DUQUESNE LIGHT COMPANY

SHIPPINGPORT ATOMIC POWER STATION

TEST EVALUATION

DLCS 3070103

PRIMARY PLANT SELF-ACTUATED RELIEF VALVE OPERATION

CORE I, SEED 3

Section 1 of 2 Sections

First Issue, January 25, 1962

DISCLAIMER

TEST EVALUATION

DLCS 3070103

PRIMARY PLANT SELF-ACTUATED RELIEF VALVE OPERATION

Purpose

The purpose of the test was to insure the reliable operation of the self-actuated reactor relief valves (06-H15-2, 3, 8 and 9) and the self-actuated pressurizer steam relief valves (06-H15-1 and 10).

Conclusions and Recommendations

The reactor relief valves (06-H15-2, 3, 8 and 9) and the pressurizer steam relief valves (06-H15-1 and 10) operated properly, and the final set pressures were all within the specified limits. These limits are 2450 ± 50 psi for the reactor relief valves and 2300 ± 50 psi for the pressurizer relief valves. Neither valve chatter nor excessive pipe movement was evident during any of the valve operations. Pressurizer steam relief valves 06-H15-1 and 10 were the only valves to exhibit any significant leakage at the conclusion of the test. The leak rates, however, were quite small as compared to the leakage existing before the pressurizer valves were repaired. (1.2 and 4.4 gal/hr respectively compared to 40.6 and 32.4 gal/hr prior to valve repair). The operating data indicated that the repair work performed on relief valves 06-H15-2, 8, 1 and 10 was satisfactory.

In order to eliminate the need for freezing the line leading to pressure indicator controller 27-06-J1-3 with liquid nitrogen, it is recommended that a manual valve be installed in the line between this instrument and the relief line.

Description of Test Equipment and Test Procedure

DLCS 3070103 was performed in accordance with the third issue of the Approved Test Procedure, dated October 17, 1961.

The leakage of each of the relief valves was determined in accordance with DLCS 21101, Primary Plant Leak Rate Test, Seventh Issue, Part V-A through V.

All relief valves, except the one being tested, were gagged. The temperatures of the ungagged relief valve were measured at various locations with a surface pyrometer. The reactor plant pressure was then increased to within 200 psig of the prescribed set pressure by using the pressurizer heaters. The valve was manually opened and held until the System pressure decreased to 1800 psig. This operation assured that the valve was not sticking. After the valve had cooled, the system pressure was increased until the valve popped or until a pressure of 105 per cent of the prescribed set pressure was obtained. If the valve popped out of the prescribed limits, an adjustment was made and the popping operation repeated.

The leakage of the individual relief valves was again determined after all valve operations had been completed.

Results

DLCS 3070103, Primary Plant Self-Actuated Relief Valve Operation, was performed in its entirety for reactor relief valves 06-H15-3 and 9 on August 10 through 14, 1961. The valve flushing portion of the test was performed at the same time for all the remaining valves except pressurizer relief valve 06-H15-1. No operation was performed on this valve due to excessive steam leakage through the bonnet. The steam leakage was eliminated when the valve was repaired during the Seed 2 - Seed 3 refueling operation. The remainder of the test was then performed on October 16 through 18, 1961.

The relief valve operating data are summarized in Table I. The data for the reactor vessel relief valves and the pressurizer steam relief valves are presented in Tables II and III, respectively. The average temperature and reactor pressure indicators were out of service when reactor relief valves 06-H15-3 and 9 were tested, therefore the individual loop temperatures and pressures were recorded. The reactor pressure indicator was isolated in accordance with the test procedure. The pressurizer temperature occasionally exceeded the range of the indicator (650°F). In Tables II and III, the pressurizer temperatures greater then 650°F have been estimated by using Thermodynamic Properties of Steam by Keenan and Keyes and the respective system saturation pressure. The leak rate data for the individual relief valves are listed in Tables IV and V, and the Heise gage calibration data are listed in Table VI. Due to the accuracy of the Heise gage, no corrections were required on the original data.

The information obtained during the operation and repair of the relief valves is discussed below for each pair of valves.

REACTOR RELIEF VALVES 06-H15-3 AND 06-H15-9

Reactor relief valves 06-H15-3 and 9 popped within the prescribed limits (2450 ± 50 psig) after one adjustment was made to each valve. There was some noticeable pipe movement when the valves popped but the piping was steady when the valves were blowing. No valve chatter was evident. Valve 06-H15-9 had to be isolated after the first operation due to low pressurizer level.

REACTOR RELIEF VALVES 06-H15-2 AND 06-H15-8

Reactor relief valves 06-H15-2 and 8 were successfully flushed in August, 1961. These valves were then repaired during the refueling operation. The repair of valve 06-H15-2 consisted of; replacement of spring and spring washers, and lapping and installation of a new disc insert. A new seat was cut and a new disc insert was installed in valve 06-H15-8. The lift of the relief valves was not changed. Valves 06-H15-2 and 8 were then popped automatically in October, 1961. Valve 06-H15-2 was popped four times before it operated properly. The valve closed immediately after it opened on the first run, and did

not reseat on the two succeeding runs. Valve 06-H15-2 then functioned properly on the final run. An attempt was made to manually flush valve 06-H15-8 at the request of the Atomic Energy Commission, however, the valve popped before it could be manually opened. Valve 06-H15-8 then popped out of the prescribed limits during the first two attempts, but it operated properly during the next run.

PRESSURIZER STEAM RELIEF VALVES 06-H15-1 AND 06-H15-10

No attempt was made to manually flush pressurizer steam relief valve 06-H15-1 in August, 1961, due to steam leakage through the bonnet. Relief valve 06-H15-10 popped automatically during an attempt to flush valve 06-H15-8. This was considered an adequate flush for valve 06-H15-10. The internals of valves 06-H15-1 and 10 were then replaced with those of available spare valves during the refueling operation. The old disc inserts, disc pins and bellows were scrapped. All other internals were decontaminated and sent to Crosby Steam Gage and Valve Company along with the spare bodies, new disc inserts, and one new bellows assembly. The valves will be reconditioned, hydrostatic tested, and returned for use as spares.

Some difficulty was encountered with relief valves 06-H15-1 and 10 following their repair and prior to testing. On September 29, 1961, valve 06-H15-1 popped at approximately 1375 psig during the calibration of reactor coolant pressure instrumentation. When the associated motor-operated valve was cycled, relief-valve 06-H15-10 also popped. The spring settings on both valves were adjusted, but valve 06-H15-1 popped at 2000 psig on September 30, and again at 1937 psig on October 2. No further adjustment could be made because the valve was already at the limit of its adjusting range. A vendors representative adjusted the nozzle ring and eductor adjusting ring of valves 06-H15-1 and 10 on October 3, 1961. No additional, premature relieving occurred after the adjustments were made.

Relief valves 06-H15-1 and 10 were then tested on October 17-18, 1961. Valve 06-H15-1 was manually opened at the request of the Atomic Energy Commission in order to measure the amount of lift. A high pitched sound was then evident when 06-H15-1 opened automatically during the first two runs. The System pressure did not decrease appreciably during the open period of one minute, therefore it may be concluded that the valve was not fully open. An adjustment was made, and the valve operated properly on the third run. Relief valve 06-H15-10 did not pop during the first attempt and popped out of specifications on the second run. The valve then operated properly on the third run after the spring setting was adjusted.

RELIEF VALVE FLOW RATES

The flow rates through reactor relief valves 06-H15-2, 3, 8 and 9 were calculated by utilizing the change in pressurizer level. The results are presented in Table II. The flow rates were, in some cases, considerably lower than the design flow of 725 gpm. The accuracy of these calculated flow rates, however, is very limited,

for in most cases, the times were rounded off to the nearest minute. A stopwatch will be used in future performances of DLCS 30701 to determine the length of time that a valve is open. It is felt that a reasonably accurate flow rate is helpful in judging the performance of a relief valve.

No flow rates were calculated for the pressurizer steam relief valves (06-H15-1 and 10) because of the erratic performance of the wide range pressurizer level instrumentation. The reference leg of the differential pressure cell is connected to the discharge line between the pressurizer and the pressurizer steam relief valves. Whenever one of the pressurizer relief valves popped, the sudden reduction of pressure in the discharge line cause a momentary high level indication. The existence of the surge was verified by examination of the pressurizer, wide range, level recorder chart. Although the duration of the instrumentation surge was brief, in some cases the relief valves reseated before the transient subsided. The pressurizer level readings for relief valves 06-H15-1 and 10 are, therefore, unreliable.

RELIEF VALVE LEAK RATES

The leak rate of each relief valve was determined before and after valve operation. The data are presented in Tables IV and V. There was little change in the leak rate of the relief valves except for valve 06-H15-8 which decreased from approximately 33 gph to 0.3 gph. Table I shows the effectiveness of the repair work performed on pressurizer relief valves 06-H15-1 and 10. The leak rates have been reduced to a tolerable level.

TABLE I

SUMMARY OF RELIEF VALVE OPERATING DATA

VALVE NO.	LOCATION	FINAL SET PRESSURE PSIG	LEAK RATE GAL/HR		
			BEFORE POPPING	AFTER POPPING	BEFORE VALVE REPAIR
06-H15-3	Reactor Relief	2440	0.00	0.08*	----
06-H15-9	Reactor Relief	2450	0.55	0.09*	----
06-H15-2	Reactor Relief	2435	0.98	0.03	0.09
06-H15-8	Reactor Relief	2400	33.70*	0.30	3.60
06-H15-1	Pressurizer Relief	2340	0.74	1.20	40.60
06-H15-10	Pressurizer Relief	2265	0.00	4.40	32.40

* Average of two runs.

TABLE II

REACTOR VESSEL RELIEF VALVES

VALVE NO.		06-H15-3		06-H15-3		06-H15-3[1]		06-H15-9	
DATE		8-12-61		8-12-61		8-12-61		8-12-61	
		Before Manual Lift	After Reseat	Popping	Reseat	Popping	Reseat	Before Manual Lift	After Reseat
Time				0745	0746	1103	1104		
System Pressure (Heise Gage)	psig			2385	2000	2440	2305		
Pressurizer Pressure (AIP)	psig				2040		2250		
Pressurizer Temperature (MCC-RS)	F				638		656		
Pressurizer Level (AIP)	in.			126	63	166	150		
1A Coolant Loop Tc	F			500.8	498.6	498.2	497.9		
1B Coolant Loop Tc	F			501.5	499.3	498.6	498.6		
1C Coolant Loop Tc	F			500.9	500.3	498.9	498.9		
Average Temperature	F			OOS	OOS	OOS	OOS		
1A Coolant Loop Pressure	psig			OOS	OOS	2500	2350		
1B Coolant Loop Pressure	psig			OOS	OOS	2470	2320		
1C Coolant Loop Pressure	psig			OOS	OOS	2500	2350		
Reactor Pressure (MCC-RS)	psig			OOS	OOS	OOS	OOS		
Relief Valve Temperatures									
Time		0612			0746		1104	1338	
Body	F	200			340		----	290	
Bonnet	F	150			200		----	175	
Inlet Nipple	F	332			460		420	400	
Outlet Nipple	F	170			410		270	190	
Maximum Back Pressure	psig				700		180		
Relief Period	min.	----		1.0		1.0		----	
Calculated Flow Rate	gpm	----		628.0		159.5		----	

[1]As Left

TABLE II (cont'd)

REACTOR VESSEL RELIEF VALVES

VALVE NO.		06-H15-9		06-H15-9[1]		06-H15-2		06-H15-2	
DATE		8-12-61		8-12-61		8-12-61		10-18-61	
		Popping	Reseat	Popping	Reseat	Before Manual Lift	After Reseat	Popping	Reseat
Time		1542	1544	1640	1645			0609	0609:04
System Pressure (Heise Gage)	psig	2385	----	2450	1880			2480	2440
Pressurizer Pressure (AIP)	psig		1850		1880			----	----
Pressurizer Temperature (MCC-RS)	F		629		628			667	664
Pressurizer Level (AIP)	in.	166	70	174	81			180	178
1A Coolant Loop Tc	F	499.0	498.4	499.6	499.0				
1B Coolant Loop Tc	F	499.3	498.8	500.5	499.9				
1C Coolant Loop Tc	F	499.9	499.3	500.7	500.5				
Average Temperature	F	OOS	OOS	OOS	OOS			503.8	504.0
1A Coolant Loop Pressure	psig	2440	1900	2500	1930				
1B Coolant Loop Pressure	psig	2440	1870	2460	1910				
1C Coolant Loop Pressure	psig	2440	1900	2500	1920				
Reactor Pressure (MCC-RS)	psig	OOS	OOS	OOS	OOS			OOS	OOS
Relief Valve Temperatures									
Time			---		1652	1916	1935	0609	0610
Body	F		---		310	190	250	250	340
Bonnet	F		---		190	255	180	200	260
Inlet Nipple	F		---		525	490	480	360	560
Outlet Nipple	F		---		340	240	270	172	400
Maximum Back Pressure	psig		---		520				---
Relief Period	min.	2		5		---		.066	
Calculated Flow Rate	gpm	478.5		185.4		---		299	

[1]As Left

TABLE II (cont'd)

REACTOR VESSEL RELIEF VALVES

VALVE NO.		06-H15-2		06-H15-2[1]		06-H15-8		06-H15-8[2]	
DATE		10-18-61		10-18-61		8-12-61		10-17-61	
		Popping	Reseat	Popping	Reseat	Before Manual Lift	After Reseat	Popping	Reseat
Time		1104	Did Not Reseat	1301:29	1301:59			2150	Did Not Reseat
System Pressure (Heise Gage)	psig	2460	----	2435	2280			2145	
Pressurizer Pressure (AIP)	psig	2450		2430	2270				
Pressurizer Temperature (MCC-RS)	F	666	650	664	655				
Pressurizer Level (AIP)	in.	156	83	179	153				
Average Temperature	F	499.3	499.3	498.2	498.2				
Reactor Pressure (MCC-RS)	psig	2460	----	2430	2280				
Relief Valve Temperatures			After M.O.V.						After M.O.V.
Time		1103	Closed	1301	1303	1703	1715	2150	Closed
Body	F	190	310	300	310	210	340	180	390
Bonnet	F	165	165	170	175	180	160	120	160
Inlet Nipple	F	420	550	530	490	515	516	350	600
Outlet Nipple	F	160	370	230	330	235	390	210	450
Maximum Back Pressure	psig		580		75				
Relief Period	min.	---		0.5		---		---	
Calculated Flow Rate	gpm	---		518.4		---		---	

[1] As Left
[2] Popped automatically when a manual flush was attempted

TABLE II (cont'd)

REACTOR VESSEL RELIEF VALVES

VALVE NO.		06-H15-8		06-H15-8[1]	
DATE		10-18 61		10-18-61	
		Popping	Reseat	Popping	Reseat
Time		0705	Did Not Reseat	1207:34	1209:32
System Pressure (Heise Gage)	psig	2150	----	2400	1900
Pressurizer Pressure (AIP)	psig	----	----	2400	1920
Pressurizer Temperature (MCC-RS)	F	646	650	662	650
Pressurizer Level (AIP)	in.	158	84	178	63
Average Temperature	F	506.0	505.5	505.0	505.0
Reactor Pressure (MCC-RS)	psig	OOS	OOS	2400	1950
Relief Valve Temperatures			After M.O.V.		
Time		0705	Closed	1207	1210
Body	F	240	310	260	380
Bonnet	F	180	300	160	165
Inlet Nipple	F	520	575	500	585
Outlet Nipple	F	250	420	210	440
Maximum Back Pressure	psig		---		490
Relief Period	min.	---		1.97	
Calculated Flow Rate	gpm	---		582.00	

[1] As Left

TABLE III

PRESSURIZER STEAM RELIEF VALVES

VALVE NO.		06-H15-1		06-H15-1[2]		06-H15-1[2]		06-H15-1[1]	
DATE		8-12-61		10-17-61		10-17-61		10-18-61	
		Before Manual Lift	After Reseat	Popping	Reseat	Popping	Reseat	Popping	Reseat
Time		No attempt was made to pop this valve manually due to steam leakage through bonnet.		1509	1510	1513:45	1514:45	0310	0310:17
System Pressure (Heise Gage)	psig			2225	2215	2225	2215	2340	2025
Pressurizer Pressure (AIP)	psig			2225	2205	2215	2205	2340	2050
Pressurizer Temperature (MCC-RS)	F			645	645	648	648.5	658	639
Pressurizer Level (AIP)	in.			161	161	163	163	---	154
Average Temperature	F			501	501	500.5	500.5	506.0	505.0
Reactor Pressure (MCC-RS)	psig			2220	2210	2220	2210	OOS	OOS
Relief Valve Temperatures									
Time				1508			1515	0310	0311
Body	F			110			190	240	235
Bonnet	F			100			105	140	140
Inlet Nipple	F			125			490	570	580
Outlet Nipple	F			105			205	260	300
Maximum Back Pressure	psig				---		---		---

[1]As Left
[2]Valve did not open fully

TABLE III (cont'd)

PRESSURIZER STEAM RELIEF VALVES

VALVE NO.		06-H15-10		06-H15-10		06-H15-10		06-H15-10[1]	
DATE		8-12-61		10-17-61		10-17-61		10-17-61	
		Before Manual Lift	After Reseat	Popping	Reseat	Popping	Reseat	Popping	Reseat
Time		Valve popped automatically when pressure was raised to pop 06-H15-8 manually. Gag was not tight.		1730		1830:22	1831:45	1955:10	1955:25
System Pressure (Heise Gage)	psig			2415		2385	2130	2265	2075
Pressurizer Pressure (AIP)	psig					2400	----	2260	2075
Pressurizer Temperature (MCC-RS)	F					639	639	644	644
Pressurizer Level (AIP)	in.					184	---	155	156
Average Temperature	F					502.0	501.0	498.2	498.2
Reactor Pressure (MCC-RS)	psig			Valve did not pop.		----	----	2275	2075
Relief Valve Temperatures									
Time						1820	1833	1931	1957
Body	F					120	240	160	300
Bonnet	F					100	140	110	160
Inlet Nipple	F					325	600	350	600
Outlet Nipple	F					140	290	230	360
Maximum Back Pressure	psig						---		---

[1] As Left

TABLE IV

LEAK RATE DATA FOR
REACTOR VESSEL RELIEF VALVES

VALVE NO.		06-H15-3					
DATE		8-10-61		8-14-61		8-14-61	
		Before Popping		After Popping			
Time		1303	1403	0550	0650	2225	2325
Collection Vessel Temp.	F	110	110	105	105	150	150
Collection Vessel Level Change	in.	0		5/8		1/16	
Leak Rate	gal/hr	0		0.15		0.015	

VALVE NO.		06-H15-9					
DATE		8-10-61		8-14-61		8-14-61	
		Before Popping		After Popping			
Time		1410	1510	0700	0846	2116	2216
Collection Vessel Temp.	F	110	110	105	92	150	152
Collection Vessel Level Change	in.	2 1/4		1 1/8		1/8	
Leak Rate	gal/hr	0.55		0.16		0.03	

VALVE NO.		06-H15-2				06-H15-8					
DATE		10-16-61		10-18-61		10-16-61		10-16-61		10-18-61	
		Before Popping		After Popping		Before Popping				After Popping	
Time		t*	t + 62 min	2200	2300	t*	t + 11.75 min	t*	t+ 11.3 min	1837	1937
Collection Vessel Temp.	F	--	85	--	95	--	--	--	--	--	95
Collection Vessel Level Change	in.	4 1/8		1/8		26 1/2		26 1/4		1 1/4	
Leak Rate	gal/hr	0.98		0.03		33.3		34.1		0.3	

* Starting time not available

TABLE V

LEAK RATE DATA
FOR
PRESSURIZER STEAM RELIEF VALVES

VALVE NO.		06-H15-1				06-H15-10			
DATE		10-16-61		10-18-61		10-16-61		10-18-61	
		Before Popping		After Popping		Before Popping		After Popping	
Time		t*	t + 60 min	2050	2150	t*	t + 60 min	1722	1822
Collection Vessel Temp.	F	--	80	--	95	--	80	--	100
Collection Vessel Level Change	in.	3		4 7/8		0		17 7/8	
Leak Rate	gal/hr	0.74		1.2		0		4.4	
Leak Rate Before Valve Repair (8-10-61)	gal/hr	40.6				32.4			

* Starting time not available

TABLE VI

CALIBRATION DATA

Instrument: Heise Pressure Gage
Serial No.: H14406
Date of Calibration: October 13, 1961

Applied Pressure* psig	Indicated Pressure - psig	
	Up	Down
0	0	0
200	200	200
400	400	400
800	800	800
1200	1200	1200
1600	1600	1600
2000	2000	2000
2400	2400	2400
2800	2800	2800
3200	3200	3200
3600	3600	3600
4000	4000	4000

* Dead weight tester

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PRIMARY PLANT SELF-ACTUATED RELIEF VALVE OPERATION

Prepared By J. McColligan

Reviewed By R W Noble

Approved (Duquesne Light Company) George A Santel