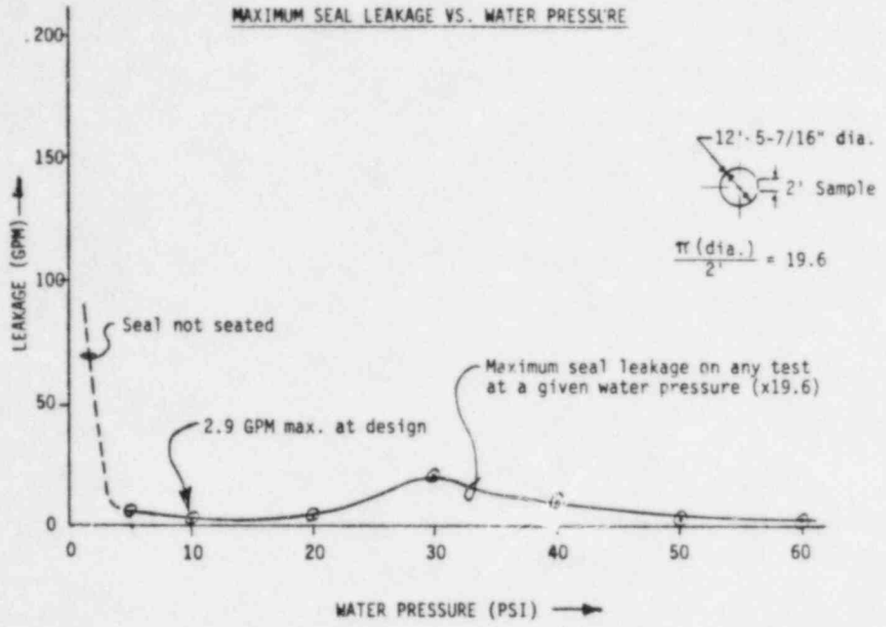


Figure No. 13 - Leakage Rate

5.5 Creep

Several creep readings were taken at varying pressures during testing. As can be expected, the amount of creep displacement varied with time as well as with the water pressure the seal was subjected to. In general, the individual results were typical of the curves shown on Figure No. 14. Creep at the design head was virtually nonexistant. Creep at 2 to 3 times the normal water head would diminish after 5-10 minutes with a total displacement of .015-.020". At higher pressures, the seal height would level off in 10-20 minutes after displacing .030-.080 in.

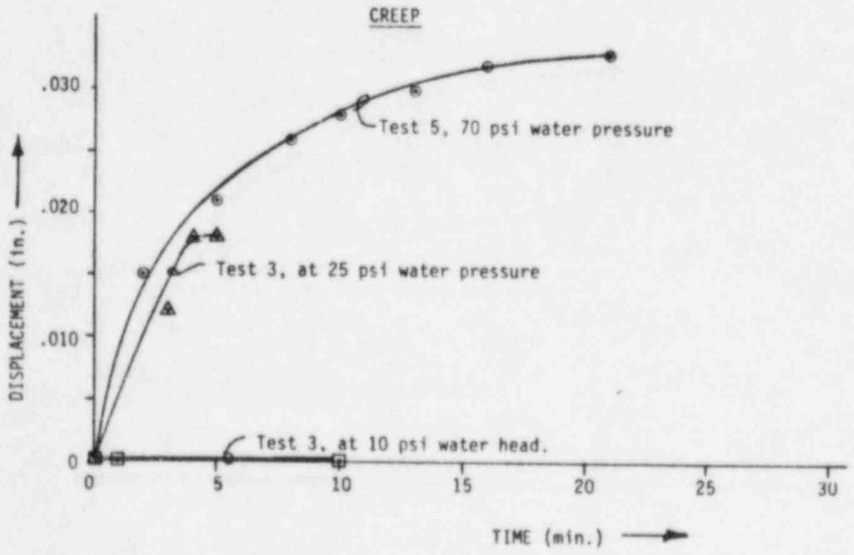


Figure No. 14 - Creep

5.6 Air Bladder Pressure Loss

Several tests were conducted to evaluate the effects of sudden pressure loss of the air bladder. Sample test results are shown on Figure No. 15

As can be seen on the graph, sudden loss of air bladder pressure produced additional seal movement into the gap. The amount of the displacement into the gap however was minor. The effects of sudden bladder loss did not adversly affect seal performance.

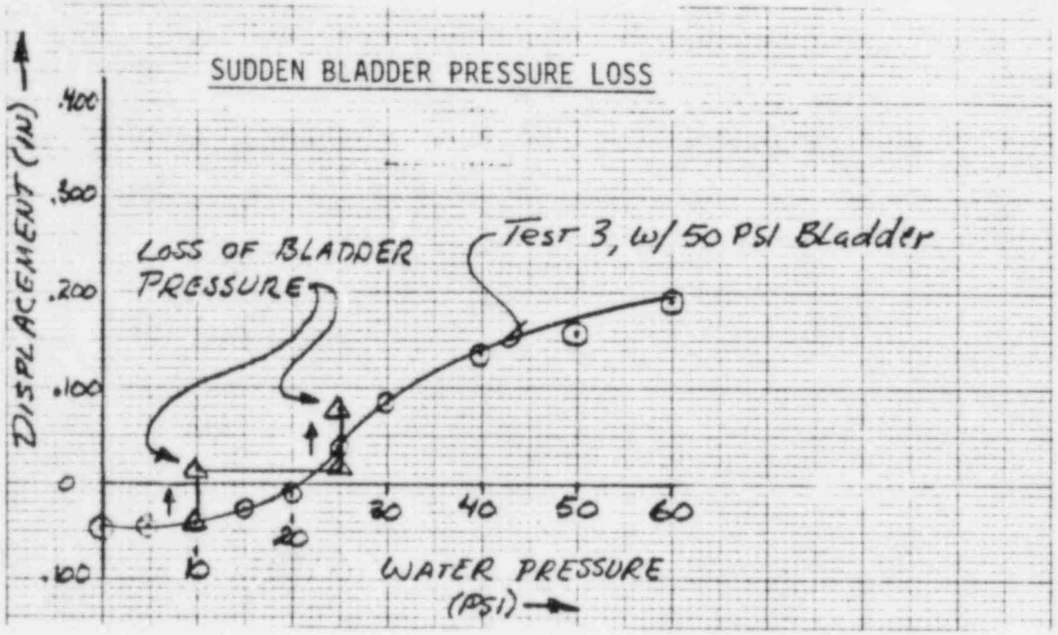
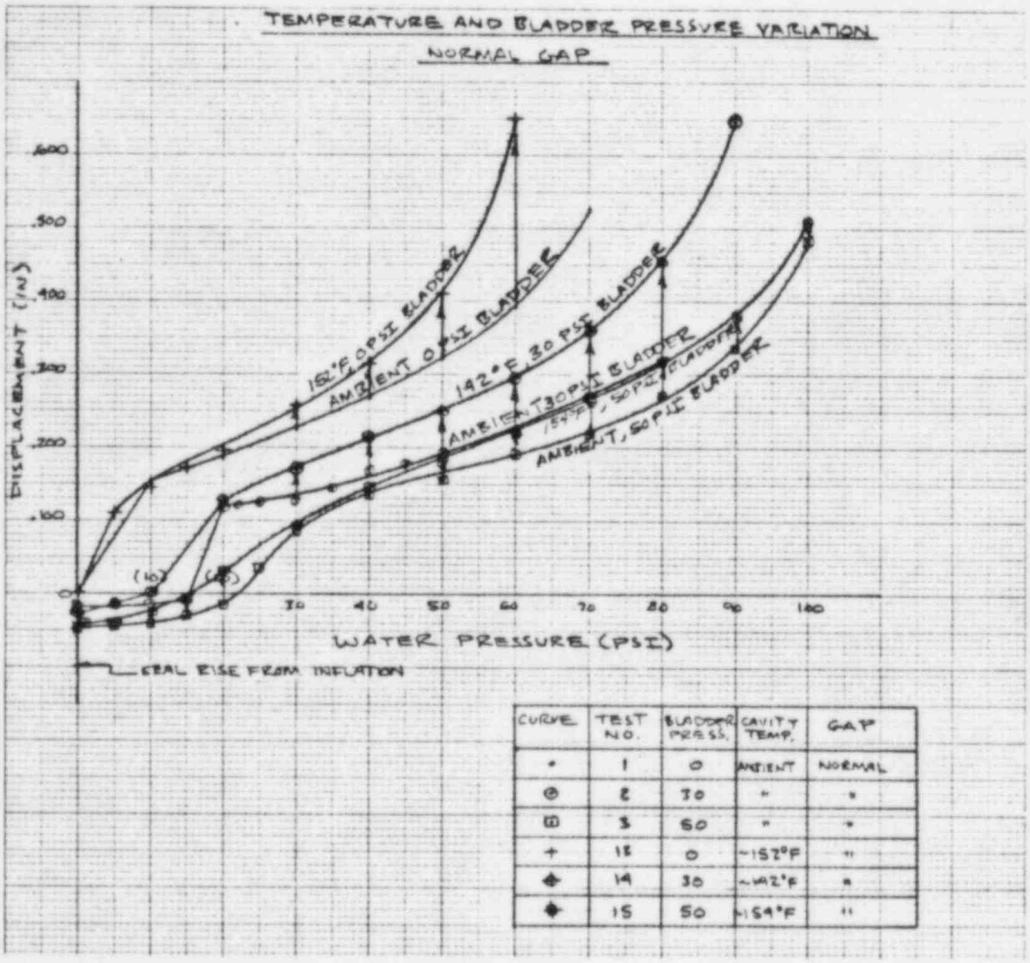


Figure No. 15 - Bladder Pressure Loss Effects

5.7 Temperature Effects

Three tests at varying bladder pressure with normal gap dimensions were conducted at an elevated temperature of approximately 150°F. More displacement was observed at the elevated temperatures (see Figure 16) than at ambient temperatures. The elevated temperatures however, were not detrimental to the seals push through resistance. It is important to note that at the design cavity water pressure, increased temperature has a negligble effect on push through resistance. Each of the higher temperature tests were terminated after reaching the pressure limit of the test apparatus (approximately 12 times design head) without incurring failure by push through.



CURVE	TEST NO.	BLADDER PRESS.	CAVITY TEMP.	GAP
•	1	0	AMBIENT	NORMAL
⊙	2	30	"	"
⊡	3	50	"	"
+	12	0	~152°F	"
◆	14	30	~142°F	"
◆	15	50	~154°F	"

Figure No. 16 - Temperature Effects

5.8 Lubrication Effects

Prior to installation, the seal is fully cleaned by plant procedure to remove surface debris. A lubricated seal was tested to account for the possibility of improper handling and installation.

As shown in Figure No. 17 a seal lubricated with silicone grease displaced more than an unlubricated seal. As opposed to a displacement surge at around 20 psi of cavity pressure for an inflated unlubricated seal, the displacement surge occurred as soon as cavity pressure was applied. The remainder of the displacement curve paralleled the unlubricated curve.

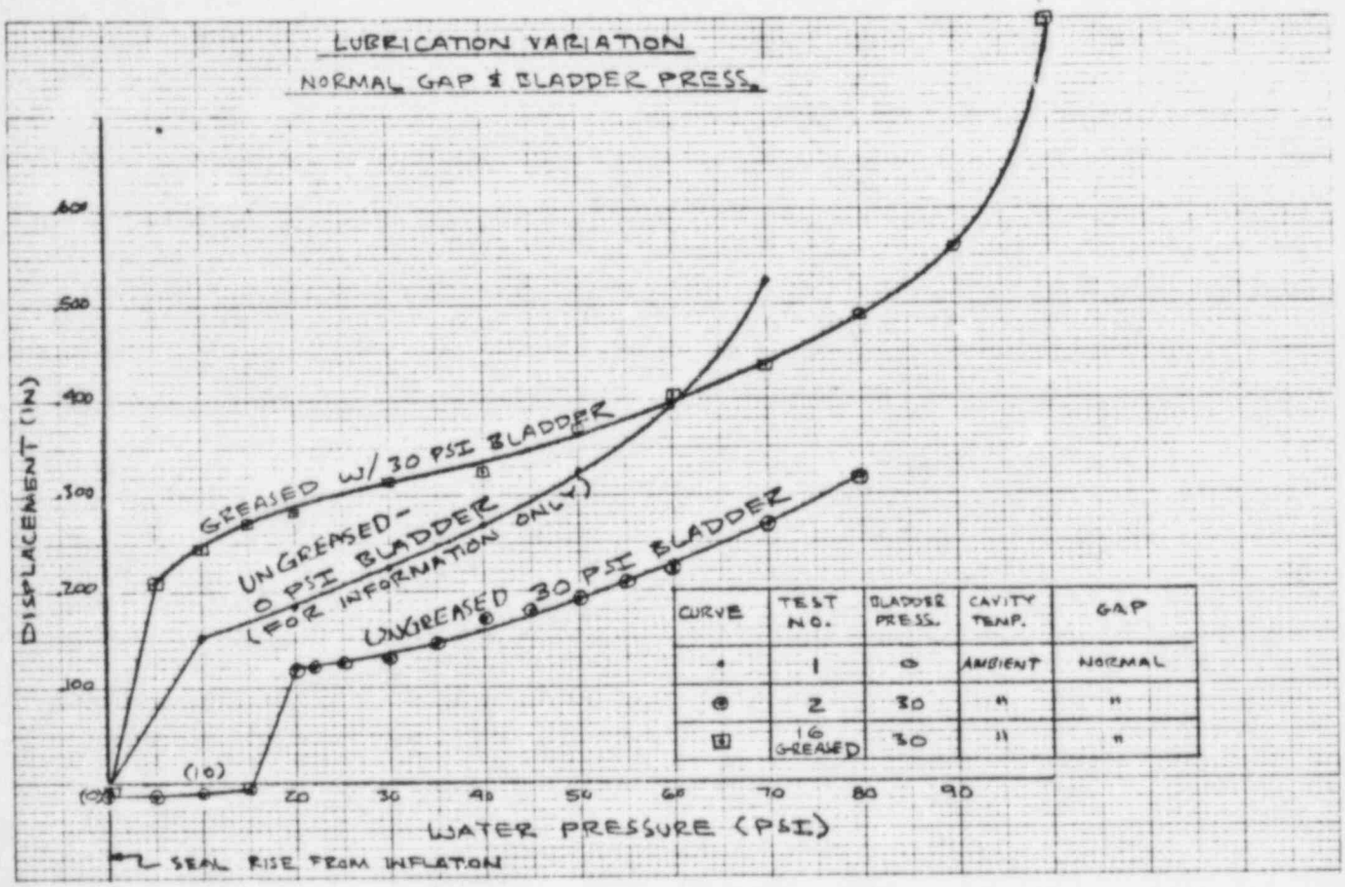


Figure No. 17 - Lubrication Effects

5.9 Installation Effects

In order to observe effects of not completely installing and seating a seal prior to inflation and cavity pressurization, one test was conducted at normal conditions (70°F, 30 psi bladder, normal gap) with the seal flange between 5/8" and 3/4" above the point of being seated. Figure No. 18 is a normalized curve comparing unseated seal behavior to that of a seated seal. As can be seen from this graph the cavity pressure associated with the displacement surges corresponds to approximately 15 to 20 psi for both the seated and unseated seal. Once seated, the seal that was initally unseated will have appropriately the same displacement characteristics as the seated seal.

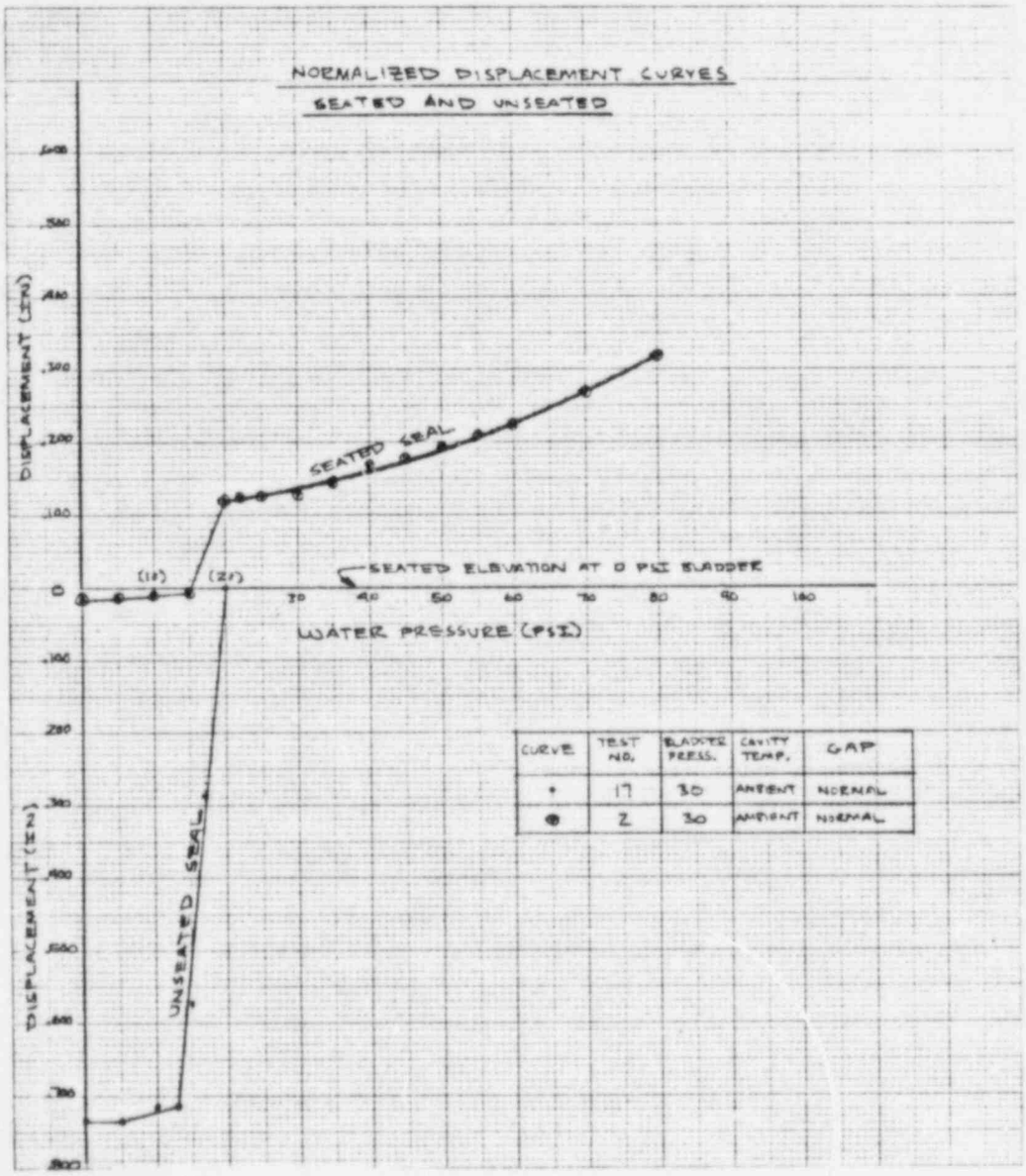


Figure No. 18 - Installation Effects

6.0 CONCLUSION

The Presray Seal provided a resistance to gross push through exceeding the capacity of the test apparatus (12X design head) for the installation tolerances existing at Yankee. Gross push through of the seal was prevented by the lower horizontal plate on the cavity liner side.

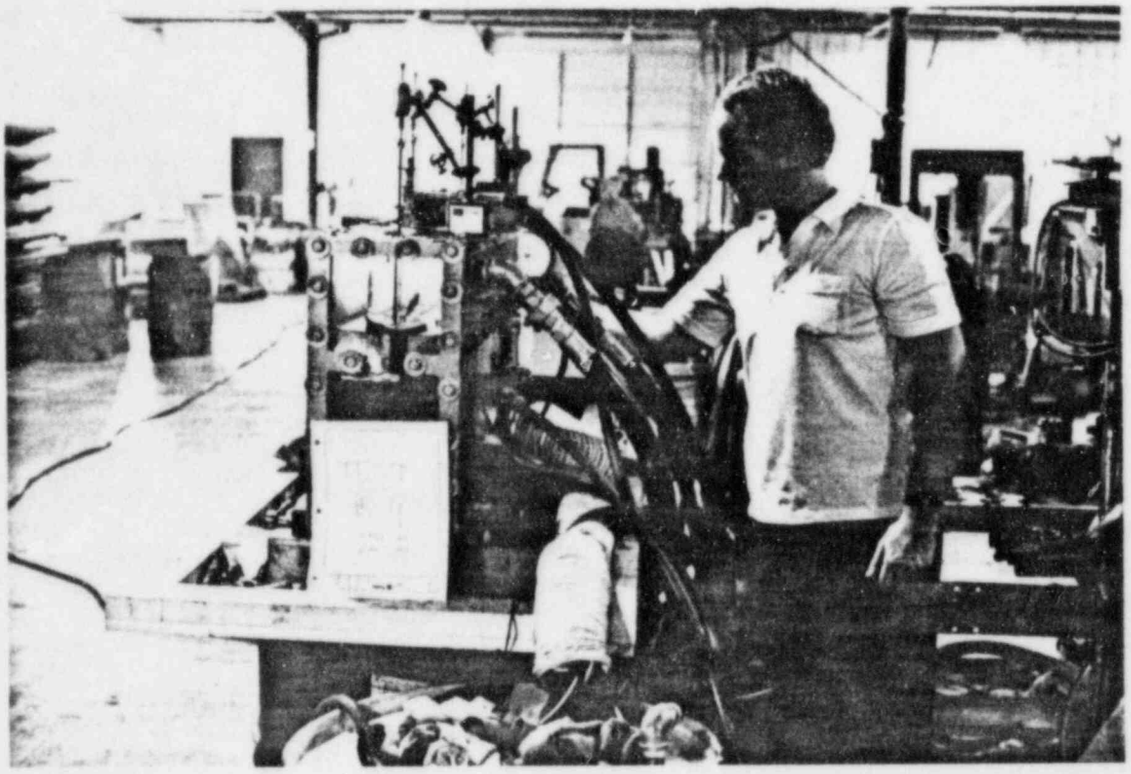
The effects of gap dimensions, bladder pressure, creep, sudden bladder pressure loss, temperature, seal lubrication and incomplete seal installation were studied. Though the effects of variation in the bladder pressures, temperatures, and lubrication were visible, no detrimental effect to seal integrity resulted. The effects of creep, sudden bladder pressure loss, and incomplete seal installation were also shown not to have a detrimental effect on seal integrity.

Cavity leakage rate was monitored for all tests. The seal's resistance to leakage was exceptional. The majority of the tests exhibited no leakage. Bladder pressure proved to be critical to maintain sealing for water heads from 0 to approximately 12 feet cavity pool depth. At the normal cavity water depth of 25 ft. the inflated seal (30 or 50 psi) exhibited no leakage for the various gap dimensions and temperatures tested.

In general, the volume of data collected during testing provided consistent results. Five different seals were used with few data discrepancies noted. For the installation tolerances at Yankee, the seal exhibited exceptional protection against push through and leakage considerations.

APPENDIX A

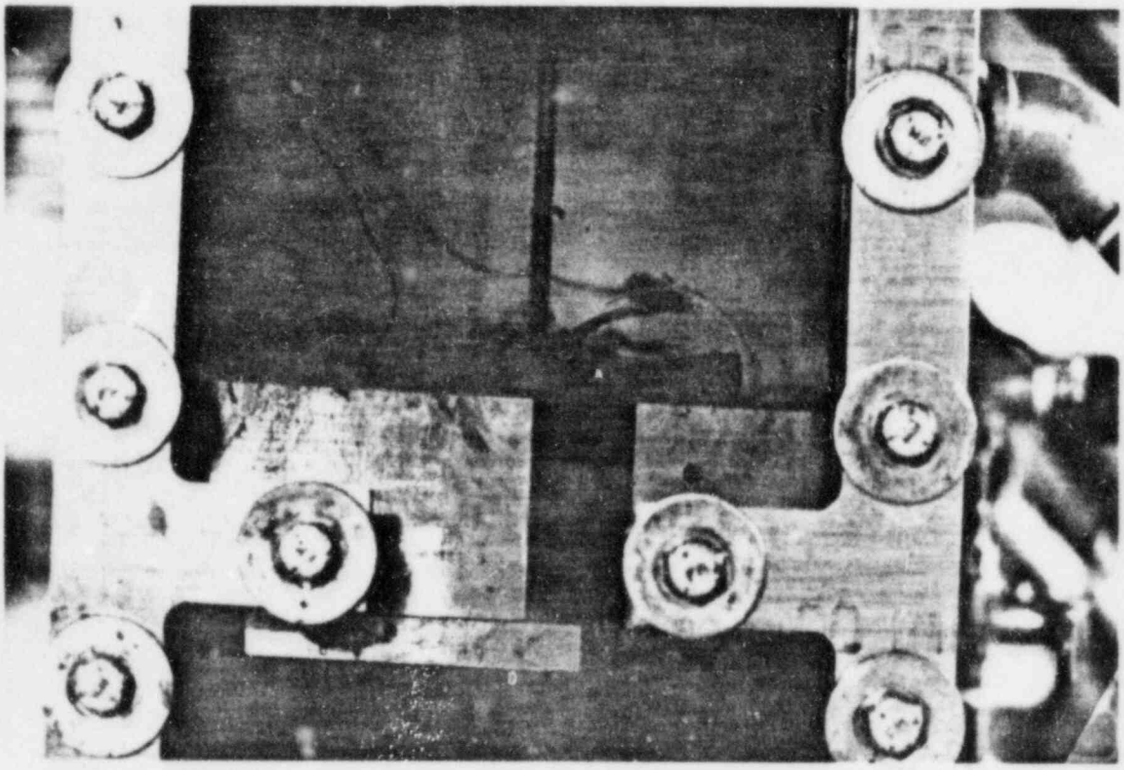
	No. of Pages
Photographs	4



PHOTOGRAPH NO. 1 - TEST NO. 4

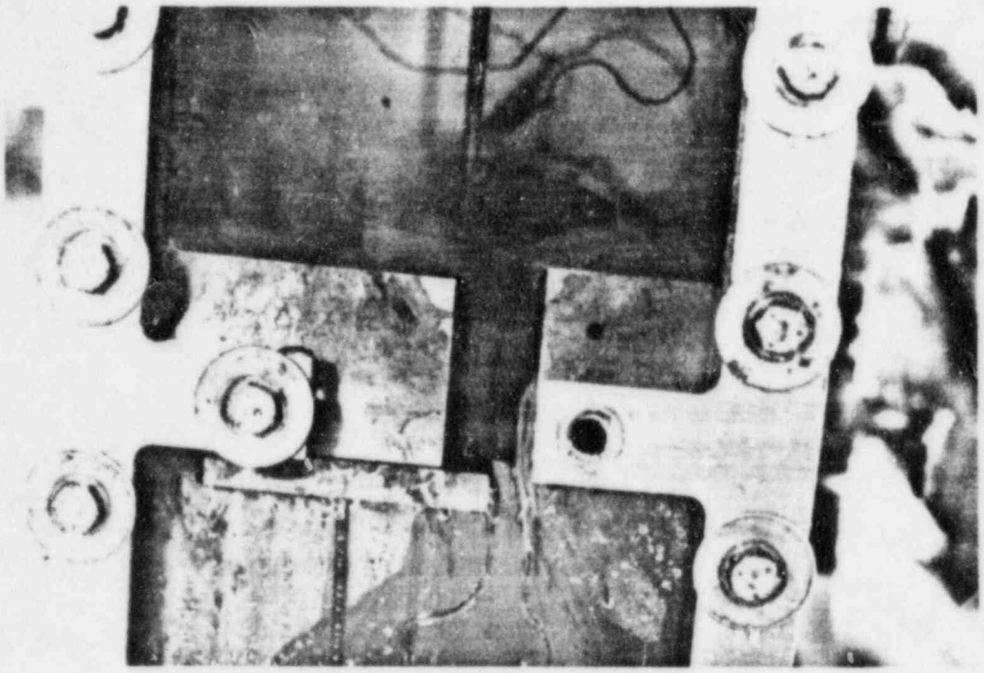
with a 1-1/16" gap under a design

head (10 psi) without bladder pressure.



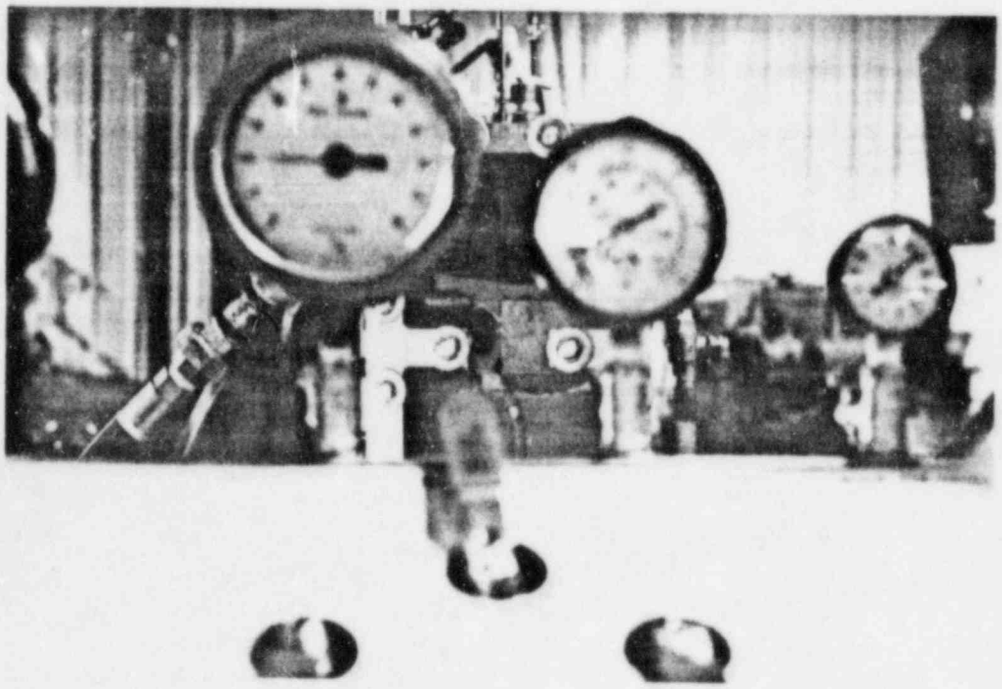
PHOTOGRAPH NO. 2 - TEST NO. 6

at the design head with a bladder pressure of 50 psi. The gap width is 1-1/16".



PHOTOGRAPH NO. 3 - TEST NO. 7

at the design head without bladder pressure. The gap is 1-1/16" and has a 1/4" offset.



PHOTOGRAPH NO. 4 - TEST NO. 9
at the design head with an over-
pressurized bladder. The gap width
is 1-3/16" with a 1/4" offset.

APPENDIX B

	No. of Pages
Test Matrix	1
Data Sheets	70
Displacement Probe Location	1

CAVITY SEAL TEST MATRIX

Test No.	Bladder Pressure	Head of Water 5-10 psi incr	Leakage Readings	Displacement Readings	Water Temperature	Annulus Gap Size	Air Bladder Pressure Loss	Creep Effects	Failure Test
1	0 psi	0-300 ft.	X	X	70	Normal		X	
2	30 psi	0-300 ft.	X	X	70	Normal	X	X	X or worst case
3	50 psi	0-300 ft.	X	X	70	Normal	X	X	of tests 1,2,3
4	0 psi	0-300 ft.	X	X	70	Max. 1		X	
5	30 psi	0-300 ft.	X	X	70	Max. 1	X	X	X or worst case
6	50 psi	0-300 ft.	X	X	70	Max. 1	X	X	of tests 4,5,6
7	0 psi	0-300 ft.	X	X	70	Max. 1 & offset		X	
8	30 psi	0-300 ft.	X	X	70	Max. 1 & offset	X	X	X or worst case
9	50 psi	0-300 ft.	X	X	70	Max. 1 & offset	X	X	of tests 7,8,9
10	0 psi	0-300 ft.	X	X	70	Max. 2 & offset		X	
11	30 psi	0-300 ft.	X	X	70	Max. 2 & offset	X	X	X or worst case
12	50 psi	0-300 ft.	X	X	70	Max. 2 & offset	X	X	of tests 10,11,12
13	0 psi	0-300 ft.	X	X	150	Normal	---	X	
14	30 psi	0-300 ft.	X	X	150	Normal	---	X	X or worst case
15	50 psi	0-300 ft.	X	X	150	Normal	---	X	of tests 13,14,15
16	30 psi	0-300 ft.	X	X	70	Normal w/grease	---	X	----
17	30 psi	0-300 ft.	X	X	70	Seal not seated	---	X	----

Gap dimensions are as follows:

1. Normal = 15/16 in.
2. Max. 1 = 1-1/16 in.
3. Max. 2 = 1-3/16 in.
4. Offset = + 1/4 in.

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/22/95

2. Test No. 1

3. Seal I.D. 2

4. Nominal Gap Width (in) 15/16

   Offset (in) 0

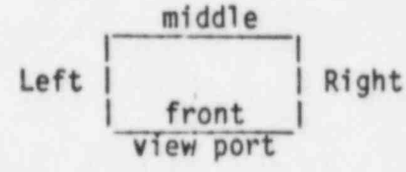
5. Bladder Pressure (psi) 0

6. Cavity Temperature (°F) 70

7. Installation (lub/unlub) unlub Method N/A

8. Gap Width (in) Offset (in)

Left	.939	.018
Middle	N/A	N/A
Right	.926	.008



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.750"	4.768"
Right	4.750"	4.758"

10. Gauges a) Air Model No. ASHCROFT 0-107 Range 0-60
    Smallest subdivision .5 psi

    b) Water Model No. ASHCROFT 0-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH - J8024, 0-300 psi @ 10 psi subdivisions

    c) Temp. Model No. FENWALL 55-000-3160-454 Range 0-1200°C
    Smallest Subdivision 1°C °F

11. Dial indicators: Left Model No. N/A
    Middle Model No. 99823 SEARS
    Right Model No. 11347 SEARS

REV	BY	DATE	CHECKED	DATE	
0	SLW	4/22/95	WA	4/27/95	IMPELL CORPORATION

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Yankee Atomic Plant
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0	SLW	4/22/85	WF	4/22/85

IMPELL CORPORATION

Yankee Atomic Elect. Co.
Yankee Atomic Plant

JOB NO 0570-035-2551

CALC NO 0570-035-01

Date 4/22/85
Test No. 1

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements L (in.)	5. Displacements M (in.)	5. Displacements R (in.)	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
1	10:30	1		0	0	0	3	27°C	200ml/7(s)	LEAKS AT ONE PLACE, CHECK FOR HARD SPOT
2	10:47	5		N/A	N/A	N/A	9			SEATED, LEAKAGE STOPPED
3	10:47	10		.816	.848	.835	0		200ml/21.5(s)	
4	10:52	20		.780	.915	.906	0		0	
5	10:54	N/C		N/C	N/C	N/C	N/C		N/C	
6	10:55	30		.748	.776	.768	0		100ml/45(s)	LEAKS AT POT. HARD SPOT
7	10:58	N/C		N/C	N/C	N/C	N/C		N/C	
8	10:59	40		.707	.730	.725	0		0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/22/85	WA	4/22/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
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TEST DATA SHEET
Presray Seal Test

Date 4/22/85
Test No. 1

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
9	11:00	50		.667	.675	.664	0		100ml/10(s)	LEAK AT PST. HARD SPOT
10		N/C	11:04	.662	N/C	N/C	0			
11	11:04	60		.615	.607	.575	0		200ml/18(s)	LEAK AT SAME PST. HARD SPOT
12			11:07	.608	N/C	.555	0			DEEP-V SEAL SHAPE
13	11:08	68		.561	.475	.477	0		0	CHANGED TO MARSH GAUGE
14		N/C	11:10	~.507	~.426	~.492	0		0	
15	11:11	78		N/A	N/A	.368	0		100ml/33½(s)	LEAK AT SAME PST. HARD SPOT
16		N/C	11:16	N/A	N/A	.335	0			

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	9/22/85	WM	9/27/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

TEST DATA SHEET
Presray Seal Test

Date 9/22/85
Test No. 1

Temperatures at test completion:
Ambient ~70 °F

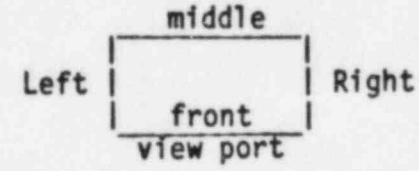
1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
17	11:17	98	11:18	N/A	N/A	.280	0		0	SEAL FLANGES VERTICAL MOST OF THE LENGTH
18	11:20	108		N/A	N/A	.244	0	27°C	0	
19	11:24	118		N/A	N/A	.228	0		0	
20	11:26	131		N/A	N/A	.187	0	27°C	0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/22/85
2. Test No. 2
3. Seal I.D. 2
4. Nominal Gap Width (in) 15/16
   Offset (in) 0
5. Bladder Pressure (psi) 30
6. Cavity Temperature (°F) 70
7. Installation (lub/unlub) unlub. Method N/A
8. Gap Width (in) Offset (in)

Left	.939	.018
Middle	N/A	N/A
Right	.926	.008



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.750"	4.768"
Right	4.750"	4.758"

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi
    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH-J8024, 0-300psi @ 10psi subdivisions
    c) Temp. Model No. FENWALL 55-103360-404 Range 0-1200°C
    Smallest Subdivision 1°C °F
11. Dial indicators: Left Model No. N/A
    Middle Model No. 99823 SEARS
    Right Model No. 11347 SEARS

REV	BY	DATE	CHECKED	DATE
0	SLW	4/22/85	WF	4/22/85

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Yankee Atomic Plant
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REV	BY	DATE	CHECKED	DATE
0	SLW	4/22/85	WJ	4/22/85

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Yankee Atomic Electric Co.
Yankee Atomic Plant

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Date 4/22/85
Test No. 2

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements L	5. Displacements M (in.)	5. Displacements R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0		0		N/A	0	0	0			SEAL BUMPY
1	8:22	0		N/A	+.015	+.016	30		0	
2	8:23	5		N/A	+.013	+.014	30		0	
3		5	8:25	N/A	+.013	+.014	30		0	NO CREEP
4	8:26	10		N/A	+.011	+.011	30.2		0	
5	8:27	15		N/A	+.007	+.004	30.0		0	
6		15	8:29	N/A	+.007	+.003	30.0		0	
7	8:30	20		N/A	-.880	-.786	30.0		0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/22/85	WH	4/22/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

TEST DATA SHEET
Presray Seal Test

Date 4/22/85
Test No. 2

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8	8:37	22		.890	.878	.785	30		0	
9		22	8:42	.890	.878	.785	30		0	
10	8:43	25	8:44	.887	.875	.781	30		0	
11	8:45	30		.882	.871	.774	30		0	PROB. HIT BOTTOM
12	8:48	35		.873 ~~.874~~	.855	.762	30		0	HAVE NOT HIT BOTTOM
13		35	8:50	.869	.849	.761	30		0	
14		35	8:53	.869	.849	.761	30		0	
15	8:55	40		.859	.830	.749	30			SEAL LEVEL

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/22/85	WL	4/17/85

IMPELL CORPORATION

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Yankee Atomic Plant

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Date 4/22/85
Test No. 2

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
16		<10	8:57	.858	.825	.748	30		0	
17		<10	8:59	N/C	N/C	N/C	30		0	
18	9:00	45		.854	.821	.739	30		0	SEAL HAS HIT BOTTOM OF GAP
19		45	9:02	.848	.819	.736	30		0	
20		45	9:05	N/C	N/C	N/C	30		0	
21	9:05	50		.835	.808	.726	30		0	
22		50	9:08	.830	.803	.722	30		0	
23		50	9:10	.830	N/C	.722	30		0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/22/85	WT	4/22/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-075-2551
CALC NO 0570-075-01

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TEST DATA SHEET
Presray Seal Test

Date 4/22/85
Test No. 2

Temperatures at test completion:
Ambient ~70 °F

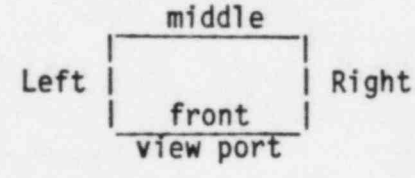
1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
24	9:10	55		.817	.791	.711	29.9		82 drops/min	
25		55	9:14	.814	.786	.705	30		N/L	
26	9:15	60		.805	.777	.696	30		134 drops/min	
27		60	9:16	.799	.768	.689	30			SEAL CLOSER TO BOTTOM
28		~~60~~ 58 (MARSH)	9:19	.798	.767	.688	30.0			60 ON ASHCROFT
29	9:21	68		.719	.730	.656	30		200ml/2.5min (FROM ASHCROFT END)	MARSH GUAGE
30		68	9:28	.707	.718	.646	30			
31	9:30	78		.683	.681	.615	30		LEAKAGE STOPPED	SEAL HAS HIT BOTTOM PLATE

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/23/85
2. Test No. 3
3. Seal I.D. 2
4. Nominal Gap Width (in) 15/16
   Offset (in) 0
5. Bladder Pressure (psi) 50
6. Cavity Temperature (°F) 70
7. Installation (lub/unlub) unlub Method N/A
8. Gap Width (in) Offset (in)

Left	.939	.018
Middle	N/A	N/A
Right	.926	.008



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.750"	4.768"
Right	4.750"	4.758"

ASHCROFT

10. Gauges a) Air Model No. Q-107 Range 0-60
    Smallest subdivision .5 psi
    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH-J8024, 0-300psi @10psi subdivisions
    c) Temp. Model No. FENWALL 55-003160-409 Range 0-1200°C
    Smallest Subdivision 1°C °F
11. Dial indicators: Left Model No. N/A
    Middle Model No. 99823 SEARS
    Right Model No. 11347 SEARS

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					Yankee Atomic Plant	
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REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WJ	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

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Date 4/23/85
Test No. 3

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements L	M (in.)	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	11:24	0		N/A	0	0	0		N/A	
1	11:25	1		N/A	+.021	+.013	30		0	
2	11:26	1		N/A	+.042	+.035	50	23°C	0	
3	11:27	.2		N/A	+.047	+.043	50		0	FLANGES AT INSIDE EDGE HAVE LIFTED OFF ALUMINUM
4	11:29	.2		N/A	+.047	+.046	49.5		0	
5		.2	11:31	N/A	+.047	+.047	50		0	
6	11:32	5		N/A	+.045	+.039	50	23°C	0	
7		5	11:33	N/A	N/C	N/C	50		0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	[illegible]	4/27/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

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CALC NO 0570-035-01

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Date 4/23/85
Test No. 3

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8	11:34	10		N/A	+.041	-.987	50			
9		10	11:35	N/A	N/C	-.985	50			
10		10	11:44	N/A	N/C	N/C	50			NO CREEP
11	11:45	15		N/A	+.030	-.943	49.5	24°C	~150 drops/min	LEAKAGE AT PT. HARD SPOT
12		15	11:48	N/A	N/C	N/C	49.5		N/C	
13	11:48	20		N/A	+.016	-.925	50	24°C	N/C	
14		N/C	11:53	N/A	+.015	N/C	N/C	N/C	N/C	
15	11:53	25		N/A	-.980 → -.965	-.902	50	24°C	~60 drops/min	SINKING POINT

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WJ	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-TSS1
CALC NO 0570-075-01

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Date 4/23/85
Test No. 3

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
16		N/C	11:56	N/A	.953	.902	N/C			
17		N/C	11:57	N/A	.947	.902	N/C	25°C		
18		N/C	11:58	N/A	N/C	N/C	N/C	N/C	~60 drops/min	
19	11:59	30	12:00	N/A	.916	.876	50	25°C	~80 drops/min	
20	12:02	40	12:03	N/A	.863	.843	50	25°C	~30 drops/min	
21	12:04	50	12:05	N/A	.843	.812	50		0	LEAKAGE STOPPED
22	12:05	60	12:06	N/A	.810	.779	50	25°C	0	
23		68		N/A	.779	.737	50		0	SWITCH TO MARSH GAUGE

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WJ	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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Date 4/23/85
Test No. 3

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
24		68	12:12	N/A	.765	.725	50		0	
25	12:13	78	12:14	N/A	.727	.669	50	25°C	0	
26	12:15	88	12:16	N/A	.662	.603	50	25°C	0	
27	12:17	98	12:18	N/A	.516	.489	50		0	
28	12:18	108	12:22	N/A	~.4	.326	50		0	LOST CENTER PROBE
29	12:24	118		N/A	N/A	.279	50		0	
30	12:25	128		N/A	N/A	.248	50		0	
31		128	12:29	N/A	N/A	.231	50	26°C		3/8" Extrusion 5/8"

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/22/85	WJ	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-075-2551
CALC NO 0570-035-01

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TEST DATA SHEET
Presray Seal Test

Date 4/23/85
Test No. 3

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
32		128	12:30	N/A	N/A	.231	50	26°C	0	
33	12:34	128		N/A	N/A	.231	50	26°C		RAPID DEPRESSURIZATION
34	12:35	128		N/A	N/A	.175	0	26°C	0	
35		128	12:36	N/A	N/A	.165	0	26°C	0	
36	12:47	10		N/A	.900	.900	50		~1 Load drops/min	
37	12:49	11		N/A	.842	.862	0		SOME LEAKAGE NO TIME TO MEASURE	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WT	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-25511
CALC NO 0570-035-01

Date 4/23/85
Test No. 3

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
38		N/C	12:51	N/A	N/C	N/C	N/C		LEAKAGE STOPPED	
39	12:53	25		N/A	N/C	N/C	50		~60 drops/min	
40	12:54	25		N/A	.776	.797	0		LEAKAGE FOR 2 SECONDS. THEN STOPPED	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   L = at left end of seal (see diagram on initial data sheet)
   M = at middle of seal (see diagram on initial data sheet)
   R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/24/85

2. Test No. 4

3. Seal I.D. 3

4. Nominal Gap Width (in) 1 1/16

   Offset (in) 0

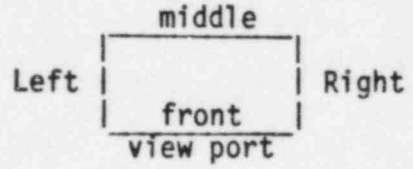
5. Bladder Pressure (psi) 0

6. Cavity Temperature (°F) 70

7. Installation (lub/unlub) unlub. Method N/A

8. Gap Width (in) Offset (in)
   SEE TEST

Left	1.062	.0060
Middle	N/A	N/A
Right	1.051	.003



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.771	4.765
Right	4.760	4.763

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi

    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH-J8029, 0-300 psi @ 10 psi subdivisions

    c) Temp. Model No. FENWALL 55-033360-1X4 Range 0-1200°C
    Smallest Subdivision 1°C °F

11. Dial indicators: Left Model No. N/A
    Middle Model No. 99523 SEARS
    Right Model No. 11347 SEARS

REV	BY	DATE	CHECKED	DATE	
					Yankee Atomic Electric Co.
					Yankee Atomic Plant
0	SLW	4/24/85	WA	4/24/85	IMPELL CORPORATION

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CALC NO 0570-035-01 OF 70

REV	BY	DATE	CHECKED	DATE
0	SLW	4/24/85	WJ	4/24/85

IMPELL CORPORATION

Yankee Atomic Electric Co.

Yankee Atomic Plant

JOB NO 0570-035-25511

CALC NO 0570-035-01

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TEST DATA SHEET
Presray Seal Test

Date 4/24/85
Test No. 4

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	1:56	0		.9	0	0	3			LEAKAGE TO GREAT 105 PSI PUMP PRESS. (~10gpm)
1	2:05	5		.719	.878	.791	0		100ml/36(s)	5psi air - 10psi 5psi water - 10psi SEATING
2		5	2:06	.716	.875	.786	0	24°C		
3	2:07	10		.687	.854	.763	0	24°C	100ml/21.5(s)	
4			2:13	N/C	N/C	N/C				
5	2:15	15		.661	.818	.740	0	24°C	100ml/26.5(s)	
6		N/C	2:19	.657	.817	.737				
7		N/C	2:23	N/C	N/C	N/C		25°C		

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/24/85	WJ	4/24/85

IMPELL CORPORATION

Yankee Atomic Electric Co.

Yankee Atomic Plant

JOB NO 0570-035-2551

CALC NO 0570-035-01

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Date 4/24/85
Test No. 9

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8	2:23	20	2:26	.633	~~.691~~ .791	.717	0		NEGLIGIBLE LEAKAGE	
9	2:27	30		.582	.745	.675	0	25°C	200ml/2.9(S)	END LEAKAGE MAY CONTRIBUTE
10	2:31	40		.525	.683	.635	0	25°C	200ml/6(S)	PURE SEAL LEAKAGE
11	2:35	50		.431	.573	.580	0		100ml/10(S)	"
12		50	~~2:41~~ 2:43	.415	.541	.564	0		100ml/10½(S)	"
13		50	2:45	.412	N/C	N/C	0			
14	2:46	60	2:47	.248	.455	.217	0	26°C	NEGLIGIBLE DROPS/MIN.	
15		60	2:49	.218	.421	.172	0			

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/24/85	WT	4/24/85

IMPELL CORPORATION

Yankee Atomic Electric Co.

Yankee Atomic Plant

JOB NO 0570-035-2551

CALC NO 0570-035-01

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Date 4/24/85
Test No. 9

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
16	2:50	68		.116	.358	.095	0	26°C	NEGLIGIBLE	MARSH GUAGE
17	2:52	78		.056	.296	.037	0		0	
18		78	2:55	.029	.270	[illegible]	0		0	
19	2:56	88		.007	.246	.986	0	26°C	0	
20	2:57	98	2:59	.919	.183	.878	0		drops	Kept. to 110
21	3:02	131		.813	N/A	N/A	0			

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/24/85

2. Test No. 5

3. Seal I.D. 3

4. Nominal Gap Width (in) 1 1/16

   Offset (in) 0

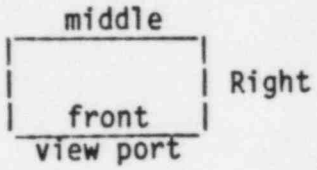
5. Bladder Pressure (psi) 30

6. Cavity Temperature (°F) 70

7. Installation (lub/unlub) Unlub Method N/A

8. Gap Width (in) Offset (in)

	Gap Width (in)	Offset (in) CALC. FROM BELOW
Left	1.062	.006
Middle	N/A	N/A
Right	1.051	.003



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.771	4.765
Right	4.760	4.763

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi

    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH-J8024, 0-300psi @ 10psi subdivisions

    c) Temp. Model No. FENWALL 55-033160-454 Range 0-1200°F
    Smallest Subdivision 1 °C

11. Dial indicators: Left Model No. N/A
    Middle Model No. 99823 SEARS
    Right Model No. 11347 SEARS

REV	BY	DATE	CHECKED	DATE
0	SLW	4/24/85	WJ	4/24/85

Yankee Atomic Electric Co.
Yankee Atomic Plant
IMPELL CORPORATION
JOB NO 0570-035-2591
CALC NO 0570-035-01
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REV	BY	DATE	CHECKED	DATE
0	SLW	1/24/85	WJ	4/24/85

IMPELL CORPORATION

Yankee Atomic Electric Co.

Yankee Atomic Plant

JOB NO 0570-035-2551

CALC NO 0570-035-01

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Date 1/24/85
Test No. 5

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements L	M (in.)	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
~~0~~	~~10:20~~	~~N/A~~		~~.900~~	~~0~~	~~0~~	~~0~~			
~~1~~	~~10:20~~	~~N/A~~		~~.908~~	~~.021~~	~~.021~~	~~30~~			TOP LEAK
0	10:50	N/A		.900	0	0	0			
1	10:51	N/A		.921	.019	.019	30			
2	10:53	5		.919	.019	.019	30	21°C	0	
3		~~10~~	10:56	N/C	N/C	N/C	~~30~~			
4	10:57	10		.912	.013	.010	30	21°C	0	
5			10:58	N/C	N/C	N/C				

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/24/85	WJ	4/24/85

IMPELL CORPORATION

Yankee Atomic Electric Co.

Yankee Atomic Plant

JOB NO 0570-035-25251

CALC NO 0570-035-01

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Date 4/24/85
Test No. 5

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
6	10:58	15		.785	.930	.872	30	20°C	0	LEAKAGE RATE HARD TO DETECT SILICONE BROKE LOOSE
7		N/C	11:03	N/C	.929	.868	N/C			
8		14.75	11:07	~~.785~~	.027	N/C ~~.785~~	30	20°C		
9			11:10	N/C	N/C	N/C				
10	11:12	20		.719	.875	.796	30	21°C	0	END LEAKAGE DRAINING ALONG LENGTH HAS STOPPED
11	11:15	30		.650	.794	.731	30	21°C	100ml/16s	
12		N/C	11:19	.647	~~.776~~ .777	.726	N/C			
13	11:20	40		.608	.742	.695	30.1	21°C		

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/29/85	WT	4/29/85

IMPELL CORPORATION

JOB NO 0570-072-2551
CALC NO 0570-035-01

Yankee Atomic Electric Co.
Yankee Atomic Plant

PAGE 24 OF 70

TEST DATA SHEET
Presray Seal Test

Date 4/29/85
Test No. 5

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
14		40	11:22	.605	.732	.694	30	21	100ml/6S	SEAL TOUCHING ½" FLANGE
15		N/C	11:25	.603	.729	.692	N/C			
16	11:26	50		.579	.691	.669	30	21°C	0	
17		N/C	11:28	.566	.684	.662	N/C	N/C		
18	11:29	60		.529	.648	.626	30.1	21°C		MARSH 58psi
19	11:31	68		.480	.602	.589	30	22°C	0	MARSH GUAGE
20			11:33	.471 ~~.511~~	.587	.576	30	22°C		
21			11:36	.466	.581	.573				

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	1/24/85	WJ	1/24/85

IMPELL CORPORATION

Yankee Atomic Electric Co.

Yankee Atomic Plant

JOB NO 0570-035-25551

CALC NO 0570-035-01

PAGE 15 OF 70

Date 1/24/85
Test No. 5

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
22		N/C	11:39	.463	.576	.571	N/C	N/C		
23		N/C	11:41	.461	.574	.570	N/C	N/C		
24		N/C	11:44	.460	.572	.569	N/C	N/C		
25		N/C	11:47	.458	.570	.568	N/C	N/C		
26		N/C	11:52	.456	.569	.568	N/C	N/C		
27	11:54	78		.394	.511 ~~.516~~	.516	30	23°C		
28	11:55	88		.284	.415	.422	30	23°C	0	
29	11:57	98		N/A	N/A	N/A	30		0	

~~.505~~ .515 .515

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/29/85	WF	4/29/85

Date 4/29/85
Test No. 5

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
30	12:02	108		N/A	N/A	N/A	30	23°C	0	MAX. DUE TO END LEAKAGE

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/25/85

2. Test No. 6

3. Seal I.D. 1

4. Nominal Gap Width (in) 1 1/16"

   Offset (in) 0

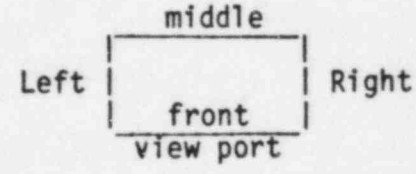
5. Bladder Pressure (psi) 50

6. Cavity Temperature (°F) 70

7. Installation (lub/unlub) unlub Method N/A

8. Gap Width (in) Offset (in)

Left	1.062	.006
Middle	N/A	N/A
Right	1.051	.003



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.771	4.765
Right	4.760	4.763

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi

    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH - J8024, 0-300 psi @ 10 psi subdivisions

    c) Temp. Model No. FENWALL 55-A07160-404 Range 0-1200°C
    Smallest Subdivision 1°C F

11. Dial indicators: Left Model No. 8241-942 B&S
    Middle Model No. 99823 SEARS
    Right Model No. 11347 SEARS

REV	BY	DATE	CHECKED	DATE
0	SLW	4/25/85	WJ	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

REV	BY	DATE	CHECKED	DATE
0	SLW	4/25/85	WJ	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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Date 4/25/85
Test No. 6

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	10:18	0		.900	0.0	0.0	0	21°C	—	
1	10:20	1		+.935	+.013	+.035	50		0	NO END LEAKS MIDDLE READING VISUAL
2	10:28	5		+.922	+.010	+.028	50		0	
3	10:29	10		.773	.994	.935	50	21°C	0	MIDDLE READ-
4		10	10:33	.771	.993	.923	50		0	
5		N/C	10:37	N/C	N/C	N/C	N/C		0	
6	10:37	15		.728	.908	.878	50		0	
7	10:38	20		.709	.831	.850	50	21°C	0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   L = at left end of seal (see diagram on initial data sheet)
   M = at middle of seal (see diagram on initial data sheet)
   R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/25/85	WJ	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

TEST DATA SHEET
Presray Seal Test

Date 4/25/85
Test No. 6

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8	10:39	30		.677	.771	.813	50	21°C	100ml/26(s)	END LEAKAGE
9			10:46	.662	.762	.809				
10	10:46	40		.692	.741	.781	50	21°C	100ml/24(s)	
11	10:49	50	10:50	.605	.703	.748	50		0	LEAKAGE DECREASED
12	10:51	60		.572	.675	.720	50	23°C	0	END LEAKAGE 1/16" PULLED AWAY FROM PLEXI-GLASS
13		N/C	10:55	.565	.670	.708	N/C	N/C	N/C	
14	11:00	62		.547	.648	.695	50	24°C	0	SWITCH TO MARSH GAUGE
15		60	11:06	.521	.629	.679	50	24°C		

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/25/85	WJ	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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Date 4/25/85
Test No. 6

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

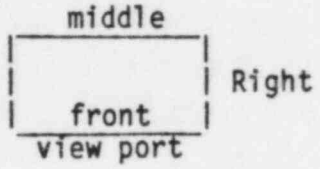
1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
16		59	11:16	.515	.593*	.638*	50	23°C	0	*Questionable
17		N/C	11:20	N/C	N/C	N/C	N/C	N/C	0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/25/85
2. Test No. 7
3. Seal I.D. 3 & 4
4. Nominal Gap Width (in) 1 1/16
   Offset (in) 1/4
5. Bladder Pressure (psi) 50
6. Cavity Temperature (°F) 70
7. Installation (lub/unlub) UNLUB Method N/A
8. Gap Width (in) Offset (in)

	Gap Width (in)	Offset (in)
Left	1.079	.246
Middle	N/A	N/A
Right	1.058	.255



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left		4.624
Right		4.873

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi
    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH - J8029, 0-300 psi @ 10 psi subdivisions
    c) Temp. Model No. FENWALL 55-003160-409 Range 0-1200°C
    Smallest Subdivision 1°C °F
11. Dial indicators: Left Model No. N/A
    Middle Model No. 99823 SEARS
    Right Model No. 11397 SEARS

REV	BY	DATE	CHECKED	DATE
0	RGC	4-25-85	WJ	4/26/85

Yankee Atomic Electric Co.
Yankee Atomic Plant
IMPELL CORPORATION
JOB NO 0570-035-2551
CALC NO 0570-035-01

REV	BY	DATE	CHECKED	DATE
0	RJC	4-25-85	WJ	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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Date 4/25/85
Test No. 7

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	5:46	0		0	0	0	0	22°C		
1	5:50	0		.055	.038	.050	~5-10			LEAK-GAUGE READING NOT ACCURATE
2	6:00	1-1007					5-10			PUSH THRU
3	7:58	0		.800	0.0	.900	0	26		RETEST SEAL# 4
4	8:04	5		.701	.959	.785	10	27		
5		5	8:01	.701	.912	.775	0	27	None	
6	8:09	10		.656	.819	.726	0	26	"	
7	8:10	15		.630	.796	.687	0	26	"	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	RGC	4-25-85	WJ	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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Date 4/25/85
Test No. 7

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8		15	8:14	.626	.712	.686	0	26		
9	8:15	20		.601	.766	.668	0	26		
10	8:17	30		.538	.711	.592	0	26	100ml/125	SMALL LEAK
11		30	8:18	.530	.705	.581	0	26		
12	8:20	40		.451	.643	.528	0	26		
13	8:21	50	8:24	.264	.569	.341	0	26		
14		55								CREEPING BLADDER
15										

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/25/85

2. Test No. 8

3. Seal I.D. 3

4. Nominal Gap Width (in) 1 1/16

   Offset (in) 1/4

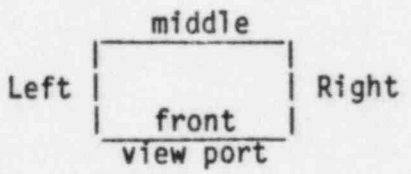
5. Bladder Pressure (psi) 30

6. Cavity Temperature (°F) 70

7. Installation (lub/unlub) UNLUB Method N/A

8. Gap Width (in) Offset (in)

Left	1.079	.246
Middle	N/A	N/A
Right	1.058	.255



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left		4.624
Right		4.873

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi

    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH-J8029, 0-300 psi @ 10 psi subdivisions

    c) Temp. Model No. FENWALL 55-033160-004 Range 0-120°C
    Smallest Subdivision 1°C °F

11. Dial indicators: Left Model No. N/A
    Middle Model No. 99823 SEARS
    Right Model No. 11347 SEARS

					Yankee Atomic Electric Co. Yankee Atomic Plant	
0	SLW	4/25/85	[illegible]	4/25/85	IMPELL CORPORATION	JOB NO 0570-035-2551
REV	BY	DATE	CHECKED	DATE		CALC NO 0570-035-01

REV	BY	DATE	CHECKED	DATE
0	SLW	4/25/85	WJ	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551

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Date 4/25/85
Test No. 8

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	4:02	0		0	0	0	0	22°C		
1	4:03	0		.026	.010	.020	30	22°C		
2	4:08	5	4:09	N/C	.013	.011	30		0	END LEAKAGE
3	4:10	10	4:13	.943	.002	.009	30	23°C	0	
4		N/C	4:19	.942	N/C	N/C	30	24°C	0	
5	4:20	15		.791	.997	.853			0	
6		SEATED	PRESS. VENT TO <10				AND DROPPED TO 20			
7	4:24	20		.625	.666	.699	30	24°C		

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/25/85	WJ	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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Date 4/25/85
Test No. 8

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8	4:25	30		.609	.652	.692	30	24°C	0	
9	4:26	40		.561	.618	.652	30		0	
10	4:27	50		.477	.498	.580			60 drops / min.	TOUCHING BOTTOM PLATE
11			4:30	.458	.477	.570			STOPPED 0	
12			4:31	.455	N/C	N/C				
13			4:33	.450	.475	N/C				
14		49.6	4:36	.446	.472	.569	30	25°C	0	
15			4:37	.443	.470	N/C				

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/25/85	NJAC	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.

Yankee Atomic Plant

JOB NO 0570-035-2551

CALC NO 0570-035-01

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Date 4/25/85
Test No. 8

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

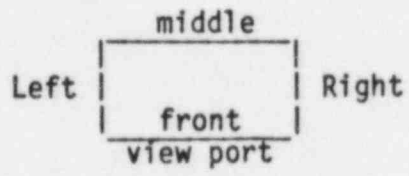
1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
16		50.2	4:39	.442	N/C	.568	30	25°C	0	
17	4:42	60	4:44	.323	.362	.490	30	25°C		58 MARSH
18	4:44	68					30	25°C		EXTRUDED THRU
19	4:52	117								DID NOT FAIL
20	8:31	10		.7	0	.7	30	27		LOSS OF BLADDER TEST
21		10	8:33	.663	.718	.658	0	27	NONE	
22	8:34	30		.580	.743	.547	30	27		
23		30	8:35	.551	.681	.512	0	27	100 ml/11.5s	Small Leak

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/25/85
2. Test No. 9
3. Seal I.D. 4
4. Nominal Gap Width (in) 1 1/16
   Offset (in) 1/4
5. Bladder Pressure (psi) 50
6. Cavity Temperature (°F) 70
7. Installation (lub/unlub) UNLUB Method N/A
8. Gap Width (in) Offset (in)

Left	1.079	.246
Middle	N/A	N/A
Right	1.058	.255



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left		4.624
Right		4.873

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi
    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH - J8029, 0-300 psi @ 10 psi subdivisions
    c) Temp. Model No. FENWAL 55-033[illegible]-009 Range 0-1200°C
    Smallest Subdivision 1°C °F
11. Dial indicators: Left Model No. N/A
    Middle Model No. 99873 SEARS
    Right Model No. 11347 SEARS

REV	BY	DATE	CHECKED	DATE
0	RGC	4-25-85	MH	4/25/85

Yankee Atomic Electric Co.
Yankee Atomic Plant
IMPELL CORPORATION
JOB NO 0570-035-2551
CALC NO 0570-035-01
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REV	BY	DATE	CHECKED	DATE
0	RSC	4-25-85	WJ	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant
JOB NO 0570-035-2551
CALC NO 0570-035-01
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Date 4-25-85
Test No. 9

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	7:07	0		.900	0	0	0			
1	7:10	0		.965	+.050	+.007	50			
2	7:13	5	7:15	.957	?.049	0.0	60	24	DRY	
3	7:15	10	7:16	.893	?.049	.943	50	24	DRY	
4			7:18	.893	.049	.943	50	24	DRY	
5	7:19	15		.811	.049	.893	50	24	DRY	
6	7:21	20		.748	.042	.831	50	24	DRY	
7			7:24	.744	.042	.828	50	24	DRY	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	RBC	4-25-85	WJF	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant
JOB NO 0570-035-2551
CALC NO 0570-035-01
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Date 4-25-85
Test No. 9

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8	7:25	30		.680	.026	.719	50	24	NO LEAK IN MIDDLE	SMALL LEAK ON ENDS
9	7:27	40		.621	.803	.644	50	24	100ml/49s	SMALL LEAK
10		40	7:32	.619	.787	.644	50	24		
11		40	7:34	.619	.786	.644	50	24		
12	7:35	50		.582	.728	.585	50	24	100ml/35s	SMALL LEAK
13		50	7:37	.582	.720	.584	50	24		
14	7:39	60		.546	.697	.582	50	24		NO LEAK
15	7:41	60 MARSH 68		.485	.658	.513	50	24		NO LEAK

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	RGC	4/25/85	WJ	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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Date 4-25-85
Test No. 9

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

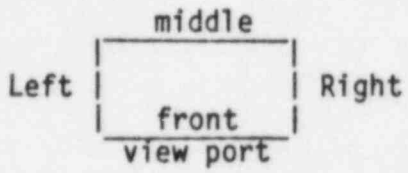
1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
16	7:44	78		.397	.616	.462	50	25	DRY	
17	7:46	88	7:48	.252	.539	N/A	50	25		STOP TEST

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/26/85
2. Test No. 10
3. Seal I.D. 5
4. Nominal Gap Width (in) 1 3/16
   Offset (in) 1/4"
5. Bladder Pressure (psi) 0
6. Cavity Temperature (°F) 70
7. Installation (lub/unlub) UNLUB Method N/A
8. Gap Width (in) Offset (in)

	Gap Width (in)	Offset (in)
Left		.247
Middle	N/A	N/A
Right		.251



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.616	4.863
Right	4.628	4.879

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi
    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH-J 8024, 0-300 psi @ 10 psi subdivisions
    c) Temp. Model No. FENWALL 55-033160-114 Range 0-1200°C
    Smallest Subdivision 1°C °F
11. Dial indicators: Left Model No. N/A
    Middle Model No. 99823 SEARS
    Right Model No. 11397 SEARS

REV	BY	DATE	CHECKED	DATE
0	SLW	4/26/85	[illegible]	4/26/85

Yankee Atomic Electric Co.
Yankee Atomic Plant
IMPELL CORPORATION
JOB NO 0570-035-2551
CALC NO 0570-035-01
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Date 4/26/85
Test No. 10

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	11:46	0		.800	.900	.900	0			N/water to ↑10psi to air
1	11:50	5		.568	.742	.651	DROPPED TO 0		0	
2	11:51	10	11:52	.529	.685	.608	0	24°C	0	
3	11:52	15		.489	.647	.561			0	
4	11:53	20		.423	.593 ~~.592~~	.510		24°C	100ml/12(s)	
5		20	11:56	.415	.580	.495			100ml/6(s)	
6		20	11:59	.411	.576	.491			100ml/6(s)	
7		20	12:02	.410	.573	.489			100ml/17½(s)	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV: 0 | BY: SLW | DATE: 4/26/85 | CHECKED: WT | DATE: 4/26/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-255
CALC NO 0570-035-01

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REV	BY	DATE	CHECKED	DATE
0	SLW	4/26/85	WJ	4/26/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

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CALC NO 0570-035-01

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Date 4/26/85
Test No. 10

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8		20	12:05	.407	.571	.487	0		100 ml / 17½ (S)	
9	12:08	25		.310	.497	.427	0		100 ml / 56½ (S)	
10		25	12:11	N/A	.482	.421	0	25°C		
11	12:14	30		N/A	.372	.365	0		0	12:15 RUPTURE FLANGE II SWITL EPV & CAVITY
									@ 12:15 200 ml / 7½ (S)	
Special test	1:41	10		.530	.700	.700	0	25°C	100 ml / 7½ (S)	LOADED 10 PSI CONF
		10	2:03	N/C	N/C	N/C		54°C	100 ml / 5½ (S)	
		10	2:12	N/C	N/C	N/C		61°C 60°C	100 ml / 4½ (S)	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/26/85

2. Test No. 11

3. Seal I.D. 5

4. Nominal Gap Width (in) 1 3/16"

   Offset (in) 1/4"

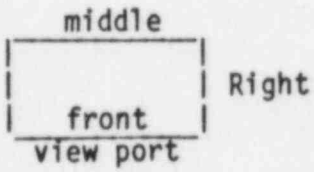
5. Bladder Pressure (psi) 30

6. Cavity Temperature (°F) 70

7. Installation (lub/unlub) UNLUB Method N/A

8. Gap Width (in) Offset (in)

Left	.247	
Middle N/A	N/A	
Right	.251	



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.616	4.863
Right	4.628	4.879

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi

    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH-J8024, 0-300psi @ 10psi subdivisions

    c) Temp. Model No. FENWALL 46-007160-004 Range 0-120°C
    Smallest Subdivision 1°C °F

11. Dial indicators: Left Model No. N/A
    Middle Model No. 99823 SEARS
    Right Model No. 11347 SEARS

REV	BY	DATE	CHECKED	DATE
0	SLW	4/26/85	WJ	4/26/85

Yankee Atomic Electric Co.
Yankee Atomic Plant
IMPELL CORPORATION
JOB NO 0570-035-2551
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REV	BY	DATE	CHECKED	DATE
0	SLW	4/26/85	WG	4/26/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO. 0570-035-2551
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Date 4/26/85
Test No. 11

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient - 70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	10:32	0		.900	0	0	0		NO WATER	
1		0		.918	+.062	+.023	30	22°C	NO WATER	
2	10:36	1		.920	+.068	+.025	30		0	
3	10:38	10		.640	+.037	.886	30	23°C	0	
4		N/C	10:40	.635	+.039	.866	N/C			
5	10:41	15		.502	.905	.754	30	23°C	0	
6	10:42	20		.453	.826	.669	30	24°C	0	
7	10:43	30		.352	.669	.569	30	23°C	100 ml/33 (s)	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

Date 4/26/85
Test No. 11

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8		29.4	10:48	N/C	.666	.553	N/C			
9	10:49	40		.223	.572	.492	N/C	24°C	0	
10	10:51	50		N/A	.471	.390			0	
11	10:56	60		N/A	N/A	N/A	30 → 0			PARTIAL PUSH THRU
12	11:00	90		N/A	N/A	N/A	0		STILL NO OR LITTLE UNROUGHENED LEAKAGE	LOST PRESS DUE TO PARTIAL PUSH THROUGH

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV 0 | BY SLW | DATE 4/26/85 | CHECKED WJ | DATE 4/26/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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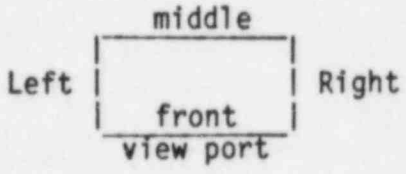
INITIAL DATA SHEET
Presray Seal Test

1. Date 4/26/85
2. Test No. 12
3. Seal I.D. 4
4. Nominal Gap Width (in) 1 3/16
   Offset (in) 1/4
5. Bladder Pressure (psi) 50
6. Cavity Temperature (°F) 70
7. Installation (lub/unlub) UNLUB Method N/A
8. Gap Width (in) Offset (in)

Left	1 3/16	.247
Middle	N/A	N/A
Right	1 3/16	.251



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.616	4.863
Right	4.628	4.879

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi
    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH -J8024, 0-300 psi & 10 psi subdivisions
    c) Temp. Model No. FENWALL 58-033160-404 Range 0-1200°C
    Smallest Subdivision 1°C °F
11. Dial indicators: Left Model No. N/A
    Middle Model No. 99828 SEARS
    Right Model No. 11397 SEARS

					Yankee Atomic Electric Co.	
					Yankee Atomic Plant	
0	SLW	4/26/85	MJ	4/30/85	IMPELL CORPORATION	JOB NO 0570-035-2551 / CALC NO 0570-035-01 / PAGE 48 OF 70
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REV	BY	DATE	CHECKED	DATE
0	SLW	4/26/85	[illegible]	4/26/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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OF 70

Date 4/26/85
Test No. 12

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient 74°F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	12:56	0		.800	.900	.900	0		N/M	
1	12:59	0		.884	.027	.946	50		N/M	PRESS. SURGE
2	1:03	0		.800	.900	.900	0		N/M	RESTART
3	1:04	0		.853	.039	.938	50		N/M	
4	1:07	5		.800	.037	.885	50		0	
5	1:09	10		N/A	.961	.80	50	25°C	0	
6	1:10	15		.595	.996	N/A			0	
7	1:12	20	1:13	.545	.792	.611	50	29°C	drips	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/26/85	WF	4/26/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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Date 4/26/85
Test No. 12

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient 24°C °F

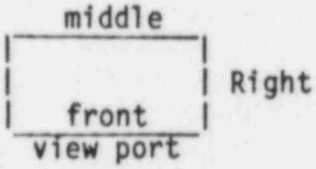
1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8		N/C	1:17	N/C	N/C	N/C	50	N/C		
9	1:17	25		.530	.750	.591	50	25°C	STEADY INSIGNIFICANT STREAM TO SKIRT	
10		N/C	1:20	N/C	N/C	N/C	50	N/C		
11	1:20	30		.500	.700	.563	50	25°C	drops	
12	1:21	40		.435	.638	.538	50		0	
13	1:23	50		.331	.569	.491	50		0	
14	1:25	60		.182	.470	.359	50	25°C	0	5% MARSH
15	1:27	65								1:29 START TO GO

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/23/85
2. Test No. 13
3. Seal I.D. 2
4. Nominal Gap Width (in) 15/16
   Offset (in) 0
5. Bladder Pressure (psi) 0
6. Cavity Temperature (°F) 150
7. Installation (lub/unlub) unlub Method N/A
8. Gap Width (in) Offset (in)

Left	.939	.018
Middle	N/A	N/A
Right	.926	.008



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.750"	4.768"
Right	4.750'	4.758"

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi
    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH - J 8029, 0-300 psi @ 10 psi subdivisions
    c) Temp. Model No. FENWALL 55-033-60-409 Range 0-1200°C
    Smallest Subdivision 1°C °F
11. Dial indicators: Left Model No. N/A
    Middle Model No. 99023 SEARS
    Right Model No. 11347 SEARS

REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WJ	4/23/85

Yankee Atomic Electric Co.
Yankee Atomic Plant
IMPELL CORPORATION
JOB NO 0570-035-2551
CALC NO 0570-035-01
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Date 7/23/85
Test No. 13

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0		0		N/A	0	0	0	64°C		TO MUCH LEAKAGE TO MEASURE
1	3:00	5		N/A	.889	.956	0	67°C	200 ml/29(s)	SEATED
2	3:04	10		N/A	.853	.859	0	69°C	0	
3	3:06	15		N/A	.829	.837	0	68°C	0	
4		15	3:09	N/A	N/C	N/C	0	67°C	0	
5	3:10	20		N/A	.804	.814	0	67°C	0	
6	3:11	30		N/A	.744	.759	0	67°C	0	
7	3:11	40		N/A	.686	.680	0	66°C	0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	7/23/85	WJ	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2561
CALC NO 0570-035-01

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REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WF	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-25521

CALC NO 0570-035-01

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Date 4/23/85
Test No. 13

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8	3:12	50		N/A	.588	.558	0	66°C	0	
9	3:13	60		N/A	~.35	.340	0	67°C	0	
10		60	3:17	N/A	N/A	.323	0	67°C	0	
11	3:18	68		N/A	N/A	.299	0		0	SWITCH TO MARSH GAUGE
12	3:20	78		N/A	N/A	.218	0	66°C	0	
13	3:20	88		N/A	N/A	.163	0		0	
14	3:21	98		N/A	N/A	.109	0	66°C	0	
15	3:22	108		N/A	N/A	.076	0	65°C	0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   L = at left end of seal (see diagram on initial data sheet)
   M = at middle of seal (see diagram on initial data sheet)
   R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLL	4/23/85	WJ	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

PAGE 5 OF 70

Date 4/23/85
Test No. 13

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
16	3:23	118		N/A	N/A	.075	0		0	
17	3:23	129		N/A	N/A	.057	0	69°C	0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   L = at left end of seal (see diagram on initial data sheet)
   M = at middle of seal (see diagram on initial data sheet)
   R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/23/85

2. Test No. 14

3. Seal I.D. Z

4. Nominal Gap Width (in) 15/16

   Offset (in) 0

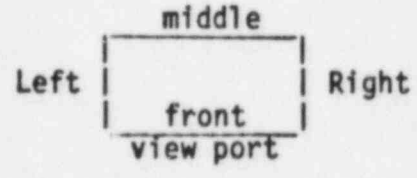
5. Bladder Pressure (psi) 30

6. Cavity Temperature (°F) 150

7. Installation (lub/unlub) unlub Method N/A

8. Gap Width (in) Offset (in)

Left	.939	.018
Middle	N/A	N/A
Right	.926	.008



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.750"	4.768"
Right	4.750"	4.759"

ASHCROFT

10. Gauges a) Air Model No. Q-107 Range 0-60
    Smallest subdivision .5 psi

    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH-J8024, 0-300 psi @ 10 psi subdivisions

    c) Temp. Model No. FENWALL 58-003-602-A04 Range 0-1200°C
    Smallest Subdivision 1°C °F

11. Dial indicators: Left Model No. N/A
    Middle Model No. 99923 SEARS
    Right Model No. 11347 SEARS

					Yankee Atomic Electric Co.	
					Yankee Atomic Plant	
0	SLW	4/23/85	WJ	4/23/85	IMPELL CORPORATION	JOB NO 0570-075-2551
REV	BY	DATE	CHECKED	DATE		CALC NO 0570-035-01

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PEV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WF	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-25551
CALC NO 0570-035-01

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TEST DATA SHEET
Presray Seal Test

Date 4/23/85
Test No. 14

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	2:09	0		N/A	0	0	0	64°C		
1	2:10	0		N/A	+.027	+.016	30		0	
2	2:11	5		N/A	+.016	-.975	30	69°C	0	
3	2:13	10		N/A	-.999	-.899	30	62°C	0	
4	2:15	20		N/A	-.873	-.850	30	60°C	~60 dpm	
5		20	2:18	N/A	N/C	N/C	30	61°C	~100 dpm	
6		N/C	2:19	N/A	N/C	N/C	N/C	N/C	N/C	
7	2:20	30		N/A	-.828	-.812	30	62°C	0	ALL LEAKS STOPPED

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WT	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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Date 4/23/85
Test No. 14

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8	2:20	40		N/A	.785	.776	30	62°C	0	
9		40	2:22		N/C	.774	30	63°C	0	
10	2:23	50			.750	.725	30	64°C	0	
11	2:24	60			.703	.665	30	69°C	N/C	SWITCH TO MARSH GAUGE
12		N/C	2:27		.698	.658	N/C	69°C	N/C	
13		N/C	2:29		N/C	N/C	N/C	69°C	N/C	
14	2:30	68			.641	.570	30	69°C	0	
15	2:32	78		↓	.595	.432	30	69°C	0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WJ	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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Date 4/23/85
Test No. 14

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
16	2:34	88		N/A	~.35	.228	30	62°C		Lost Middle Probe
17		N/C	2:36	↓	N/A	N/C	N/C	62°C	0	
18	2:37	98		↓	↓	.195	N/C	61°C	0	
19	2:38	108		↓	↓	.147	N/C	60°C	0	
20	2:40	118		↓	↓	.107	N/C	58°C	0	
21	2:41	130		↓	↓	.063	30	58°C	0	3/8 Extrusion
22		N/C	2:49	↓	↓	.048	N/C	N/C		
23		N/C	2:46	↓	↓	N/C	N/C	N/C		

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WJ	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-025-2551
CALC NO 0570-055-01

PAGES 1 OF 10

Date 4/23/85
Test No. 14

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
24	2:47	N/C		N/A	N/A	N/C	0	58°C		SUDDEN PRESSURE LOSS

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/23/85

2. Test No. 15

3. Seal I.D. 2

4. Nominal Gap Width (in) 15/16

   Offset (in) 0

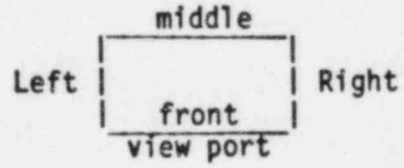
5. Bladder Pressure (psi) 50

6. Cavity Temperature (°F) 150

7. Installation (lub/unlub) unlub Method N/A

8. Gap Width (in) Offset (in)

	Gap Width (in)	Offset (in)
Left	.939	.018
Middle	N/A	N/A
Right	.926	.009



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.750	4.768
Right	4.750	4.758

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi

    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH-J8629, 0-300psi @ 10psi subdivisions

    c) Temp. Model No. FENWALL 55-033160-A04 Range 0-1200°C
    Smallest Subdivision 1°C °F

11. Dial indicators: Left Model No. N/A
    Middle Model No. 99823 SEARS
    Right Model No. 11347 SEARS

REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	[illegible]	4/23/85

Yankee Atomic Electric Co.
Yankee Atomic Plant

IMPELL CORPORATION

JOB NO 0570-035-2551
CALC NO 0570-035-01

REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WJ	4/25/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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Date 4/23/85
Test No. 15

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	3:34	0		N/A	0	0	5	68°C		
1	3:35	1			+.038	+.010	50		0	
2	3:36	5			N/C	.000	50	68°C	0	
3	3:36	10			+.025	-.968	56	68°C		
4		10	3:39		N/C	N/C	50			
5	3:40	15			+.007	-.935	50	68°C	0	
6	3:41	20			-.970	-.910	50	68°C	0	
7	3:41	30		↓	-.919	-.868	50	68°C	0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WJ	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551

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Date 4/23/85
Test No. 15

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8	3:42	40		N/A	.855	.815	50	68°C	0	
9	3:43	50			.819	.777	50	68°C	0	
10	3:44	60			.779	.728	50	68°C	0	
11	3:45	68			.727	.668	50	68°C	0	SWITCHED TO MARSH GAUGE
12	3:46	78			.678	.565	50	68°C	0	1/8" EXTRUSION
13		N/C	3:48		.671	.548	50		0	
14		78	3:50		N/C	N/C	50	68°C		
15	3:51	88		↓	.618	N/A	50			LOST RIGHT PROBE

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/23/85	WF	4/23/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

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CALC NO 0570-035-01

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Date 4/23/85
Test No. 15

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
16		88	3:52	N/A	.575	N/A	50	68°C		
17	3:53	98		↓	.490	N/A	50	N/C		BLADDER BLEW AFTER READING
18		N/C	3:56	↓	N/A	N/A	0			EXTRUDED 1"+
19	3:57	130		↓	N/A	N/A	0	65°C	0	EXTRUDED TIL FLANGE EDGES EVEN WITH TOP SIDE OF ALUMINUM FLANGES

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/29/85

2. Test No. 16

3. Seal I.D. 3

4. Nominal Gap Width (in) 15/16

   Offset (in) 0

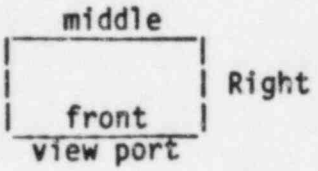
5. Bladder Pressure (psi) 30

6. Cavity Temperature (°F) 70

7. Installation (lub/unlub) lub Method grease

8. Gap Width (in) Offset (in)

Left	.954	.025
Middle	N/A	N/A
Right	.976	.128



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.772	4.797
Right	4.759	4.887

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi

    b) Water Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .2 psi
    MARSH-J 8024, 0-300 psi @ 10 psi subdivisions

    c) Temp. Model No. FENWALL 55-033160-404 Range 0-1200°C
    Smallest Subdivision 1°C → °F

11. Dial indicators: Left Model No. N/A
    Middle Model No. 99823 SEARS
    Right Model No. 11347 SEARS

REV	BY	DATE	CHECKED	DATE
0	SLW	4/29/85	WH	4/29/85

Yankee Atomic Electric Co.
Yankee Atomic Plant

IMPELL CORPORATION

JOB NO 0570-075-2551
CALC NO 0570-075-01

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REV	BY	DATE	CHECKED	DATE
0	SLW	4/29/85	WJ	4/29/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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TEST DATA SHEET
Presray Seal Test

Date 4/29/85
Test No. 16 GREASED WITH DOW CORNING 4 COMPOUND (HIGH TEMP. SERVICE SILICONE GREASE)

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	1:58	N/W		N/A	.000*	900	0	N/W	N/W	
1	1:59	N/W			.009*	.912	30	N/W	N/W	
2	2:01	5			.790	.879	30	24°C	0	
3	2:04	10			.754	.809	30	24°C	0	
4			2:08		N/C	.805	30	24°C		
5			2:12		N/C	N/C	30	24°C		
6	2:12	15			.727	.762			0	DEPS FROM AROUND THE END
7	2:14	20			.713	.731				PROB HIT BOTTOM

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

* - QUESTIONABLE

REV	BY	DATE	CHECKED	DATE
0	SLW	4/29/85	WJ	4/29/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-075-2551

CALC NO 0570-075-01

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Date 4/29/85
Test No. 16

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements L	5. Displacements M (in.)	5. Displacements R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
8	2:16	30		N/A	.655	.748*	30	24°C	0	
9	2:16	40	2:17	N/A	.676	.723				
10	2:18	50		N/A	.630	.695	30	25°C	0	
11			2:21		N/C	.693				
12			2:24		N/C	N/C				
13			2:27		N/C	.691		25°C	0	
14	2:29	60			.594	.665	30			SEE MARSH
15	2:30	68			.563	.639				MARSH

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/29/85	WJ	4/29/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551

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Date 4/29/85
Test No. 16

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
16	2:32	78		N/A	.511	.611	30	25C	0	
17	2:33	88			.439	.570	30	25C		
18		N/C	2:35		.385	.552	N/C	N/C		
19		N/C	2:37		.369	N/C	N/C	N/C		
20	2:39	98			~.2	.375	30	25C	0	Y-M Y-L+R
21	2:41	108			N/A	.314	30	25°C	0	
22	2:42	118				.250	30		0	
23	2:43	124		↓	↓	.165	30	25C	0	

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

REV	BY	DATE	CHECKED	DATE
0	SLW	4/29/85	WJ	4/29/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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Date 4/29/85
Test No. 16

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ~70 °F

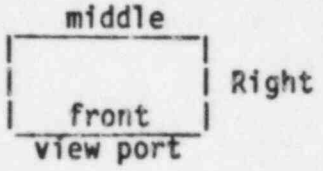
1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
24		N/C	2:45	N/A	N/A	.153	30	25°C		
25		N/C	2:48	N/A	N/A	.128	30	25°C	0	PRESS. VERIFIED 129 psi

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

INITIAL DATA SHEET
Presray Seal Test

1. Date 4/29/85
2. Test No. 17
3. Seal I.D. 3
4. Nominal Gap Width (in) 15/16
   Offset (in) 0
5. Bladder Pressure (psi) 30
6. Cavity Temperature (°F) 70
7. Installation (lub/unlub) unlub Method N/A
8. Gap Width (in) Offset (in)

Left	.954	.025
Middle	N/A	N/A
Right	.976	.128



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	4.772	4.797
Right	4.759	4.857

10. Gauges a) Air Model No. ASHCROFT Q-107 Range 0-60
    Smallest subdivision .5 psi
    b) Water Model No. ASHCROFT Q-103 Range 0-60
    Smallest subdivision .2 psi
    MARSH-J3024, 0-30 psi @ 10 psi subdivisions
    c) Temp. Model No. FENWALL 55-303160-404 Range 0-1200°C
    Smallest Subdivision 1°C °F
11. Dial indicators: Left Model No. N/A
    Middle Model No. 99823 SEARS
    Right Model No. 11347 SEARS

					Yankee Atomic Electric Co.
					Yankee Atomic Plant
					JOB NO 0570-075-2551 PAGE 69
0	SLW	4/29/85	WJ	4/29/85	CALC NO 0570-075-01 OF 70
REV	BY	DATE	CHECKED	DATE	IMPELL CORPORATION

REV	BY	DATE	CHECKED	DATE
0	SLLS	4/29/85	WJ	4/30/85

IMPELL CORPORATION

Yankee Atomic Electric Co.
Yankee Atomic Plant

JOB NO 0570-035-2551
CALC NO 0570-035-01

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5/8" (L) to 3/4" (R) ABOVE FULLY INSTALLED

Date 4/29/85
Test No. 17

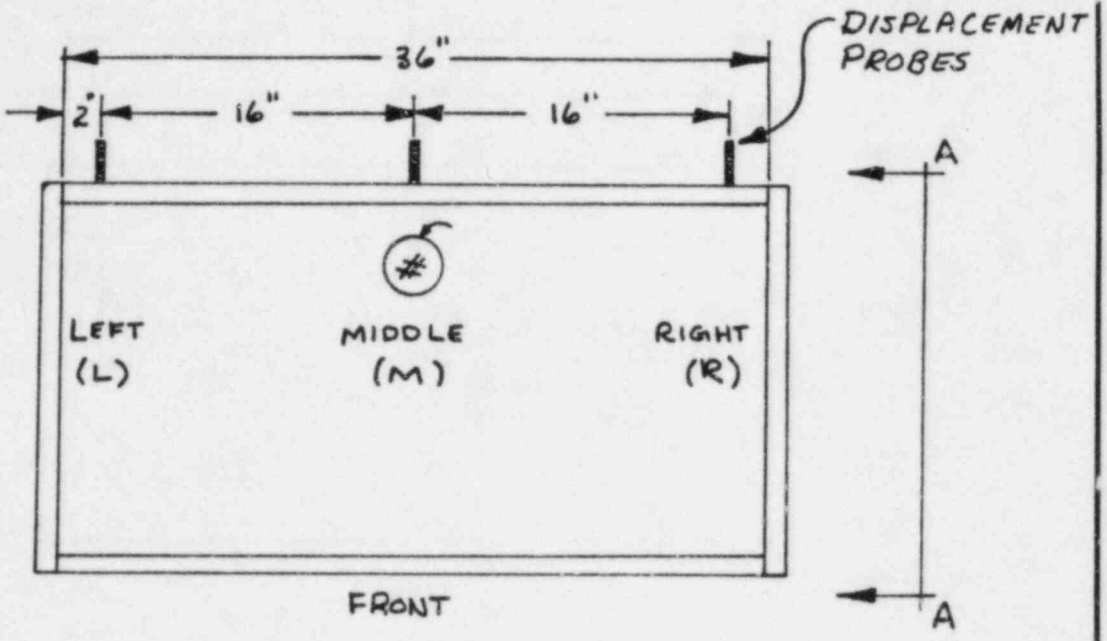
TEST DATA SHEET
Presray Seal Test

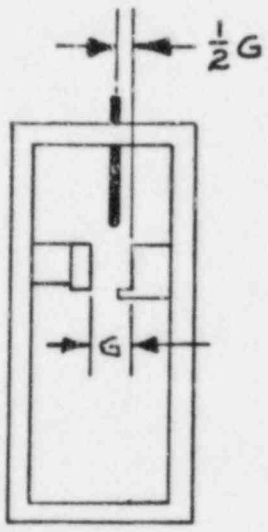
Temperatures at test completion:
Ambient ~70 °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments
0	1:15	N/W		N/A	.900	.900	5		N/W	NOT SEATED
1	1:17	N/W			.925	.921	30		N/W	
2	1:23	5			.925	.920	30	23°C	0	
3	1:24	10			.906	.840	30	N/C		
4	1:25	13			.904	.236	30		0	RIGHT END SEATED AT 13 PSI (MIDDLE STILL UP) LEFT END SEATED SHORTLY THEREAFTER
5	1:27	15	1:29		.763	.159	30	23°C	0	MIDDLE CREEPING TO SEAT SLOWLY
6	1:32	17	1:32		SUDDEN DISPL .478	.107	30	24°C	0	MIDDLE CREPT DOWN (STARTED)
7	1:35	20			SUDDEN DISPL .189	.078				MIDDLE CREPT MORE AND SEATED

DISPL LIGHTS NOT WORKING

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations





NOTE:
NOT TO SCALE

SECTION A-A

DISPLACEMENT PROBE LOCATIONS

					YANKEE Atomic Electric Co Yankee Nuclear Power Station	
					JOB NO 0570-035-2551	PAGE 1
0	mf.	4/18/85			CALC NO	OF 1
REV	BY	DATE	CHECKED	DATE	IMPELL CORPORATION	

APPENDIX C

	No. of Pages
Instrumentation Identification	1
Calibration Certificates	9

INSTRUMENT IDENTIFICATION

INSTRUMENT	FUNCTION	MFG.	SIZE	SMALLEST DIAL SUBDIVISION	RANGE
GAUGE	AIR PRESSURE	ASHCROFT Model 1279AS1/4L Q-107	4 1/2"DIAL	.5 PSI	0-60 PSI
GAUGE	WATER PRESSURE	ASHCROFT Model 1082 1/4L Q-103	4 1/2"DIAL	.2 PSI	0-60 PSI
GAUGE	WATER PRESSURE	MARSH Model J8024	3 1/2"DIAL	10 PSI	30-0-300PSI
DIAL INDICATOR	DISPLACEMENT	SEARS 99823	1"DIAL	.001IN.	1 IN TRAVEL
DIAL INDICATOR	DISPLACEMENT	SEARS 11347	1"DIAL	.001IN.	1 IN TRAVEL
VERNIER CALIPER	DISTANCE	SEARS		.001 IN.	6" ID or OD
THERMOMETER	AIR TEMPERATURE		6"	2°F	-30- +212°F
THERMOMETER	WATER TEMP.	FENWALL		1°C	0-+1200°C

IMPELL CORPORATION

JAY INSTRUMENT AND SPECIALTY CO.

2999 Pacific Drive, Suite E
Norcross, GA 30071
(404) 449-4400
GA Wats: (800) 282-9879
Outside GA Wats: (800) 241-5808

Sales | Engineering | Repair Service

DATE 1/30/85

IMPELL CORP.

333 RESEARCH CT.
TECHNOLOGY CT.
ATLANTA GA.

tlemen:

following instrument (right hand column) has been compared with standards ceable to N.B.S. If no deviation shows, instrument is within manufactured erance at points indicated. Deviation greater than manufactured tolerance l show if error occurs in areas of span where it cannot be corrected.

STANDARD

Dead Wht. Tester

Instrument Certified:

① 4½" 1082/42. 0/60#

Mfg. Tol.

t. Date

O-PSI	O-PSIG
0 #	0 #
10 #	10 #
20 #	20 #
30 #	30 #
40 #	40 #
50 #	50 #
60 #	60 #

y truly yours,

Instrument & Specialty Company

Certification Ref. No.

Y8844

trument Shop Superviser

Certified By: Bob Dent

Q103

JAY INSTRUMENT AND SPECIALTY CO. ATL. GA.

2999 Pacific Drive, Suite E
Norcross, GA 30071
(404) 449-4400
GA Wats: (800) 282-9879
Outside GA Wats: (800) 241-5808

Sales Engineering Repair Service

DATE 5/21/85

D: Impell Corp.
333 Research Court
Technology Park
ntlemen: Norcross, GA. 30092

e following instrument (right hand column) has been compared with standards aceable to N.B.S. If no deviation shows, instrument is within manufactured erance at points indicated. Deviation greater than manufactured tolerance l show if error occurs in areas of span where it cannot be corrected.

STANDARD

Dead Wht. Tester

Instrument Certified:
① 4½" 1082-1/4 L
0-60 PSI
GAUGE Q103

Mfg. Tol.

rt. Date

O-PSI	O-PSIG
0 #	0 #
10 #	10 #
20 #	20 #
30 #	30 #
40 #	40 #
50 #	50 #
60 #	60 #

y truly yours,

Instrument & Specialty Company
8-5-1597

Certification Ref. No.
3497

trument Shop Superviser

Certified By: Bob Austo

Q103

JAY INSTRUMENT AND SPECIALTY CO.

2999 Pacific Drive, Suite E
Norcross, GA 30071
(404) 449-4400
GA Wats: (800) 282-9879
Outside GA Wats: (800) 241-5808

Sales | Engineering | Repair Service

DATE 1/30/85

IMPELL CORP

333 RESEARCH CT.
TECHNOLOGY PARK
ATLANTA GA.

ntlemen:

e following instrument (right hand column) has been compared with standards aceable to N.B.S. If no deviation shows, instrument is within manufactured lerance at points indicated. Deviation greater than manufactured tolerance il show if error occurs in areas of span where it cannot be corrected.

STANDARD

Dead Wht. Tester

Instrument Certified:

(1) 4½" 1279AS¼L 0/60#

Mfg. Tol.

rt. Date

0-PSI	0-PSIG
0 #	0 #
10 #	10 #
20 #	20 #
30 #	30 #
40 #	40 #
50 #	50 #
60 #	60 #

y truly yours,

Instrument & Specialty Company

Certification Ref. No.

18844

trument Shop Superviser

Certified By: Bob Hunter

Q107

JAY INSTRUMENT AND SPECIALTY CO.
ATL. GA.

2999 Pacific Drive, Suite E
Norcross, GA 30071
(404) 449-4400
GA Wats: (800) 282-9879
Outside GA Wats: (800) 241-5808

Sales Engineering Repair Service

DATE 5/21/85

: Impell Corp.
333 Research Court
Technology Park
ntlemen: Norcross, GA. 30092

e following instrument (right hand column) has been compared with standards aceable to N.B.S. If no deviation shows, instrument is within manufactured lerance at points indicated. Deviation greater than manufactured tolerance l show if error occurs in areas of span where it cannot be corrected.

STANDARD

Dead Wht. Tester

Instrument Certified:
① 4½" 1279A ¼ L
0-60 PSI
Gauge-Q107

Mfg. Tol.

t. Date

0-PSI		0-PSIG
0 #		0 #
10 #		10 #
20 #		20 #
30 #		30 #
40 #		40 #
50 #		50 #
60 #		60 #

truly yours,

Instrument & Specialty Company
S-1597

Certification Ref. No.
3497

Q-107

rument Shop Supervisor

JAY INSTRUMENT
AND SPECIALTY CO.

2999 Pacific Drive, Suite E
Norcross, GA 30071
(404) 449-4400
GA Wats: (800) 282-9879
Outside GA Wats: (800) 241-5808

Sales Engineering Repair Service

DATE 1/31/85

D: IMPELL CORP.

333 RESEARCH CT.
TECHNOLOGY PARK
ATLANTA GA.

ntlemen:

e following instrument (right hand column) has been compared with standards aceable to N.B.S. If no deviation shows, instrument is within manufactured lerance at points indicated. Deviation greater than manufactured tolerance ll show if error occurs in areas of span where it cannot be corrected.

STANDARD

Dead Wht. Tester

Instrument Certified:

(1) 3½"A" 1/4 L 300#/Vac
MARSH GAUGE

Mfg. Tol.

rt. Date

O-PSI	O-PSIG
0	0
20	20
40	40
62	60
82	80
102	100
122	120
150	150
200	200
250	250
300	300

y truly yours,

Instrument & Specialty Company

Certification Ref. No.

18814

trument Shop Superviser

Certified By: Bob Bond

MARSH

JAY INSTRUMENT AND SPECIALTY CO.
ATL. GA.

2999 Pacific Drive, Suite E
Norcross, GA 30071
(404) 449-4400
GA Wats: (800) 282-9879
Outside GA Wats: (800) 241-5808

Sales | Engineering | Repair Service

DATE 5/21/85

: Impell Corp.
333 Research Court
Technology Park
ntlemen: Norcross, GA. 30092

e following instrument (right hand column) has been compared with standards aceable to N.B.S. If no deviation shows, instrument is within manufactured lerance at points indicated. Deviation greater than manufactured tolerance ll show if error occurs in areas of span where it cannot be corrected.

STANDARD

Dead Wht. Tester

Instrument Certified:

① 3½" 1/4 Low
300#/V2c 0-2100 KPA
GAUGE

Mfg. Tol.

t. Date

0-PSI	0-PSIG
0 #	0 #
50 #	50 #
100 #	100 #
150 #	150 #
200 #	200 #
250 #	250 #
300 #	300 #

y truly yours,

Instrument & Specialty Company

-5-1597

Certification Ref. No.

3497

rument Shop Superviser

Certified By: Bob Marsh

MARSH

DISPLACEMENT MEASUREMENT DEVICE

ACCURACY VERIFICATION

The following displacement measuring device has been compared to a device which has been calibrated to standards traceable to N.B.S.

Instrument Compared:	Instrument Verified:
DAPRA GAGE BLOCKS	SEARS 1" Travel Dial
SN 52492, ACC grade 2	Indicator Gauge
DAPRA Corp Bloomfield Conn	SN 99823

Travel: 1"

Accuracy: .0025

Witnessed by/date: (1) Dennis M. Drake QAM

(2) W LaCrosse 7/15/85

IMPELL CORPORATION

DISPLACEMENT MEASUREMENT DEVICE

ACCURACY VERIFICATION

The following displacement measuring device has been compared to a device which has been calibrated to standards traceable to N.B.S.

Instrument Compared:	Instrument Verified:
DAPRA Gage Blocks	SEARS 1" Travel Dial
SN* 52492 ACC Grade 2	Indicator Gauge
DAPRA Corp - Bloomfield Conn.	SN 11397

Travel: 1"

Accuracy: .0025"

Witnessed by/date: (1) Dennis M. Drake QAM

(2) W.F. Crosse 7/15/85

IMPELL CORPORATION

TEMPERATURE MEASUREMENT DEVICE

ACCURACY VERIFICATION

The following temperature measuring device has been compared to a device which has been calibrated to standards traceable to N.B.S.

Instrument Compared:		Instrument Verified:	
Taylor Instrument		Fenwall	
Consumer/Scientific Div.		CAT. NO. 55-003160-409	
Arden N.C. (Merc. Thermometer)		MANUFACTURING NO. 605-0155	
	Thermometer No.	Date Cal.	
51°F	9M2624	10-16-80	10°C
90°F	9M2624	10-16-80	32°C
100°F	9M6638	10-16-80	37°C
122°F	9M6771	10-16-80	50°C
150°F	9M4763	10-16-80	65°C
200°F	9M4760	10-16-80	93-94°C

Witnessed by/date: (1) Scott L Wieland 5-17-85

(2) J. C. [illegible] 5-17-85

IMPELL CORPORATION

APPENDIX D

	No. of Pages
Correspondence	6

YANKEE ATOMIC ELECTRIC COMPANY

Telephone (617) 872-8100
TWX 710-380-7619

1671 Worcester Road, Framingham, Massachusetts 01701

March 14, 1985
YRP 263/85
DCC YR 85-070
W.O. 3913

Impell Corporation
333 Research Court
Technology Park/Atlanta
Norcross, GA 30092

Attention: Mr. Wills LaCrosse

Subject: Yankee Plant Cavity Seal Ring

Reference: Drawing No. 9699-FV-5A

Dear Wills:

Pursuant to our telephone conversation. I have enclosed the referenced drawing which details the Yankee cavity seal ring configuration.

If you have any questions, please feel free to call.

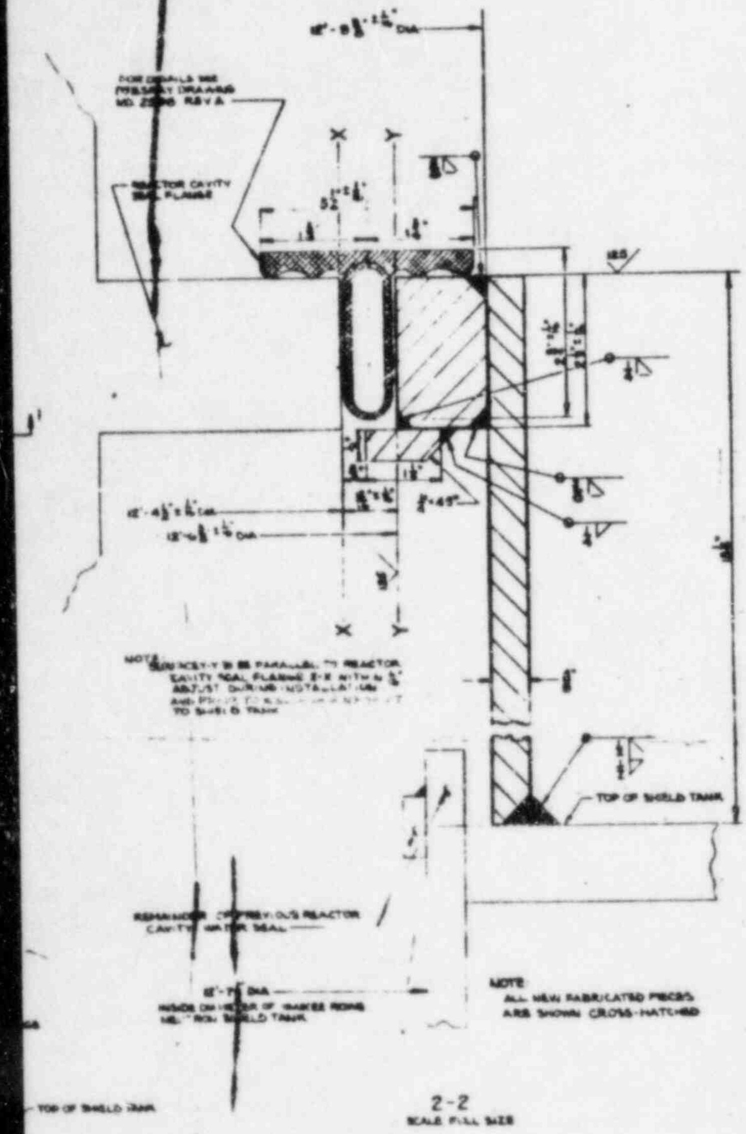
Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

R. G. Carter
Engineer
Yankee Project

RGC/ba

Enclosure



NOTE:
ALL NEW FABRICATED PIECES ARE SHOWN CROSS-HATCHED

2-2
SCALE FULL SIZE

GENERAL:
THIS SPECIFICATION COVERS THE FURNISHING OF ALL LABOR, MATERIALS AND EQUIPMENT NECESSARY TO FABRICATE A RING WITH SKIRT FOR A REPLACING CAVITY WATER SEAL FOR THE YANKEE ATOMIC ELECTRIC COMPANY.
THE RING WITH SKIRT SHALL BE FABRICATED AS SHOWN ON THIS DWG.

STANDARDS:
THE LETTERS "ASME" SHALL HEREAFTER REFER TO THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, AND THE ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII.
THE LETTERS "ASTM" SHALL HEREAFTER REFER TO THE AMERICAN SOCIETY FOR TESTING MATERIAL.

MATERIAL:
ALL MATERIAL SHALL BE NEW AND CONFORM TO THE ASTM OR AISI DESIGNATIONS SPECIFIED ON THE [illegible]
THE MATERIAL FOR THE RING AND SKIRT SHALL CONFORM TO ASTM [illegible].
THE MATERIAL FOR THE INFLATABLE CAVITY SEAL SHALL CONFORM TO EPDM COMPOUND NO. [illegible] NYLON REINFORCED, WITH A SHORE HARDNESS OF [illegible].
THE REACTOR CAVITY SEAL SHALL CONFORM TO PRESRAY DRAWING NO. [illegible], REV. A. THE SEAL SHALL BE EXTRUDED AND MOLDED.

WELDING:
THE WELDMENT SHALL BE FABRICATED AND SHIPPED IN ONE PIECE.
ALL WELDING SHALL CONFORM TO THE REQUIREMENTS OF THE LATEST EDITION OF SECTION IX WELDING QUALIFICATIONS AND SECTION VIII OF THE ASME BOILER & PRESSURE VESSEL CODE AND SHALL BE PERFORMED IN ACCORDANCE WITH THE SELLER'S WELDING PROCEDURE AS APPROVED BY THE ENGINEERS. THE QUALIFICATION OF THE WELDING PROCEDURE AND THE WELDING OPERATOR SHALL BE IN ACCORDANCE WITH THE CODE.
VISUAL INSPECTION SHALL BE PERFORMED BY THE SELLER'S INSPECTOR AND SHALL INCLUDE CHECKING FOR FLAWS OR OTHER DEFECTS DURING WELDING. PRIOR TO WELDING, IT SHALL INCLUDE THE EXAMINATION OF WELD GROOVE PREPARATION. DEFECTS IN WELDS SHALL BE REMOVED BY CHIPPING OR GRINDING UNTIL SOUND METAL IS REACHED. THE RESULTING CAVITY SHALL BE REWELDED, EMPLOYING AN APPROVED PROCEDURE.
ALL WELDS SHALL BE CHECKED EITHER BY THE DRY POWDER MAGNETIC INSPECTION TEST IN ACCORDANCE WITH ASTM E 109 OR THE LIQUID PENETRANT INSPECTION TEST IN ACCORDANCE WITH ASTM E 165. THE ROOT PASS OF EACH WELD AND ALL INTERMEDIATE WELD DEPTHS IN INCREMENTS OF ONE-THIRD DEPTH AND TWO-THIRDS DEPTH UP TO THE FINAL PASS SHALL BE CHECKED.

INSPECTION AND TOLERANCES:
THE SELLER SHALL PROVIDE MEASURING DEVICES AND OTHER FACILITIES TO MEASURE THE DIMENSIONS OF THE WATER SEAL UNIT WITHIN THE SPECIFIED TOLERANCES.
THE GENERAL TOLERANCE, IF NOT OTHERWISE SPECIFIED, SHALL BE:

DIMENSIONS, IN.	TOLERANCES, IN.
UNDER 6	[illegible]
6-12	[illegible]
OVER 12	[illegible]

THE SELLER SHALL CHECK ALL DIMENSIONS AND TOLERANCES TO ASSURE THAT THEY MEET SPECIFICATIONS.
THE PURCHASER RESERVES THE RIGHT TO CHECK ALL DIMENSIONS AT THE PLANT BEFORE SHIPMENT.
FINAL INSPECTION AND ACCEPTANCE SHALL BE MADE BY THE PURCHASER AT THE SELLER'S PLANT.
A RECORD OF ALL MEASUREMENTS SHALL BE KEPT BY THE SELLER.
THE UNIT SHALL BE SATISFACTORILY CLEANED WHEN OFFERED FOR INSPECTION.
REMOVE ALL DIRT, DUST, SCALE, OR GREASE.
ALL MATING SURFACES SHALL BE TRUE AND CONCENTRIC.

SAND BLASTING:
AFTER THE HEAT TREATMENT AND MACHINING OF THE UNIT, ALL SURFACES OF THE WELDMENT SHALL BE SAND-BLASTED. THE BLASTED SURFACES SHALL CONFORM TO A "NEAR WHITE BLAST" AS DESCRIBED BY THE STEEL STRUCTURES PAINTING COUNCIL SPECIFICATION NO. [illegible].

PAINTING:
AFTER SANDBLASTING, THE UNIT SHALL BE COATED WITH ONE COAT OF EXTERIOR [illegible] PRIMER NO. [illegible] AS MADE BY KEELER & LONG, INC., OR EQUAL, [illegible] MILS OF COAT THICKNESS.

HEAT TREATMENT:
AFTER WELDING, THE RING WITH SKIRT SHALL BE STRESS RELIEVED AT A TEMPERATURE OF [illegible]

MACHINING:
AFTER HEAT TREATMENT, THE RING WITH SKIRT SHALL BE MACHINED TO A SURFACE FINISH OF [illegible] MICRO-INCHES. FINAL MACHINED DIMENSION OF THE UNIT SHALL CONFORM TO DRAWING.

SHIPPING:
DURING SHIPMENT, SUITABLE PROTECTION AGAINST MOISTURE SHALL BE PROVIDED. ALL MACHINED SURFACES SHALL BE PROTECTED DURING SHIPMENT.

DESIGN, WORKMANSHIP AND MATERIALS:
WARRANTY: THE SELLER WARRANTS THAT THE [illegible] WELDMENT SHALL BE FREE OF DEFECTS IN WORKMANSHIP AND MATERIAL AND SHALL BE SUITABLE FOR ITS INTENDED USE.

INSPECTION REPORTS:
CERTIFIED MATERIAL REPORTS SHALL BE SUBMITTED TO THE ENGINEERS AS SOON AS POSSIBLE AFTER COMPLETION OF INSPECTION.
THE ORIGINAL AND [illegible] COPIES OF ANY OR ALL INSPECTION REPORTS NECESSARY TO FULFILL THE REQUIREMENTS OF THIS ORDER/CONTRACT SHALL BE MAILED TO:

STONE & WEBSTER ENGINEERING CORPORATION
INSPECTION DIVISION
P.O. BOX [illegible]
BOSTON, MASSACHUSETTS [illegible]

REPORTS SHALL BE IDENTIFIED WITH YANKEE ATOMIC ELECTRIC COMPANY PURCHASE ORDER NUMBER, JOB NUMBER, AND EQUIPMENT TITLE [illegible], AS WELL AS SELLER'S NAME AND ADDRESS, IN ORDER TO EXPEDITE ANY REQUIRED COMMUNICATIONS.

INSTALLATION:
THE SEAL RING WITH THE SKIRT WILL BE INSTALLED AND WELDED TO THE SHIELD TANK BY THE YANKEE ATOMIC ELECTRIC COMPANY.
PRIOR TO THE INSTALLATION OF THE MODIFIED SEAL, THE EXISTING WATER SEAL SHALL BE REMOVED BY THE YANKEE ATOMIC ELECTRIC COMPANY.
RECHECK ELEVATION OF YANKEE ATOMIC SHIELD TANK AND REACTOR SEAL FLANGE. IN THE COLD CONDITION THE REACTOR FLANGE AND TOP SURFACE OF THE SEAL RING SHALL BE AT THE SAME ELEVATION, WITHIN [illegible] IS DESIRABLE, HOWEVER, NOT EXCEEDING [illegible] IN.

LEAKAGE RATE TEST:
TEST SHALL BE IN ACCORDANCE WITH PRESRAY SPEC. [illegible] DATED [illegible]. THE TEST SHALL BE CERTIFIED AND WITNESSED BY A STONE & WEBSTER ENGINEERING CORPORATION REPRESENTATIVE.

APPROVED [signature]
REGISTERED PROFESSIONAL ENGINEER
COMMONWEALTH OF MASSACHUSETTS

REACTOR CAVITY
WATER SEAL

POWER STATION
YANKEE ATOMIC ELECTRIC COMPANY
ROWE, MASS.

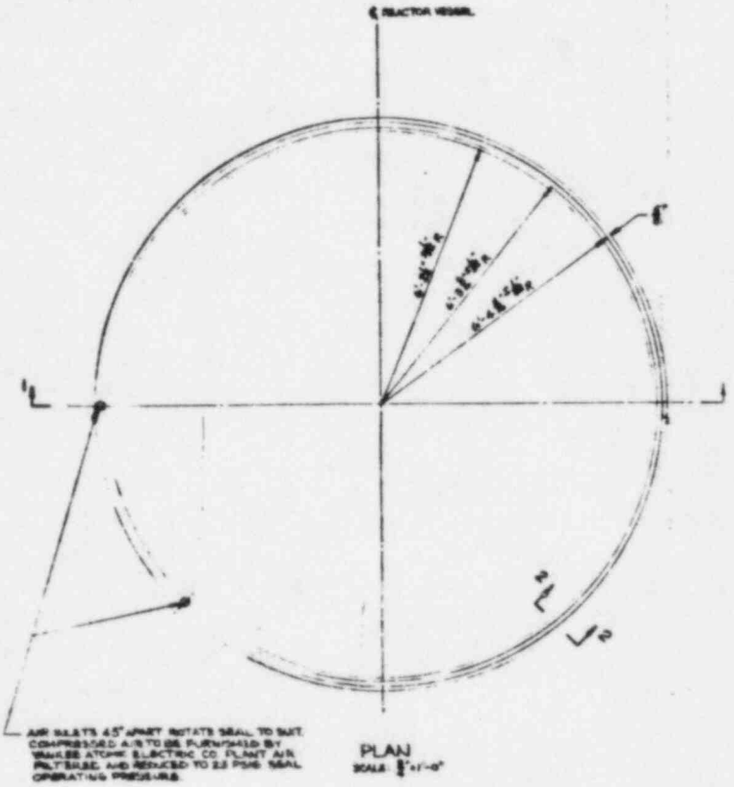
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 9699-FV-5A

ORIGINAL ISSUE

Designed by R. A. FLAHERTY Drawn by R. A. FLAHERTY
Sec. Ch'd by [illegible] Ch'd by [illegible]

9699-FV-54



PLAN
SCALE: 1/4"=1'-0"

I-I
SCALE: 1/4"=1'-0"

IMPELL CORPORATION

Record of Conversation

File: _____

Copy: KNKassam
BMHinton
JMTriompo
SWieland

☒ Telephone ☐ Meeting ☐ Other _____

To: Bob Carter From: Wills LaCrosse WJ

Company: Yankee Atomic Phone No.: 617-872-8100 Date: 4/1/85

Subject: Seal Project

Summary of Conversation:

1. Yankee will send two samples with the air taps plus several plain samples. The air tap seal length will allow placement of the tap 0-6" from an end.

2. Bob requires a Project Schedule ASAP.

3. A gap dimension sheet will be telecopied for their review.

4. Bob indicated a curved section is to be used.

5. A Purchase Order number will be coming by Wednesday or Thursday of this week due to accounting backlogs. Bob has provided verbal authorization to proceed on the project.

6. The design water head is to be 30 ft.

7. Aluminum is an acceptable material for the simulated RPV/Cavity liner surfaces.

WL/dr

IMPELL CORPORATION

Record of Conversation

File: 0570-035

Copy: BMHinton
KNKassam
SLWeiland

☒ Telephone ☐ Meeting ☐ Other

To: Bob Carter From: WLaCrosse WJ.

Company: Yankee Atomic Phone No.: (617) 872-8100 Date: 4/11/85

Subject: Seal Test

Summary of Conversation:

1) The normal water level is 25 feet. We are to revise the test spec. as required.

2) The test matrix is to remain unchanged.

3) An update on the project was given to Bob.

4) Bob has tentatively set his schedule to come down 4/22 to witness several of the tests.

WL/cjl

IMPELL CORPORATION

Record of Conversation

File: 0570-035-2551

Copy: BMHinton
JGilbert(Boston)
KNKassam
SLWeiland

☒ Telephone ☐ Meeting ☐ Other

To: Ted Holinder From: Wills LaCrosse WJ

Company: Presray Corp. Phone No.: Date: 5/2/85

Subject: Yankee Atomic Seal Data

Summary of Conversation:

The Presray seal used at Yankee Atomic is a model PR-2598 made of 60 durometer EPDM Compound E-603.

APPENDIX E

	No. of Pages
Test Specification	10

TEST SPECIFICATION

Experimental Verification
of the
Presray Reactor Cavity Liner Seal
for the
Yankee Atomic Plant

Prepared for:

YANKEE ATOMIC ELECTRIC COMPANY

Prepared by:

Impell Corporation
333 Research Court
Technology Park/Atlanta
Norcross, Georgia 30092

April, 1985

Specification 0570-035-01
Revision 0
0570-035

IMPELL CORPORATION

IMPELL CORPORATION

APPROVAL COVERSHEET

Document Title: Experimental Verification of the Presray Reactor Cavity Liner Seal

Control Number: 0570-035-01

Client Yankee Atomic Electric Company **Job No.** 0570-035-1544

Project Yankee Atomic Plant

Revision Record

Rev. No.	Date	Prepared	Reviewed	Approved
0	4/11/85	Scott L Weiland	Wills Jackson	FWK Lisa M Hinton

RECORD OF REVISION

Rev. No.	Pages Revised, Description of Change
0	
Issued for Use	Page i
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Issued for Use	Page iii
Issued for Use	Page iv
Issued for Use	Page 1-10

TABLE OF CONTENTS

IMPELL

1.0 INTRODUCTION

This test specification delineates requirements necessary to perform experimental verification of the Reactor Pressure Vessel (RPV) - Cavity Liner Seal for the Yankee Atomic Plant. This test is being conducted to satisfy a requirement of NRC I. E. Bulletin 84-03 by demonstrating that the Presray Inc. T-Slot Seal will not undergo gross failure during use in the refueling cavity. Gross failure is interpreted as the pushing through of the seal between the RPV and the refueling cavity liner or incurring a leakage rate above the cavity filling pumps capacity. This bulletin was issued by the NRC as a result of an event that occurred during a recent refueling at Haddam Neck. In particular, the seal between the RPV and the refueling cavity did not retain its integrity during refueling and the cavity drained into the containment. If a fuel assembly had been in the process of removal during the accident it could have been partially or completely uncovered with possible high radiation levels, fuel cladding failure and release of radioactivity. In addition, if the fuel transfer tube had been open, the spent fuel pool could have drained to a level which would have uncovered the top of the fuel.

While certain experimental tests have been performed in conjunction with the Presray Seal, conservatism has been introduced in a number of ways. While conservatism is normally an advantage, in this case, it reduces the accuracy of the test. The test results cannot be used to clearly distinguish the true behavior of the seal for a specified water head and bladder pressure. The testing to be performed in accordance with this specification eliminates excessive conservatism and improves the accuracy of seal testing.

This test specification includes the objectives of the experimental test, general design requirements of the test apparatus and the conditions to be tested. Procedures for setting up the test in addition to the recording test measurements are provided. Precautions are included which need to be considered during testing. Documentation and quality assurance requirements are also provided.

2.0 TEST OBJECTIVE

The objective of this test is to evaluate the integrity of the Presray Inc. T-Slot Seal in terms of:

1. Failure limit/factor of safety.
2. Push through resistance/water pressure vs. seal displacement.
3. Bladder pressure effects/worst case determination.
4. Leakage rate vs. other parameters.
5. Temperature effects.
6. Creep determination.
7. Gap width/height offset effects.

The seal will be tested at an equivalent refueling cavity water depth of up to 300 feet or until "gross seal failure" occurs. The normal cavity depth is 25 feet.

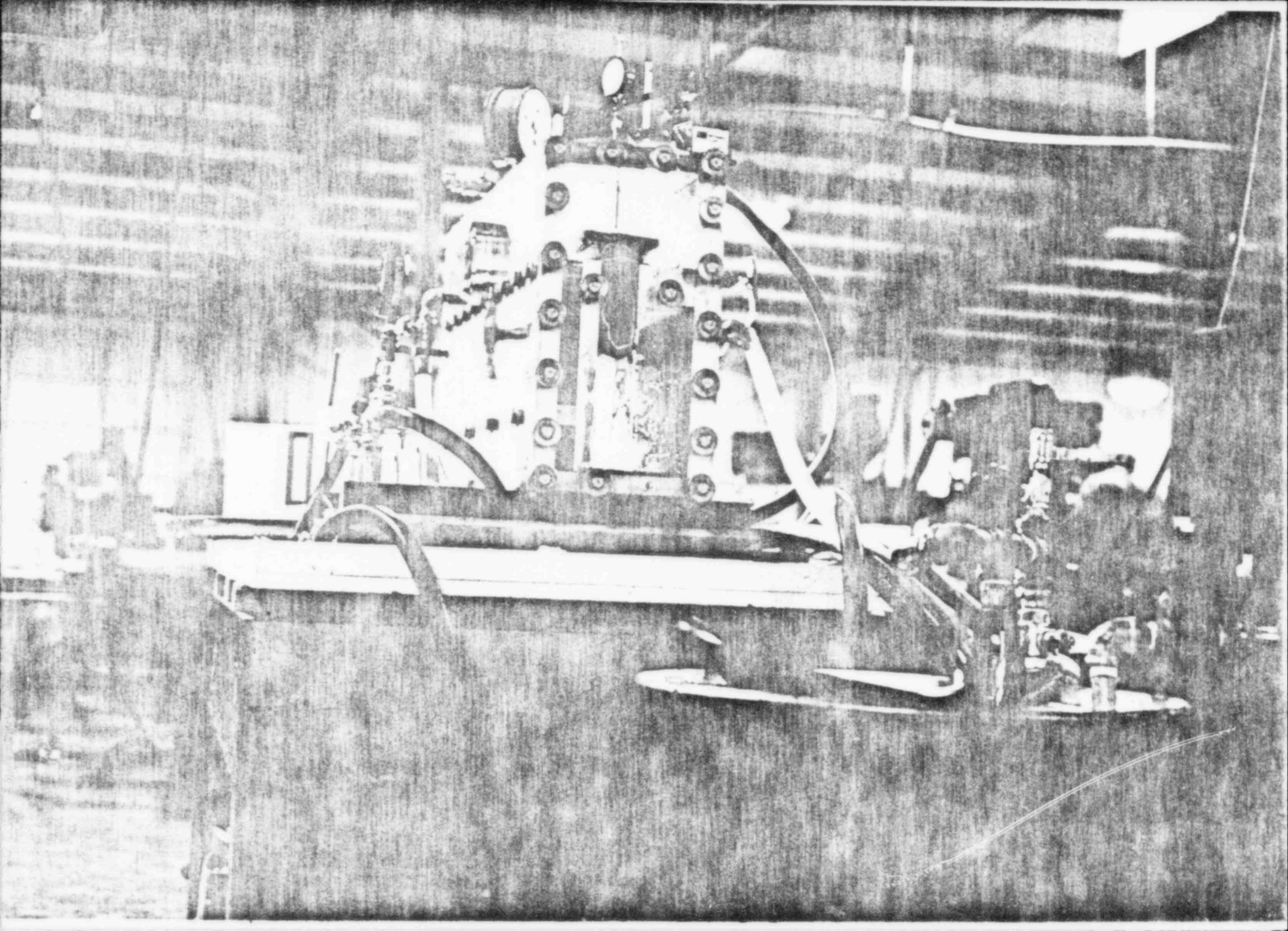
3.0 TEST APPARATUS

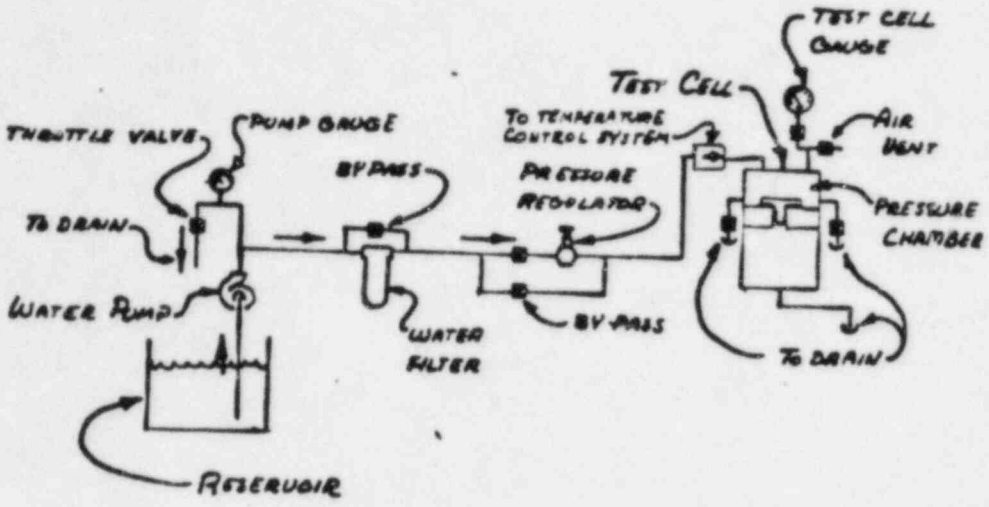
In order to meet the objectives of the test, the Impell test apparatus will be modified to represent the RPV-Seal-Cavity interface for the Yankee Atomic Plant. A conceptual sketch of this configuration is shown on Figures 3.1 and 3.2. The modified test cell is to be constructed such that the seal behavior may be observed while safely maintaining a test pressure boundary above the seal. Necessary precautions and steps should be taken to assure simulation of the environment and behavior of seals used during refueling. Since only a three foot section of the seal is to be tested, restriction of the longitudinal ends should be considered and the effects minimized. Pressure boundaries of both the bladder and the simulated cavity shall be designed to maintain relatively constant pressure during testing in spite of volume changes caused by seal movement into the gap. A temperature regulation control system is to be added to the existing test cell that will constantly maintain an elevated test temperature. Also, a device to measure seal leakage rate is to be designed, constructed and installed into the test cell. The specific seal seating surface shall be modified to simulate that of the Yankee Atomic Plant for the entire pressure range of the test. Gauges should be used to monitor bladder and cavity pressures, leakage rate, seal displacement, and temperature of the simulated cavity.

4.0 TEST CONDITIONS

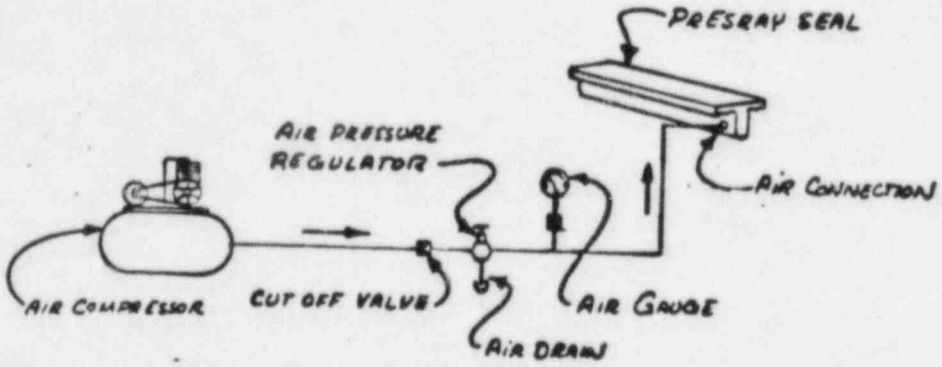
To ensure test accuracy, environmental conditions during testing shall simulate those experienced at the RPV-Seal-Cavity liner interface during refueling at the Yankee Atomic Plant. In particular, the ambient temperature should be between 65°F and 75°F. Atmospheric pressure both above the refueling cavity and beneath the seal, inside containment, are the same during refueling. Therefore, appropriate measures shall be taken to assure equal atmospheric pressure for both the simulated refueling cavity and drywell.

The actual test conditions to be imposed upon the seal are as specified in the Test Matrix (Table 4.1). A minimum of 14 tests are to be performed. Parameters such as the RPV-refueling cavity temperature, gap width, seal bladder pressure, and external surface conditions of the seal are to be varied. In all cases the refueling cavity pressure is to be gradually increased to a minimum head of 300 feet (or 130 psi) if test conditions permit. Five tests call for the cavity pressure to be gradually increased until gross failure occurs by means of the seal being pushed through the RPV-cavity gap.

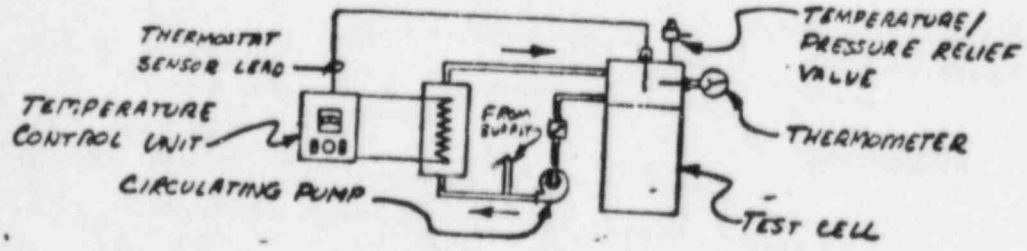




RPV - Seal - Cavity Liner
Hydraulic System



Seal Bladder Pressurization System



Temperature Regulation Control System

FIGURE 3.2

Test Apparatus Support Systems

The simulated RPV and cavity liner flanges are to be curved at a radii of 74-1/4" and 75-3/16" respectively. The RPV-cavity gap shall be varied from 15/16 to 1-3/16 inches. Testing shall also be conducted with elevations of the RPV flange and cavity liner offset by 1/4". Figure 4.1 shows a detailed cross section of this interface. Typical bladder pressure of the seal during refueling at Yankee Atomic is 30 psi. Testing shall be conducted at a bladder pressure of 50 psi to observe the effect of overpressurization and at 0 psi to observe the effect of under pressurization. Three tests are to be conducted at an elevated temperature of 150° to evaluate temperature effects on seal integrity. The rubber material is of a viscoelastic nature and is subject to creep. Creep effects should be considered in all tests. The effects of sudden bladder pressure loss is to be examined also. The seal is typically installed dry and seated prior to filling the refueling cavity. However the surface should be greased in one test in order to study lubrication effects. Also one test should be conducted without seating the seal.

CAVITY SEAL TEST MATRIX

Test No.	Bladder Pressure	Head of Water 5-10 psi incr	Leakage Readings	Displacement Readings	Water Temperature	Annulus Gap Size	Air Bladder Pressure Loss	Creep Effects	Failure Test
1	0 psi	0-300 ft.	X	X	70	Normal		X	
2	30 psi	0-300 ft.	X	X	70	Normal	X	X	X or worst case
3	50 psi	0-300 ft.	X	X	70	Normal	X	X	of tests 1,2,3
4	0 psi	0-300 ft.	X	X	70	Max. 1		X	
5	30 psi	0-300 ft.	X	X	70	Max. 1	X	X	X or worst case
6	50 psi	0-300 ft.	X	X	70	Max. 1	X	X	of tests 4,5,6
7	0 psi	0-300 ft.	X	X	70	Max. 1 & offset		X	
8	30 psi	0-300 ft.	X	X	70	Max. 1 & offset	X	X	X or worst case
9	50 psi	0-300 ft.	X	X	70	Max. 1 & offset	X	X	of tests 7,8,9
10	0 psi	0-300 ft.	X	X	70	Max. 2 & offset		X	
11	30 psi	0-300 ft.	X	X	70	Max. 2 & offset	X	X	X or worst case
12	50 psi	0-300 ft.	X	X	70	Max. 2 & offset	X	X	of tests 10,11,12
13	0 psi	0-300 ft.	X	X	150	Normal	---	X	
14	30 psi	0-300 ft.	X	X	150	Normal	---	X	X or worst case
15	50 psi	0-300 ft.	X	X	150	Normal	---	X	of tests 13,14,15
16	30 psi	0-300 ft.	X	X	70	Normal w/grease	---	X	----
17	30 psi	0-300 ft.	X	X	70	Seal not seated	---	X	----

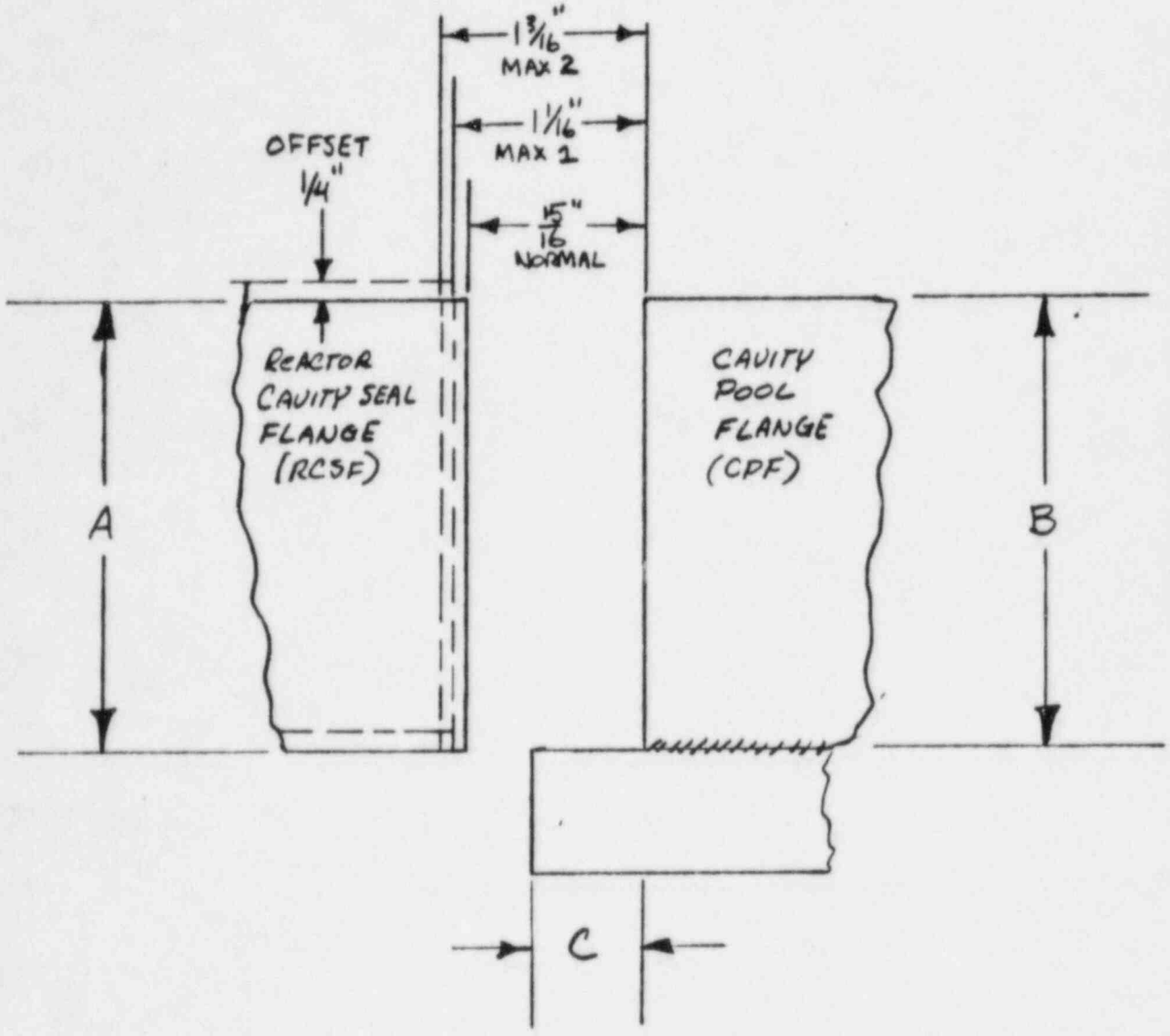
Gap dimensions are as follows:

1. Normal = 15/16 in.
2. Max. 1 = 1-1/16 in.
3. Max. 2 = 1-3/16 in.
4. Offset = + 1/4 in.

Note: Tests #10 - #12 will not be attempted if results from tests #7 - #9 are considered poor

Table 4.1

TEST CELL GAP CONFIGURATION



1) LONGITUDINAL LENGTH: 3 Ft, (CURVED or STRAIGHT)

If Curved, RADIUS of RCSF = 74.25"
RADIUS of CPF = 75.187"

2) A = 2½"
B = 2½"
C = 0.562"

FIGURE 4.1

					YANKEE ATOMIC ELECTRIC COMPANY	
					FOR YANKEE ATOMIC PLANT AT ROWE, MASS	
					JOB NO	PAGE 1
0	WJA	4/01/85	SLW	4/10/85	IMPELL CORPORATION	CALC NO TEST CELL GAP DIMENSIONS
REV	BY	DATE	CHECKED	DATE		OF 1

5.0 TEST PROCEDURE

This section contains, in outline form, procedures to be followed and precautions to be considered to ensure the objectives of the test are met. The procedures are to be used through the course of setting up the test equipment, preparation for testing, and the recording and documenting of test measurements.

5.1 Procedures

5.1.1 Equipment Set-up

5.1.1.1 Calibrate all critical pressure and temperature gauges.

5.1.1.2 RPV-Cavity Liner Test Simulator

a. Mount test cell on level and elevated surface to allow for proper cavity bleeding and simulator drainage.
b. Locate potable water reservoir local to the test cell.
c. Mount thermometers to monitor ambient and reservoir temperatures.
d. Connect water supply with in-line pressure gauge to test cell.
e. Attach pump suction and test cell drain lines to the reservoir.
f. Apply sealant between bolted surfaces of test cell to ensure water tightness.

5.1.1.3 RPV-Cavity Liner Seal

a. Record serial number of seal.
b. Inspect seal for imperfections.
c. Seal bladder for subsequent pressurization.
d. Mark seal ends with a grid pattern.
e. Lubricate ends of seal to limit end restrictions.
f. Lubricate sides of seal as required in test matrix.
g. Install seal, connect air supply to bladder, and close test cell.

5.1.2 Test Preparation

a. Ensure adequate water supply in reservoir and that all fittings are connected.
b. Turn on water pump and air compressor and check for leaks.
c. Turn on temperature control unit and adjust to test temperature.
d. Zero-out displacement measuring devices.
e. With seal in place, fill cavity with water and bleed off air.

5.1.3 Measurements

a. Complete Initial Data Sheet, record ambient and reservoir temperatures.
b. Pressurize bladder in accordance with test matrix and complete Test Data sheet for data point 0.
c. Increase cavity water pressure incrementally, stabilize bladder and cavity pressure, and complete the Test Data Sheet for subsequent data points.
d. Continue this process until the maximum cavity pressure in the test matrix has been achieved.
e. If more than one minute has elapsed between stabilizing the pressures and taking displacement readings, the time at the displacement reading should be recorded.
f. At test completion, the ambient temperature should be re-recorded on the Test Data Sheet.
g. The test engineer and a witness shall sign-off the data sheets prior to continuing to the next test.

5.2 Precautions

a. In order to use a seal in more than one test, caution should be exercised when removing it from the cavity at the completion of a test.

6.0 MATERIALS, INSTRUMENTATION AND CALIBRATION

Material and instrumentation necessary to perform the seal testing will be procured by Impell Corporation. Sufficient samples of the Presray seal will be provided with traceability by the Yankee Atomic Electric Company. The necessary instrumentation used to make test measurements will be procured by Impell. Two different gauges are to be used to monitor cavity pressure. One gauge shall have a range from 0 to 60 psig with subdivisions of no more than .2 psig. The second gauge shall have a range from approximately 0 to 300 psig with subdivisions no greater than 10 psig and will be used for pressure readings in access of the range of the primary gauge. A gauge to monitor the seal bladder air pressure

shall range from approximately 0 to 60 psig with subdivisions no greater than .5 psig. All pressure gauges shall be calibrated to within the accuracy of the gauge. Calibration certificates traceable to the National Bureau of Standards (NBS) shall be obtained and turned over to Yankee Atomic as part of the final report. Displacement read-out gauges accurate to within 1/1000 inch are to be used to monitor displacements of the seal. As the displacement readings are not required to achieve the objectives of the test, traceable calibration of the displacement read out gauges is not required. Thermometers are to be used to monitor the atmospheric temperature and the cavity water temperature. The thermometer used to monitor the atmospheric temperature can be of the common domestic variety and is only used to verify the consistency of a climate controlled environment. Calibration of this thermometer is not required. The thermometer used to monitor the cavity water temperature shall have a range from 0 to 200°F with subdivisions no greater than 5°F. This thermometer shall be calibrated to within the accuracy of the gauge. A laboratory grade pre-calibrated graduated cylinder is to be used to measure the seal leakage rate.

7.0 REFERENCE DOCUMENTS AND DRAWINGS

The documents and drawings governing this test are provided below.

7.1 Documents

None.

7.2 Drawings

7.2.1 Stone & Webster drawing 9699-FV-5A, Revision 1, "Reactor Cavity Water Seal, Power Station Yankee Atomic Electric Company, Rowe Mass."

8.0 DOCUMENTATION

All test documentation shall be in accordance with the Impell Quality Assurance Program. Test documentation including the test data sheets (Attachments 1 and 2) and the pressure gauge and thermometer calibration certificates will be transmitted to Yankee Atomic in a final report.

9.0 QUALITY ASSURANCE

All work shall be in accordance with the Impell Quality Assurance Program which is in compliance with the requirements of 10 CFR50, Appendix B, ANSI N45.2 and appropriate daughter standards.

ATTACHMENT 1

Initial Data Sheet

INITIAL DATA SHEET
Presray Seal Test

1. Date _____

2. Test No. _____

3. Seal I.D. _____

4. Nominal Gap Width (in) _____

   Offset (in) _____

5. Bladder Pressure (psi) _____

6. Cavity Temperature (°F) _____

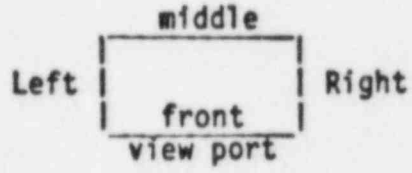
7. Installation (lub/unlub) _____ Method _____

8. Gap Width (in) Offset (in)

   Left _____ _____

   Middle _____ _____

   Right _____ _____



9. Pressure Cavity Height (H-in)

	RPV	CAVITY
Left	_____	_____
Right	_____	_____

10. Gauges a) Air Model No. _____ Range _____
    Smallest subdivision _____ psi

    b) Water Model No. _____ Range _____
    Smallest subdivision _____ psi

    c) Temp. Model No. _____ Range _____
    Smallest Subdivision _____ °F

11. Dial indicators: Left Model No. _____
    Middle Model No. _____
    Right Model No. _____

REV	BY	DATE	CHECKED	DATE	IMPELL CORPORATION	JOB NO	PAGE
						CALC NO	OF

ATTACHMENT 2

Test Data Sheet

IMPELL

REV				
BY				
DATE				
CHECKED				
DATE				

IMPELL CORPORATION

JOB NO

CALC NO

PAGE

OF

Date _____
Test No. _____

TEST DATA SHEET
Presray Seal Test

Temperatures at test completion:
Ambient ____ °F

1. Data Point	2. Time (1)	3. Water Pressure (psi)	4. Time (2)	5. Displacements (in.) L	M	R	6. Bladder Pressure (psi)	7. Cavity Temp. (°F)	8. Leakage Rate	9. Comments

Notes:
1. Sequential number
2. Wall clock time at beginning of pressure hold
3. Water pressure inside test assembly
4. Wall clock time at the time of displacement measurement
5. Displacement measurements
   - L = at left end of seal (see diagram on initial data sheet)
   - M = at middle of seal (see diagram on initial data sheet)
   - R = at right end of seal (see diagram on initial data sheet)
6. Air pressure in bladder of seal
7. Cavity water temperature
8. Cavity leakage rate
9. General observations

APPENDIX F

	No. of Pages
Test Personnel	1
Resumes	2

TEST PERSONNEL

The Impell test personnel who performed the testing are identified as follows with resumes attached.

Lead Test Engineer: Wills LaCrosse, P.E.

Test Engineer: Scott Weiland

WILLIAM LaCROSSE

EDUCATION

B., Engineering Science and Mechanics, 1975
Georgia Institute of Technology

EXPERIENCE

Mr. LaCrosse is currently a Senior Engineer in the Engineering Division at Impell. He has been involved with all the RPV/Cavity Liner Seal analysis and testing that Impell has performed. Mr LaCrosse designed and constructed the seal test assembly and is the lead test engineer.

Prior to joining Impell Mr. LaCrosse worked for several manufacturing firms producing custom engineered products with emphasis in speciality welded products and centrifugal pumps. Responsibilities included involvement in all phases in manufacturing a custom engineered product. The centrifugal pump experience provided expertise in handling complex fluid applications to solve engineering problems. Mr. LaCrosse performed and was responsible for training field personnel to perform witnessed testing startup procedures of UL/FM fire pumps. The manufacturing experience provided knowledge of the integrated phases involved to design, produce, assemble, and test various custom products. Mr. LaCrosse has performed numerous factory and field performance tests to debug, verify, and initiate operation of the company's products for their clients.

REGISTRATIONS

Professional Engineer - State of Georgia
Registration No. 14680

AFFILIATIONS

Member G.S.P.E. & N.S.P.E.

SCOTT L. WEILAND

EDUCATION

B.S., Civil Engineering
University of Michigan
Ann Arbor, Michigan

EXPERIENCE

Mr. Weiland has five (5) years experience related to nuclear power plant design and analysis. As a Senior Engineer in the Analytical Services Division, he has Project Engineering responsibilities for the static and dynamic analysis of piping systems in accordance with the ASME Section III, ANSI B31.7 and ANSI B31.1 codes.

Prior to joining Impell Corporation, Mr. Weiland was employed by Nutech Engineers. As a Project Engineer he was responsible for the design, static/dynamic analysis, and drafting of structural and mechanical components for Arkansas Power and Light Company's (AP&L) Arkansas Nuclear One. He was also responsible for project level client interface and engineering support during construction. Mr. Weiland is very familiar with AP&L personnel, procedures, records system and the PISTAR computer program. Having been involved in many back-fit projects for AP&L he is completely familiar with the layout and procedures at ANO-1 & 2.

His other experience includes linear and non-linear finite element analysis of both plate and frame structures using the STRUDL and STARDYNE computer codes. He has been involved in the development of simplified analysis procedures for corroded and pitted piping, base plates and anchor bolts, and small bore piping. He has also served as Resident Engineer on various structural related back-fit projects at both BWR and PWR nuclear power plants.