DUQUESNE LIGHT COMPANY

SHIPPINGPORT ATOMIC POWER STATION

TEST EVALUATION

DLCS 2110141
T-641102

PERIODIC REACTOR PLANT LEAK RATE TEST

CORE I SEED 2

Section 1 of 1 Section

First Issue, June 14, 1961

DISCLAIMER

TEST EVALUATION

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Purpose

The purpose of this test is to determine the magnitude and location of Reactor Coolant System leakage.

Conclusions

The total leakage from pressurizer relief valves (09-H15-1 and 10) and reactor relief valves (06-H15-2, 3, 8 and 9) was 62.1 gal/hr. which is an increase of 10% over the previous performance. The pressurizer relief valves, although somewhat changed, were responsible for most of the leakage. The reactor relief valves showed little change in their individual or collective leak rates.

The total plant leakage has decreased to 19.3 gal/hr which is 5.86 gal/hr (10%) less than the previous performance. The unaccounted for leakage of 2.2 gal/hr in this test may be due to the inaccuracy of the average 11.6 ft^3/in factor used in the conversion of blow-off tank water level changes.

Description of Test Equipment and Test Procedure

The test was conducted in accordance with approved procedure DLCS 21101, Periodic Reactor Plant Leak Rate Test, sixth issue dated February 28, 1961. Testing was done with the plant operating at 63 gross MW using all four loops.

The leak rates of individual pressurizer relief valves 06-H15-1 and 06-H15-10 and reactor relief valves 06-H15-2, 3, 8 and 9 were determined by using the permanently installed collection vessel and the associated equipment (See Figure 1). Water in the line between each relief valve and its motor operated stop valve was drained to the blow-off tank by cycling the motor operated valves. After the rate of increase in water level in the collection vessel had become constant, a reference level in the vessel was obtained by expelling the excess water to the blow-off tank using nitrogen pressure. The leakage flow from the relief valve was allowed to flow into the collection vessel for a definite period of time or until the level in the collection vessel approached the upper limit on the gauge glass. The only special equipment used was a 0-600 F hand pyrometer (No. 443) used to record temperatures at the surfaces of the relief valves and their downstream piping.

The total plant leak rate was determined by closing all telltale valves to the collection vessel and the motor operated valves for relief valves 06-H15-1, 8 and 9 were opened to the blow-off tank. The levels of the blow-off and flash tank were recorded at the start andcompletion of the test. During the period

of test, no charging of the primary system was done and sample trains were removed from service. Temperatures of the reactor coolant loop relief valves and purification loop relief valves were checked for steam leaks by measuring the valve metal temperatures.

Results

DLCS 2110141, Periodic Reactor Plant Leak Rate Test, was performed on March 1 and 2, 1961.

Figure 1 shows the relief valve piping arrangement along with the collection vessel. Tables III-V contain original data recorded during the test. The leak rates for the pressurizer and reactor relief valves were calculated in both gal/hr and lb/hr and both methods are shown in the sample calculations. The actual leak rate values for each relief valve are tabulated in Table I. The overall plant leakage is itemized in Table II.

The pressurizer relief valves, although somewhat changed, continued to indicate the relatively high leakage as found for the previous performance. The pressurizer relief valves 06-H15-1 and 10 accounted for 82% of the total valve leakage. Relief valve 06-H15-1 decreased from 29.0 gal/hr to 16.3 gal/hr which is a decrease of 44%. Relief valve 06-H15-10 increased from 15.90 gal/hr to 34.6 gal/hr which is an increase of 118% over the previous performance of this test.

The reactor relief valves showed little change in their respective leak rates. The total leakage of the four relief valves (06-H15-2, 3, 8 and 9) was 11.2 gal/hr which is the identical total of leakage as obtained in the previous performance for these four valves. While cycling the motor operated stop valve 06-H2-2, the valve began to leak water and continued to leak during the 30 minutes duration of testing relief valve 06-H15-8. This loss of water, however, would not significantly affect the leak rate for relief valve 06-H15-8.

The total leakage from the pressurizer relief valves and the reactor relief valves was 62.1 gal/hr, which is an increase of 10% over the 56.1 gal/hr of the previous performance.

The total plant leakage (Table II) was 19.3 gal/hr and the accounted for leakage was 21.5 gal/hr. The total leakage was 10% lower than the previous performance. The difference between total plant leakage and leakage accounted for is 18 lb/hr or 10% inaccuracy. If the rated accuracy of the pressurizer narrow range reading is accepted as $\pm$ 1% and the blow-off tank level scale can be read to $\pm$ 1/16 inches, the respective inaccuracies would be $\pm$ 1.6 lb/hr and 5.6 lb/hr. These combined inaccuracies are $\pm$ 4% leaving $\pm$ 6% error unaccounted for. Consideration of these two possible errors indicates that the 11.6 ft^3/in. conversion factor may be in error. This is a calculated value and has not been verified experimentally. If greater accuracy in determining the coolant system leakage accounted for is desirable, the volume increase per inch of level in the blow-off tank should be experimentally determined.

An examination of the temperatures obtained in checking the 1A, 1B, 1C and 1D loop relief valves and the 1AC and 1BD purification loop relief valves indicated that none of these valves were leaking. Any reactor coolant leakage would be indicated by high temperatures on the inlet and outlet nipples and the associated discharge piping of each valve being checked.

TABLE I

SUMMARY OF RELIEF VALVE LEAKAGE RATES

March 1, 1961

Relief Valve Number	Increase in Sight Glass Level (inches)	Δ Time (min.)	Leak Rate Gal/Hr.	Leak Rate Lb/Hr.
06-H15-1	28 3/4	26	16.3	109.2
06-H15-10	30 1/2	13	34.6	248.2
06-H15-8	5	30	2.5	19.6
06-H15-2	15 1/2	30	7.6	59.6
06-H15-3	3 3/4	83	0.7	5.5
06-H15-9	1/2	20	0.4	3.1
		Total Valve Leakage	62.1	445.2

TABLE II

SUMMARY OF REACTOR COOLANT SYSTEM LEAKAGE DATA

March 2, 1961

Plant Components	Gal/Hr	Lb/Hr
1. Make up to Reactor Coolant System	0.00	0.0
2. Decrease in Pressurizer level	19.10	159.0
3. Increase in Blow-Off Tank level	21.00	179.0
4. Change in Flash Tank level	0.00	0.0
5. Decrease in Volume Due to Tavg. Change	0.23	1.9
6. Sample Train leakage	0.00	0.0
Total Plant leakage (1 + 2 + 5)	19.30	161.0
Leakage Accounted for (3 + 4 + 6)	21.50	179.0
Leakage Unaccounted for	2.20	18.0

TABLE III

RELIEF VALVE LEAKAGE ORIGINAL DATA
March 1, 1961

Valve Name and Number	Valve Transfer Control Switch Position - MCC-RS (A or B)	Time (min)	Collection Vessel Level (in)	Temperature Indicator	Temperature Pyrometer	Pressure (psig)
Pressurizer Relief Valve 06-H15-1	B	1026 1052	* 28 3/4	158 142	370 385	270 520
Pressurizer Relief Valve 06-H15-10	A	1110 1123	* 30 1/2	194 178	270 355	110 240
Reactor Relief Valve 06-H15-8	A	1442 1512	* 5	128 112	150 135	20 20
Reactor Relief Valve 06-H15-2	B	1534 1604	* 15 1/2	112 106	150 145	20 20
Reactor Relief Valve 06-H15-3	B	1142 1305	* 3 3/4	182 130	230 220	20 20
Reactor Relief Valve 06-H15-9	A	1340 1400	* 1/2	126 115	190 180	20 20

Valve Name and Number	Time	Valve Inlet Nipple (F)	Valve Outlet Nipple (F)	Distance Downstream 1 Ft. (F)	Distance Downstream 2 Ft. (F)
Pressurizer Relief Valve 06-H15-1	1035	570	415	415	415
Pressurizer Relief Valve 06-H15-10	1120	555	340	325	325
Reactor Relief 06-H15-2	1555	300	290	185	175
Reactor Relief 06-H15-8	1510	280	225	215	215
Reactor Relief 06-H15-3	1305	325	225	170	155
Reactor Relief 06-H15-9	1345	345	240	170	150
Relief Valve Discharge 06-H15-1	1100	435	---	---	---
Pipe Temp (MIP-RS) 06-H15-10	1125	375	---	---	---

* Sight Glass Reference Level

TABLE IV

REACTOR PLANT RELIEF VALVE TEMPERATURES

Original Data

Valve Name and Number	Date	Time	Valve Inlet Nipple (F)	Valve Outlet Nipple (F)	Distance Downstream 1 Ft. (F)	Distance Downstream 2 Ft. (F)
1A Loop Relief (06-H15-4)	3-2-61	0947	132	110	105	105
1B Loop Relief (06-H15-5)	3-2-61	0937	115	105	102	102
1C Loop Relief (06-H15-6)	3-2-61	0946	99	96	96	92
1D Loop Relief (06-H15-7)	3-2-61	0938	100	97	95	92
1AC Purif. Loop Rel. (07-H15-1)	3-2-61	0945	114	103	103	103
1BD Purif. Loop Rel. (07-H15-2)	3-2-61	0935	115	107	103	102
Pressurizer Pilot Relief (06-H18-1)	3-2-61	0926	160	155	150	150
Date	3-2-61	3-2-61	3-2-61	3-2-61		
Time	0921	1021	1121	1521		
Flash Tank Level in. (Aux. Container Sight Glass)	30 1/4	30 1/4	30 1/4	30 1/4		
Blow-Off Tank Level in. (Aux. Container Sight Glass)	58 13/16	59 1/8	59 5/16	60 13/16		

TABLE V

DRAIN VALVE AND RELIEF VALVE LEAKAGE ORIGINAL DATA

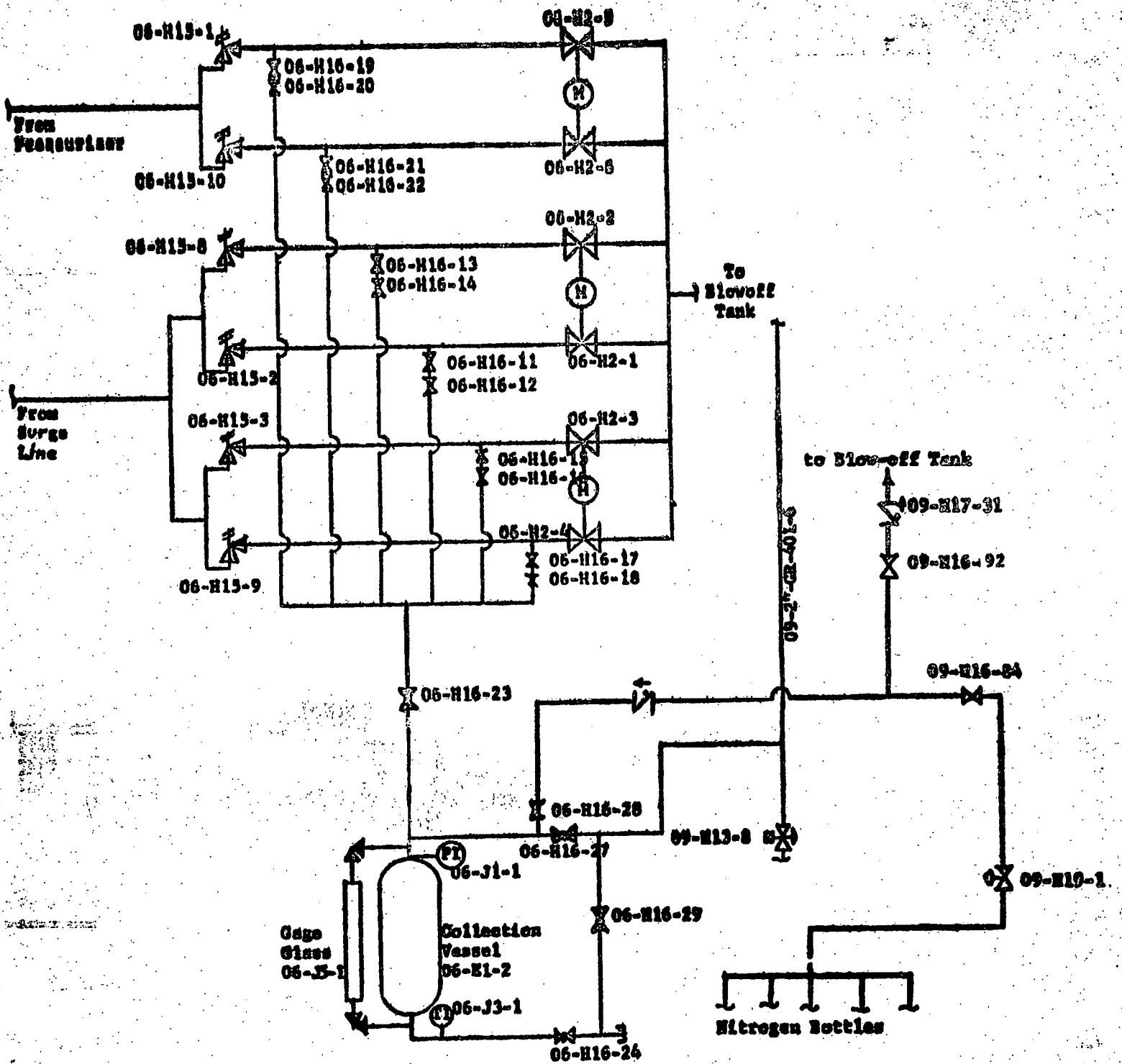
March 2, 1961

Time	0921	1021	1121	1721
Pressurizer Relief Valve Transfer Control Switch Position (MCC-RS) "A or B"	A	A	A	A
No. 1 Reactor Relief Valve Transfer Control Switch Position (MCC-RS) "A or B"	B	B	B	B
No. 2 Reactor Relief Valve Transfer Control Switch Position (MCC-RS) "A or B"	B	B	B	B
Tavg. (MCC-RS) "F"	500.1	499.9	500.0	500.2
Temp. Error (P and T Recorder - AIP) "F"	OOS	OOS	OOS	OOS
Pressurizer Temp. (MCC-RS) "F"	625.5	624.5	624.5	624.4
Blow-Off Tank Temp. (Temp. Ind. Pt. No. 5 - MIP-RS) "F"	124	124	125	128
Flash Tank Temp. (MCC-RS) "F"	104	104	104	102
Pressurizer Level (Narrow Range - AIP) "in"	105.5	104.0	102.2	81.0
VOS Flask Level (MIP-RS) "in"	277.0	277.0	277.0	277.0
Time	0930	1030	1130	1735
Charging Pump Integrator (1A Aux. Equip. Room)	OOS	000000	000001	000003

DUQUESNE LIGHT COMPANY
POWER STATIONS DEPARTMENT
SHIPPINGPORT ATOMIC POWER STATION

PERIODIC REACTOR PLANT
LEAK RATE TEST
DLCS 2110141 (T-641102)

FIGURE 1



SAMPLE CALCULATIONS FOR TABLE I

1. Method used to obtain the leak rate in gal/hr.

$$\frac{\text{Sight glass level increase (in.)}}{\text{Elapsed time needed for the run (min).}} \times \frac{60 \text{ min.}}{1 \text{ hr.}} \times .246 \frac{\text{gal.}^*}{\text{in.}} = \text{gal/hr.}$$

Leak rate for pressurizer relief valve 06-H15-1:

$$\frac{28.75 \text{ in.}}{26 \text{ min.}} \times \frac{60 \text{ min.}}{1 \text{ hr.}} \times .246 \frac{\text{gal.}}{\text{in.}} - 16.3 \text{ gal/hr.}$$

* Volume constant for the collection vessel.

2. Method used to obtain leak rate in lb/hr.

$$\frac{\text{Sight glass level increased (in.)}}{\text{Elapsed time for run (min.)}} \times \frac{60 \text{ min.}}{1 \text{ hr.}} \times .246 \frac{\text{gal.}}{\text{in.}} \times \frac{.134 \text{ ft}^3}{\text{gal.}} \times \rho tv \frac{\text{lb.}}{\text{ft}^3} = \frac{\text{lb.}}{\text{hr.}}$$

Where ρtv - Density of the saturated liquid at the saturation pressure in the collection vessel.

Pressurizer Relief Valve 06-H15-1

$$\frac{28.75 \text{ in.}}{26 \text{ min.}} \times \frac{60 \text{ min.}}{1 \text{ hr.}} \times .246 \frac{\text{gal.}}{\text{in.}} \times \frac{.134 \text{ ft}^3}{\text{gal.}} \times \frac{1 \text{ lb.}}{.0199 \text{ ft}^3} = 109.2 \frac{\text{lb.}}{\text{hr.}}$$

SAMPLE CALCULATIONS FOR TABLE II

1. Make-up to Reactor Coolant System by charging pump.

   No change.

2. Change in Pressurizer level.

   From Table V narrow range readings, 0921 - 105.5 inches
   1721 - 81.0 inches
   8 hrs. 24.5 inches decrease

   $\frac{24.5}{8}$ x 1.3 ft^3/in. x 40.03 lb/ft^3 = 159 lb/hr decrease.

3. Change in Blow-off Tank level

   From Table IV, 1721 - 60 13/16
   0921 - 58 13/16
   8 hrs. 2 inches increase

   $\frac{2 \text{ in.}}{8 \text{ hr.}}$ x 11.6 ft^3/in. x 61.61 lb/ft^3 = 179 lb/hr.

   Note: 11.6 ft^3/in is the average conversion factor in the 59" to 65" level range.

4. Change in Flash Tank level.

   No change.

5. Change in water volume due to Tavg. change.

   From Table V, 1721 - 500.2 F
   0921 - 500.1 F
   8 hrs. 0.1 F increase

   Since 4 loops were in operation, K_4 = 151.7 lb/F.

   $\frac{0.1 \text{ F}}{8 \text{ hrs.}}$ x 151.7 lb/F. = 1.9 lb/hr increase.

SAMPLE CALCULATIONS FOR TABLE II (cont'd)

6. Sample Train leakage.

None.

Total leakage = 159 + 1.9 = 160.9 lb/hr. x 0.12* gal/lb. = 19.3 gal/hr.

Leakage accounted for = 179 lb/hr x 0.12* gal/lb. = 21.5 gal/hr.

* Conversion based on 68 F and 14.7 psia.

LOG OF EVENTS

Date: 3/1/61

Time	Events
0900	Motor operated stop valve cycled and left in the position that closed 06-H2-5.
1026	Obtained initial sight glass reading for determination of leak rate for 06-H15-1.
1052	Obtained final sight glass reading, level increased 28 3/4 inches.
1100	Cycled motor operated stop valve and left it in the A position with 06-H2-6 closed.
1110	Obtained initial sight glass reading for determination of leak rate for 06-H15-10.
1123	Obtained final sight glass reading, level increased 30 1/2 inches.
1126	Cycled motor, operated stop valve 06-H2-3 and left it in closed position.
1142	Obtained initial sight glass reading for determination of leak rate for 06-H15-3.
1305	Obtained final sight glass reading, level increased 3 3/4 inches.
1310	Cycled motor operated stop valve and left it in a position with 06-H2-4 closed.
1315	Obtained initial sight glass reading for determination of leak rate for 06-H15-9.
1400	Obtained final sight glass reading, level increased 1/2 inch.
1405	Cycled motor operated stop valve 06-H2-2 and left it in the closed position.
1407	Motor operated stop valve began to leak water and continued to leak until test was completed.

LOG OF EVENTS (cont'd)

Time	Events
1442	Obtained initial sight glass reading for determination of leak rate for 06-H15-8.
1512	Obtained final sight glass reading, level increased 5.0 inches.
1510*	Cycled motor operated stop valve 06-H2-1 and left it in the closed position.
1534	Obtained initial sight glass reading for determination of leak rate for 06-H15-2.
1604	Obtained final sight glass reading, level increased 15.5 inches.
1610	Test completed.
Date: 3/2/61	
0900	1A, 1B, 1C and 1D loop hydraulic and motor operated stop valves are open.
	1A, 1B, 1C and 1D loop by-pass and loop drain valves are closed.
	Coolant discharge and vent system manually operated drain valves are in their normal position.
	Motor operated stop valves 06-H2-6, 1 and 3 are in the closed position.
	Sample train flow is off.
0921	Reactor coolant system leakage test started.
1521	Test completed.

* Error in time noted.

TEST EVALUATION DLCS 2110141
T-641102
PERIODIC REACTOR PLANT LEAK RATE TEST

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Approved (Duquesne Light Co.) George A Santel Date 6-14-61