DUQUESNE LIGHT COMPANY

SHIPPINGPORT ATOMIC POWER STATION

TEST RESULTS

DLCS 2130101
T-641124

MODIFIED PURIFICATION SYSTEM PERFORMANCE TEST

CORE I - SEED 1

Section 1 of 1 Section

First Issue, July 16, 1960

DISCLAIMER

TEST RESULTS

DLCS 2130101
T-641124

MODIFIED PURIFICATION SYSTEM PERFORMANCE TEST

CORE I - SEED 1

Purpose

To determine the overall effect of reduced coolant purification on the Reactor Plant.

Conclusion

The overall effects of reduced purification were increases in specific activity, gross gamma activity and the fission product activity of the Reactor Coolant System. There was also a general increasing trend to most activity in the Reactor Coolant System throughout core life. No definite conclusions can be made as to the effect of reduced purification on the activity and concentration of crud in the coolant because of inconsistent data. Reduced purification had no apparent effect on maintaining reference water conditions. The length of the power runs at both full and one half purification flow will be reduced to 100 or 150 EFPH in order to minimize the effects of core history on the test data in any future performance.

Description of Test Procedure and Test Equipment

The 1AC hairpin loop located in 1AC Purification Cubicle and a corresponding coolant loop were selected as test loops for the performance of this test. Following the completion of the first performance of DLCS 225, a new section of piping (Section No. 6 of Figure 1) was installed in the 1AC hairpin loop. The Reactor Plant was then operated at normal temperature and pressure with full flow through 1AC and 1BD purification loops. The Plant operated under these conditions for 1000 EFPH during which time Coolant Sampling System data was obtained. Upon completion of the second performance of DLCS 225, the 1AC test loop was surveyed. This included the draining and removal of the test section of piping for crud analysis and the subsequent installation of a new test section. The test was then repeated during the third performance of DLCS225 with 1BD purification loop isolated. During this performance of DLCS 225, the 1AC test hairpin loop was inadvertently isolated; therefore, that portion of DLCS 213 requiring one half of the normal purification flow for the Reactor Plant was performed during the fourth performance of DLCS 225. Following the completion of the fourth performance of DLCS 225, the 1AC hairpin test loop was surveyed and the test section of piping was cut out for analysis.

Results

DL-S-213, Modified Purification System Performance Test, Section I, First Performance was performed during the second and fourth 1000 hour runs (second and fourth performance of DL-S-225). During the second 1000 hour run extending from September 22, 1958 to November 3, 1958, the Reactor Plant operated with both the 1AC and 1BD purification loops in service. The Reactor Plant operated with only the AC purification loop in service during the third and fourth 1000 hour runs which extended from February 2, 1959 to May 22, 1959. The purification flow remained relatively constant at 20,000 lbs/hr in the respective loops for each part of the test. The concentration of crud in the Reactor Coolant System remained fairly constant throughout the test (See Table I of the appendix). However, the specific activity of the crud increased by approximately 50% when the Reactor Plant was operating with half of the normal purification flow.

The reduced purification flow during the fourth 1000 hour run appeared to have no effect on reference water conditions, i.e. pH, specific conductivity, and the lithium concentration which were maintained throughout the test.

The gross non-volatile gamma activity of the reactor coolant (influent to the demineralizers) remained fairly constant with both purification loops in service. However, when the 1BD purificatioon loop was taken out of service, the non-volatile gamma activity approximately doubled. The non-volatile gamma activity of the effluent from the demineralizer showed little change throughout the test.

The decontamination factor (D.F.) which is based upon the influent and effluent non-volatile 15 minute gamma activites, (D.F. = $\frac{\text{gross gamma non-volatile activity BIX}}{\text{gross gamma non-volatile activity AIX}}$), fluctuated throughout the test. However, there was a definite increase in influent activity when the purification flow was decreased. The fluctuations in the activities could be attributed to variations in the sampling rate.

The increase in the activity and the corresponding increase in the D.F. may be attributed to two factors; (a) Higher activities in the influent were the result of only one demineralizer in service and a slower clean-up rate, thus, permitting the demineralizers to use a greater percentage of its ion exchange potential; (b) during the fourth 1000 hour run, which was later in core life, the specific activity of crud and fission products in the coolant were at higher levels again permitting the demineralizers to use a greater percentage of its ion exchange potential.

It is apparent that the demineralizer has little effect on nuclides whose half lives are less than 30 minutes because these products have decayed before the demineralizer has had an opportunity to remove them. When the purification flow was reduced by a factor of two, the activities of the long lived nuclides were affected (increased by approximately a factor of two). The best example of this is I^{131} half life (8.05 days). The activity of I^{131} approximately doubled when purification flow was cut in half. Other good examples are Cs^{136} (13 days), Cs^{137} (30 years), Br^{83} (2.3 hrs.) and I^{131} (21 hrs.). A definite increase in the activity of these nuclides occurred when the purification flow was reduced.

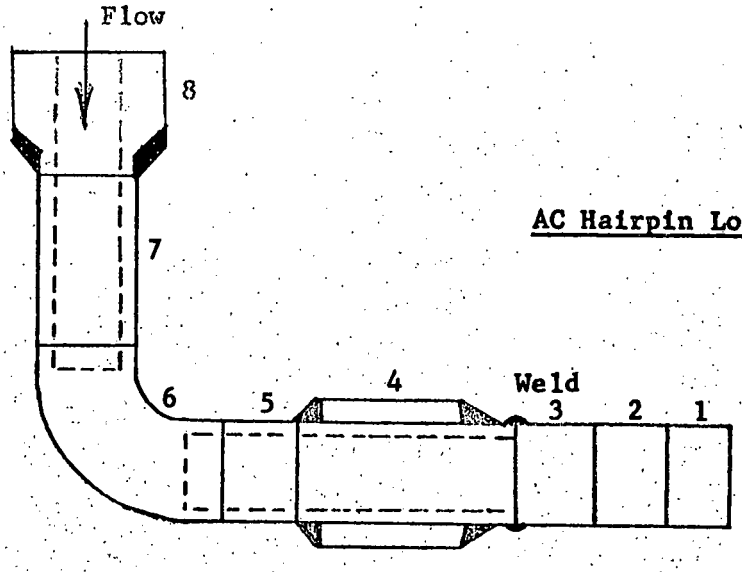
The activity of the intermediate and short lived nuclides is not only affected by purification ion exchange, but also by natural decay. From the data in Table IV, it is evident that the activity of these nuclides continued to increase after the purification flow was reduced, indicating that the production rate of these fission products was greater than the clean-up and decay rate. Some examples of these nuclides are Cs^{138} (32 min.), Cs^{139} (9.5 min.) and Br^{84} (32 min.). It is apparent that the purification demineralizer is more effective at decreasing the activity of the long lived nuclides in the reactor coolant. There was a general increasing trend to most of the fission product activites throughout corelife. This trend could be attributed to the fact that as core life progressed, the rods were raised higher exposing more core volume to the neutron flux field.

The analysis of the AC hairpin loop which was removed after each 1000 hours with full and half purification, indicates that there is a build-up of crud activity on the inside of the coolant piping. Referring to Figure 1, Sections 1, 2, 3 and 4, which made up the horizontal leg of the sample, had been in service approximately 4180 EFPH. The deposit on the inside surface of the sample was black and tightly adherent. Sections 5, 6, 7 and 8, which make up the vertical leg and one (No. 5) section of the horizontal leg, had been in service for 1000 EFPH. In these sections, the deposit was light in color, brownish to gray and tightly adherent.

Much of the crud characteristic data was unavailable because the 20 channel analyzer was out of service from April, 1959 to September of 1959. Since several half lives of the nuclides in the crud samples had passed (30-60 day half lives) the activity of the crud was so low that large errors were introduced when counting and correcting to the sampling date. Thus, most of this data was lost due to the natural decay of the products.

The gross soluble activity recorder was out of service throughout the performance of the test.

As a result of performing this test over periods of 1000 hour runs, the core history induces too many variables into the data, therefore, it is difficult to form good conclusions. The length of the power runs at both full and one half purification flow will be reduced to 100 or 150 EFPH in order to minimize the effects of core history on the test data.



AC Hairpin Loop Removed 5-19-59

The sections vary in area from 80 cm^2 to 110 cm^2.
Sections 1, 2, 3, and 4 were in service approximately 4180 EFPH.
Sections 5, 6, 7 and 8 were in service approximately 1000 EFPH.

Figure 1

Table of Content

TABLE I

Specific activity and concentration of crud

Source	Date	ppb.	% Fe_3O_4	cpm/mg
AC-BIX	9/13-9/20/58	1.8	82	1.4×10^6
AC-AIX	9/13-9/20/58	0.77	88	6.1×10^4
BD-BIX	9/22-9/28/58	3.5	104	7.1×10^6
BD-AIX	9/22-9/28/58	0.57	-	3.3×10^4
BD-BIX	9/28-10/6/58	5.0	81	2.5×10^6
BD-AIX	9/28-10/6/58	1.0	93	2.1×10^4
BD-BIX	10/6-10/13/58	3.0	-	2.1×10^6
BD-AIX	10/6-10/13/58	0.5	-	-
AC-BIX	10/13-10/20/58	4.0	-	5.7×10^6
AC-AIX	10/13-10/20/58	2.0	100	4.5×10^3
AC-BIX	10/20-10/27/58	2.2	92	6.5×10^6
AC-AIX	10/20-10/27/58	1.7	98	4.7×10^3
AC-AIX	10/27-11/3/58	0.58	98	1.1×10^7
AC-BIX	10/27-11/3/58	2.52	99	7.6×10^3
AC-BIX	2/3-2/9/59	27.9	82	6.4×10^6
AC-AIX	2/3-2/9/59	0.5	81	1.5×10^5
AC-BIX	2/11-2/16/59		Filter Burst	
AC-AIX	2/11-2/16/59		Filter Burst	
AC-BIX	2/16-2/20/59	5.9	98	4.9×10^6
AC-AIX	2/16-2/20/59	1.1	99	1.1×10^4
AC-BIX	2/20-2/27/59	1.7	96.2	6.77×10^6
AC-AIX	2/20-2/27/59	0.2	100	6.16×10^4
AC-BIX	2/27-3/9/59	7.1	98	8.6×10^6
AC-AIX	2/27-3/9/59	0.21	100	9.2×10^4
AC-BIX	3/9-3/16/59	11	105	9.4×10^6
AC-AIX	3/9-3/16/59	0.62	93	2.7×10^4
AC-BIX	3/16-3/24/59	8.5	90	1.0×10^7
AC-AIX	3/16-3/24/59	1.8	99	5.0×10^4
AC-BIX	3/23-3/30/59	3.1	101	1.15×10^7
AC-AIX	3/23-3/30/59	0.72	100	1.40×10^5
AC-BIX	4/5-4/11/59	2.0	94	1.1×10^7
AC-AIC	4/5-4/11/59	-	100	5.7×10^4
AC-AIX	4/12-4/18/59	-	100	1.1×10^7
AC-BIX	4/12-4/18/59	2.2	94	5.7×10^4
AC-BIX	4/19-4/25/59	4.2	100	1.4×10^7
AC-BIX	4/26-5/2/59	3.0	99	1.3×10^7
AC-BIX	4/27-5/4/59	2.3	-	9.5×10^6
AC-BIX	5/4-5/11/59	3.3	91	1.0×10^7
AC-AIC	5/4-5/11/59	0.2	97	5.5×10^6
AC-BIX	5/17-5/30/59	1.9	92	1.9×10^7
AC-BIX	5/25-6/1/59	2.9	92	2.1×10^7
AC-BIX	6/1-6/4/59	3.4	96	1.7×10^7

TABLE II

pH, conductivity and Li*concentration

Source	Date	Sp. cond. MMHOS	pH at 25 C	Li ppm
BD-AIX	9/12-10/4/58	18.8	9.86	0.56
BD-BIX	9/28-10/4/58	18.0	9.84	0.53
BD-BIX	10/7/58	19.7	9.90	0.50
BD-AIX	10/7/58	21.0	9.90	0.52
BD-BIX	10/14/58	17.7	9.93	0.56
BD-AIX	10/14/58	19.8	9.82	0.60
AC-BIX	10/24/58	20.0	9.85	0.45
AC-AIX	10/24/58	22.0	9.95	0.56
AC-AIX	10/28/58	17.1	9.75	0.49
AC-BIX	10/28/58	16.8	9.74	0.47
AC-AIX	10/31/58	17.5	9.81	0.47
AC-BIX	10/31/58	17.3	9.81	0.47
1000 hrs. during IV Performance of DL-S-225				
AC-BIX	3/27/59	18.9	9.91	0.51
AC-BIX	4/5/59	18.4	9.84	0.47
AC-BIX	4/8/59	18.1	9.89	0.52
AC-BIX	4/10/59	17.7	9.85	0.50
AC-BIX	4/14/59	13.0	9.70	0.30
AC-BIX	4/21/59	10.1	9.65	0.28
AC-BIX	4/26/59	18.9	9.89	0.55
AC-BIX	4/28/59	18.5	9.88	0.54
AC-BIX	5/5/59	24.3	10.0	0.72
AC-BIX	5/9/59	24.0	10.0	0.71
AC-BIX	5/12/59	21.2	9.95	0.63
AC-BIX	5/17/59	18.1	9.86	0.51
AC-BIX	5/22/59	16.4	9.83	0.58

* NOTE - 1/4 pound of Lithium was added on 4-22-59 and 5-4-59.

TABLE III

Gross Gamma Activity cpm/ml x 10^3

1000 hrs. during II Performance DL-S-225

Loop	Date	15 Min. Count x 10^3			120 Hr. Count x 10^3	
		BIX	AIX	DF	BIX	AIX
BD	9/19/58	20.2	0.16	126	2.30	0.11
BD	9/22/58	21.1	0.12	176	1.98	0.09
BD	9/23/58	22.5	0.52	43	1.23	0.06
BD	9/24/58	20.4	0.63	32	1.40	0.02
BD	9/25/58	21.9	1.48	15	1.67	0.05
BD	9/26/58	22.1	0.38	58	1.29	0.03
BD	9/27/58	24.5	0.68	36	0.82*	0.02*
AC	9/29/58	31.9	0.45	70	1.20	Background
AC	9/30/58	34.5	0.14	246	-	-
AC	10/1/58	29.1	0.31	94	1.24	0.04
AC	10/2/58	-	-	-	-	-
AC	10/3/58	-	-	-	-	-
AC	10/4/58	36.0	0.28	128	-	-
AC	10/5/58	26.4	0.38	70	1.90	0.005
AC	10/6/58	33.7	0.23	145	3.18	0.038
AC	10/7/58	31.1	0.27	115	-	-
BD	10/8/58	30.3	0.32	94	1.41	0.024
BD	10/9/58	24.8	0.33	76	2.02	0.004
BD	10/10/58	25.1	0.25	100	3.16	0.157
BD	10/11/58	30.0	0.60	50	2.16	0.017
BD	10/12/58	49.1	0.64	76	0.69	Background
BD	10/13/58	33.4	0.46	73	0.45	-
BD	10/14/58	32.3	0.27	120	0.27	Background
BD	10/15/58	30.0	0.53	60	0.53	0.039
BD	10/16/58	29.6	0.67	44	0.67	0.071
BD	10/17/58	26.2	0.55	48	0.54	0.042
BD	10/18/58	29.0	1.00	29	1.00	0.007
BD	10/19/58	24.0	0.58	41	1.43	0.29
BD	10/20/58	35.4	0.79	45	3.35	0.16
BD	10/21/58	25.6	0.38	67	0.48	0.05
AC	10/22/58	47.4	0.30	158	6.39	0.32
AC	10/23/58	50.5	0.37	136	8.04	0.27
AC	10/24/58	42.7	1.10	39	7.23	0.27
AC	10/25/58	26.6	0.28	95	2.67	0.27

TABLE III (cont'd)

Gross Non-volatile Gamma Activity cpm/ml x 10^3

Loop	Date	15 min. Count x 10^3			120 hr. Count x 10^3	
		BIX	AIX	DF	BIX	AIX
AC	2/4/59	102.0	0.510	200	44.1	0.036
AC	2/5/59	62.6	0.609	103	18.8	0.058
AC	2/6/59	51.7	0.387	134	7.65	0.132
AC	2/7/59	44.3	0.335	132	5.07	0.150
AC	/8/59	40.6	0.285	142	1.69	0.080
AC	2/9/59	45.2	0.410	110	5.74	0.061
AC	2/10/59	39.6	1.39	28	6.96	0.041
AC	2/11/59	37.0	0.235	157	1.09	0.026
AC	2/12/59	41.0	0.275	149	3.10	0.020
AC	2/13/59	46.5	0.246	189	5.18	0.019
AC	2/14/59	51.0	0.428	119	3.29	0.038
AC	2/15/59	53.5	0.240	226	2.41	0.018
AC	2/16/59	41.8	0.333	144	2.05	0.019
AC	2/17/59	39.8	0.535	134	2.48	0.021
AC	2/18/59	41.1	0.291	141	4.70	0.063
AC	2/19/59	35.9	0.300	120	4.69	0.040
AC	2/20/59	48.1	0.262	185	5.36	0.003
AC	2/21/59	49.4	0.100	494	11.4	0.038
AC	2/22/59	41.8	0.240	160	2.26	0.063
AC	2/23/59	44.8	0.281	160	2.23	0.112
AC	2/24/59	46.9	0.225	204	6.54	0.136
AC	2/25/59	40.3	0.199	203	33.2	0.044
AC	2/26/59	40.4	0.294	137	2.39	0.028
AC	2/27/59	35.4	0.281	126	2.09	0.024
AC	2/28/59	53.7	0.345	155	5.37	0.056
AC	3/1/59	46.6	0.415	112	3.37	0.118
AC	3/2/59	32.9	0.108	304	3.13	0.020
AC	3/3/59	48.3	0.101	478	1.91	0.038
AC	3/4/59	33.8	0.257	132	1.28	0.035
AC	3/5/59	45.9	0.273	168	5.40	0.027
AC	3/6/59	73.3	0.552	133	7.08	0.229
AC	3/7/59	66.9	0.273	244	6.26	0.040
AC	3/8/59	65.8	0.262	250	4.52	0.077
AC	3/9/59	53.4	0.177	310	6.20	0.015
AC	3/10/59	57.7	0.272	272	9.86	0.088
AC	3/11/59	56.2	0.205	274	7.89	0.112
AC	3/21/59	50.8	4.06	12		
AC	3/22/59	60.6	3.93	15	2.39	.043
AC	3/23/59	56.7	0.249	228	1.99	.080
AC	3/24/59	67.3	0.465	145	5.29	.139
AC	3/25/59	51.0	0.213	240	1.33	.085
AC	3/26/59	52.6	0.531	99	3.00	.278

TABLE III (cont'd)

Gross Non-volatile Gamma Activity cpm/ml x 10^3

Loop	Date	15 min. count x 10^3			120 hr. count x 10^3	
		BIX	AIX	DF	BIX	AIX
AC	3/27/59	54.7	8.50	6.4	2.49	.170
AC	3/28/59	52.2	0.330	158	3.73	.056
AC	3/30/59	57.4	0.639	90	1.71	.131
AC	3/31/59	48.2	0.761	63	2.64	.340
AC	4/1/59	63.0	2.28	27	12.4	.191
AC	4/2/59	51.2	0.265	192	3.63	.087
AC	4/3/59	47.7	0.583	82	2.52	.457
AC	4/4/59	53.7	0.439	122	4.15	.198
AC	4/5/59	49.9	0.911	55	3.20	.947
AC	4/6/59	53.6	0.606	88	12.7	.430
AC	4/7/59	50.1	0.402	124	2.69	.127
AC	4/8/59	56.9	0.440	129	1.52	0.06
AC	4/9/59	58.7	0.39	150	1.10	0.09
AC	4/10/59	58.5	0.46	127	3.19	0.05
AC	4/11/59	57.6	0.42	137	2.00	0.04
AC	4/12/59	58.2	0.47	124	2.56	0.14
AC	4/13/59	56.7	0.22	258	3.55	0.33
AC	4/14/59	58.2	0.35	166	3.58	0.42
AC	4/15/59	44.4	0.32	139	1.07	0.07
AC	4/16/59	66.0	0.48	138	2.06	0.02
AC	4/17/59	65.6	0.34	193	2.97	0.04
AC	4/18/59	-	-	-	-	-
AC	4/19/59	64.5	0.70	92	6.86	0.02
AC	4/20/59	62.1	0.38	163	4.67	0.02
AC	4/21/59	64.7	0.28	231	2.12	0.04
AC	4/22/59	60.7	0.17	357	1.38	0.04
AC	4/23/59	63.8	0.42	152	2.27	0.08
AC	4/24/59	68.3	0.55	124	-	-
AC	4/25/59	61.9	0.36	172	1.56	0.06
AC	4/26/59	64.9	1.07	61	3.51	0.81
AC	4/27/59	69.1	1.38	110	2.66	0.11
AC	4/28/59	65.3	2.27	140	2.13	0.03
AC	4/29/59	-	-	-	-	-
AC	4/30/59	-	-	-	-	-
AC	5/1/59	-	-	-	-	-
AC	5/2/59	-	-	-	-	-
AC	5/3/59	-	-	-	-	-
AC	5/4/59	-	-	-	-	-
AC	5/5/59	136.7	0.485	282	54.38	.058
AC	5/6/59	89.8	0.387	232	8.43	.079

TABLE III (cont'd)

Gross Non-volatile Gamma Activity cpm/ml x 10^3

Loop	Date	15 min. count x 10^3			120 hr. count x 10^3	
		BIX	AIX	DF	BIX	AIX
AC	5/9/59	82.3	0.463	178	7.24	.089
AC	5/10/59	92.93	0.264	352	17.5	.054
AC	5/11/59	76.03	0.498	153	4.45	.037
AC	5/12/59	72.23	0.556	130	2.63	.054
AC	5/13/59	62.56	0.212	295	3.11	.072
AC	5/14/59	61.50	0.144	427	3.96	.032
AC	5/15/59	61.70	0.386	160	2.71	.118
AC	5/16/59	60.89	0.243	251	2.20	.035
AC	5/17/59	62.37	0.270	231	3.71	.106
AC	5/18/59	57.13	0.120	476	2.08	.693
AC	5/19/59	51.40	0.271	190	-	-
AC	5/20/59	54.03	0.508	106	-	-
AC	5/21/59	61.65	0.553	111	1.17	.372
AC	5/22/59	-	-	-	-	-

DUQUESNE LIGHT COMPANY
POWER STATIONS DEPARTMENT
SHIPPINGPORT ATOMIC POWER STATION

MODIFIED PURIFICATION SYSTEM PERFORMANCE TEST
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TABLE IV

dpm/ml x 10^3

Half Life																													
							44h								2.3d					10d									
	% Power	Source	13d Cs^{136}	30y Cs^{137}	32m Cs^{138}	9.5m Cs^{139}	10.4y Kr^{85}	7.8m Kr^{87}	2.8h Kr^{88}	2.3h Br^{83}	32m Br^{84}	5.7d Xe^{133}	9.2h Xe^{135}	Xe^{138}	8.05d I^{131}	21h I^{135}	54d Sr^{89}	28y Sr^{90}	9.7h Sr^{91}	2.7h Sr^{92}	85m Ba^{139}	1.8h A^{41}	H^3	(μc/l)
9/22/58	94	BD													.25	1.6								
9/23/58	100	BD					2.0	1.6	3.3	.19	.43	11.0	6.4	3.8								3.2		
9/24/58	100	BD			7.7										.16	.16								54
9/25/58	100	BD	.0005	.002	7.7	2.6			9.0															
9/26/58	100	BD					2.0	1.8	14.0			14.0	7.0	4.6								18		
9/27/58	100	BD			9.8				14.0															
9/28/58	100	BD																						
9/29/58	100	BD	.00064	.0014	7.8	2.5									.22	2.7								
9/30/58	100	AC							16	.18				4.6								49		
10/1/58	100	AC			9.4		3.5	3.4				42			.22	2.8						18		97
10/2/58	100	AC																						
10/3/58	100	AC					2.9	2.5				35										13		
10/4/58	100	AC							10						.30	2.9	1.4							
10/5/58	100	AC					3.1	2.5				45										11		
10/6/58	100	AC	.0005	.0032	7.9	3.8			12						.25	2.6								
10/7/58	100	AC			8.2		2.9	2.9	12			57	8.9									9.5		138
10/8/58	100	AC			9.5		3.0	2.6				51	9.0	4.7	.26	2.8						8.4		
10/9/58	100	AC			7.0										.25	3.0								
10/10/58	100	AC			6.9	2.4			14	.18	.64			4.8										
10/11/58	100	BD			7.8																			155
10/12/58	100	BD			7.5		3.9	2.7	11			66	10									7.6		160
10/25/58	100	BD			11.0		2.4	1.6	9.2			44	8.6									3.6		
10/26/58	100	BD																				7.3		241
10/27/58	100	BD			9.7										.22	2.2								
10/28/58	100	BD					3.7	3.0	16	.28	.87	76	8.8	4.5								6.6		
10/29/58	100	BD			10										.31	2.9								
10/30/58	100	BD							15															
10/31/58	100	BD			7.8		5.2	4.1	13	.28	.76	93	15		.34	3.5								
11/1/58	100	BD			9.1				10						.31	2.8								279
11/2/58	100	BD																						
11/3/58	100	BD																						

DUQUESNE LIGHT COMPANY
POWER STATIONS DEPARTMENT
SHIPPINGPORT ATOMIC POWER STATION

MODIFIED PURIFICATION SYSTEM PERFORMANCE TEST
DLCS 2130101
T-641124

TABLE IV (cont'd)

dpm/ml x 10^3

	Power %	Hist. Thrs.	Cs^{136}	Cs^{137}	Cs^{138}	Cs^{139}	Kr^{85m}	Kr^{87}	Kr^{88}	Br^{83}	Br^{84}	Xe^{133}	Xe^{135}	I^{131}	I^{133}	Sr^{89}	Sr^{90}	Sr^{91}	Sr^{92}	Ba^{139}	Ba^{140}	A^{41}	H^3 µc/l
2/4/59	94	I0	0.0084	0.0086	10																		
2/5/59	95	34			13															1.6			28
2/6/59	95	58				9.2			7.1					0.61	6.6								
2/7/59	96	82												0.45	4.4					0.68			
2/8/59	96	106																					
2/9/59	96	131			16									0.47	5.4								
2/9/59	96	133				8.4			16	0.40	1.1									1.0			
2/10/59	96	155	0.0022	0.0038																1.4			
2/11/59	96	183			15									0.48	5.1								60
2/12/59	95	204										28	10										
2/13/59	97	228					2.5	2.1	14					0.57	5.1			0.45	0.33			4.4	
2/14/59	95	252			16																		
2/15/59	96	275																					
2/16/59	96	299	0.001	0.002	17	7.5																	
2/17/59	96	323					1.9	2.0	9.5	0.84	1.9	33	9.2									2.6	
2/18/59	96	346			17																		90
2/19/59	96	370							7.2														
2/20/59	100	395					1.4	1.5	7.4			28	6.5	0.44	5.2			0.41	0.29			3.3	
2/21/59	100	419			14				8.4														
3/1/59	98	611			16				8.7														
3/2/59	97	641			14	7.2	1.3	1.0	8.2			34	5.3									3.7	
3/3/59	96	659							8.8	0.58	1.8							.081					
3/4/59	96	689			14															.65			
3/5/59	71	713					1.0	0.99	16									.047					
3/6/59	98	731			18				13													2.3	
3/7/59	96	758			16							33	4.3										
3/8/59	97	771																					
3/19/59	25	-			5.2				12	0.34	0.59												
3/20/59	98	-																					
3/21/59	98	42.3			17				8.2														
3/22/59	99	68																					
3/23/59	96	90			17																		
3/24/59	95	111							7.8	0.29	0.47												
3/25/59	95	135			16		1.0					10	3.4									1.2	
3/26/59																							

TABLE IV (cont'd)

Fission Product Activities dpm/ml x 10^3

Date	% Power	Cs^{136}	Cs^{137}	Cs^{138}	Cs^{139}	Kr^{85}	Kr^{87}	Kr^{88}	Br^{83}	Br^{84}	Xe^{133}	Xe^{135}	Xe^{138}	I^{131}	I^{133}	I^{135}	Sr^{89}	Sr^{90}	Sr^{91}	Sr^{92}	Ba^{139}	A^{41}	µc/l H-3
3/27/59	97			17															0.28	0.15			
3/28/59	98							10												0.20			
3/29/59	80																						
3/30/59	97	.0034	.0077		23.7	4.6	1.5				5.3	9.7		.565	5.35							2.1	
3/31/59	80	.0016	.0075	19				6.4	0.80	2.3									0.31	0.21			
4/1/59	81			14				7.07										0.23	0.32	0.21			
4/11/59	97			19																			
4/13/59	100	.0016	.0074	23	10									.46	5.8								
4/14/59	99							10	1.2	2.1													
4/15/59	99			20										.76	7.2								243
4/16/59	98					2.3	3.3				5.5	10									1.0	2.4	
4/17/59	96							13						.85	6.9								
4/20/59	87	.0028	.0094	19	14									.64	4.4								239
4/21/59	100					2.1	4.1	18	1.0	1.7	7.7	11				.083					1.5	1.9	
4/22/59	100			19										.68	6.9								244
4/23/59	100															.032					.87		
4/24/59	100							10						.66	7.2								
5/12/59	96							13	0.99	1.5													253
5/13/59	100				21																		
5/14/59	100																				1.1		
5/15/59	100							13											0.26	0.14			
5/16/59	100				22			15															
5/17/59																							
5/18/59																							
5/19/59																							
5/20/59																							
5/21/59																							
5/22/59																							

TABLE V

Date	Source	Conductivity MMho	Purification Loop Flow lb/hr x 10^3 AC	BD
9/22/58	BD-AIX	31.5	20.2	20.0
	BD-BIX	19.0		
9/23/58	BD-AIX	24.0	20.2	20.0
	BD-BIX	16.5		
9/24/58	BD-AIX	23.0	20.2	20.0
	BD-BIX	21.0		
9/25/58	BD-AIX	22.5	20.2	20.0
	BD-BIX	21.0		
9/26/58	BD-AIX	23.0	20.1	20.1
	BD-BIX	21.0		
9/27/58	BD-AIX	24.0	20.0	20.0
	BD-BIX	21.0		
9/28/58	BD-AIX	24.0	20.2	20.2
	BD-BIX	21.0		
9/29/58	AD-AIX	24.0	20.1	20.1
	AD-BIX	21.0		
9/30/58	AC-AIX	24.0	20.5	20.2
	AC-BIX	21.0		
10/1/58	AC-AIX	24.5	20.3	20.2
	AC-BIX	16.0		
10/2/58	AC-AIX	25	20.3	20.2
	AC-BIX	21		
10/3/58	AC-AIX	23.0	20.2	20.1
	AC-BIX	20.0		
10/4/58	AC-AIX	0.48	20.2	20.1
	AC-BIX	0.44		
10/5/58	AC-AIX	0.48	20.1	20.1
	AC-BIX	0.44		
10/6/58	AC-AIX	22	20.1	20.1
	AC-BIX	24		
10/7/58	BD-AIX	24	20.0	20.2
	BD-BIX	22		
10/8/58	BD-AIX	24.5	20.0	20.1
	BD-BIX	22		
10/9/58	BD-AIX	24	20	20
	BD-BIX	22		
10/10/58	BD-AIX	23.5	19.8	20.0
	BD-BIX	21.0		
10/11/58	BD-AIX	24.0	19.9	20
	BD-BIX	23.0		
10/12/58	BD-AIX	22.5	19.8	20
	BD-BIX	20.5		

TABLE V (cont'd)

Date	Source	Conductivity MMho	Purification Loop Flow lb/hr x 10^3 AC	BD
10/13/58	BD-AIX	22.0	19.8	20
	BD-BIX	20.0		
10/14/58	BD-AIX	22.0	19.8	20
	BD-BIX	21.0		
10/15/58	BD-AIX	22.0	19.8	20
	BD-BIX	18.0		
10/16/58	BD-AIX	22.0	19.8	20
	BD-BIX	20.0		
10/17/58	BD-AIX	23.0	19.8	20
	BD-BIX	20.0		
10/18/58	BD-AIX	22.0	19.7	19.9
	BD-BIX	20.0		
10/19/58	BD-AIX	22.0	19.7	19.9
	BD-BIX	20.0		
10/20/58	BD-AIX	23.0	19.9	20
	BD-BIX	25.0		
10/21/58	BD-AIX	22.0	19.7	20
	BD-BIX	20.0		
10/22/58	AC-AIX	22.0	19.8	20
	AC-BIX	22.0		
10/23/58	BD-AIX	21.0	19.5	20
	BD-BIX	19.9		
10/24/58	BD-AIX	16.5	19.5	20
	BD-BIX	21.5		

TABLE V (cont'd)

Date	Source	Conductivity MMho	Purification Loop Flow lb/hr x 10^3 AC
3/28/59	AC-BIX	20.0	19.9
	AC-AIX	22.5	
	AC-BIX	20.0	
3/29/59	AC-BIX	19.8	19.8
	AC-AIX	22.0	
	AC-BIX	19.3	
3/30/59	AC-BIX	19.5	19.8
	AC-AIX	21.8	
	AC-BIX	19.2	
3/31/59	AC-BIX	19.0	19.7
	AC-AIX	21.3	
	AC-BIX	18.9	
4/1/59	AC-BIX	18.5	20
	AC-AIX	20.9	
	AC-BIX	18.2	
4/2/59	AC-BIX	18.3	20
	AC-AIX	20.5	
	AC-BIX	18.1	
4/3/59	AC-BIX	18.0	19.8
	AC-AIX	20.0	
	AC-BIX	17.8	
4/4/59	AC-BIX	17.9	19.5
	AC-AIX	19.9	
	AC-BIX	17.3	
4/5/59	AC-BIX	17.5	19.2
	AC-AIX	19.5	
	AC-BIX	17.2	
4/6/59	AC-BIX	17.5	19.1
	AC-AIX	19.1	
	AC-BIX	17.0	
4/7/59	AC-BIX	17.0	19.1
	AC-AIX	18.9	
	AC-BIX	16.5	
4/8/59	AC-BIX	16.8	19.1
	AC-AIX	19.0	
	AC-BIX	16.3	
4/9/59	AC-BIX	15.0	19.2
	AC-AIX	19.0	
	AC-BIX	16.5	

TABLE V (cont'd)

Date	Source	Conductivity MMho	Purification Loop Flow lb/hr x 10^3 AC
4/10/59	AC-BIX	26.0	19.0
	AC-AIX	18.0	
	AC-BIX	16.0	
4/11/59	AC-BIX	30.0	19.0
	AC-AIX	-	
	AC-BIX	-	
4/12/59	AC-BIX	32.0	19.0
	AC-AIX	18.0	
	AC-BIX	16.0	
4/13/59	AC-BIX	15.5	19.0
	AC-AIX	18.2	
	AC-BIX	16.0	
4/14/59	AC-BIX	17.5	19.0
	AC-AIX	15.5	
4/15/59	AC-BIX	18.0	19.0
	AC-AIX	18.0	
	AC-BIX	16.0	
4/16/59	AC-BIX	19.0	19.0
	AC-AIX	18.0	
	AC-BIX	15.0	
4/17/59	AC-BIX	20.0	19.0
	AC-AIX	17.0	
	AC-BIX	16.0	
4/18/59	AC-BIX	OOS	18.8
	AC-AIX	OOS	
	AC-BIX	OOS	
4/19/59	AC-BIX	15.0	19.0
	AC-AIX	18.0	
4/20/59	OOS	-	19.0
		-	
4/21/59	AC-AIX	18.0	19.0
	AC-BIX	15.0	
4/22/59	AC-AIX	28.0	19.0
	AC-BIX	30.0	
4/23/59	AC-AIX	28.0	19.0
	AC-BIX	25.0	
4/24/59	AC-AIX	26.0	19.0
	AC-BIX	20.0	
4/25/59	OOS	-	19.0

TABLE V (cont'd)

Date	Source	Conductivity Mmho	Purification Loop Flow lb/hr x 10^3 AC
4-26-59	AC-AIX	28.5	19.0
	AC-BIX	25.0	
4-27-59	O.O.S.	-	19.0
		-	
4-28-59	O.O.S.	-	19.0
		-	
4-29-59	O.O.S.	-	19.0
		-	
4-30-59	AC-AIX	25.0	19.0
	AC-BIX	23.0	
5-1-59	AC-AIX	23.0	19.0
	AC-BIX	20.0	
5-2-59	O.O.S.	-	8.0
		-	
5-3-59	O.O.S.	-	10.2
		-	
5-4-59	AC-AIX	30.0	20.0
	AC-BIX	30.0	
5-5-59	AC-AIX	30.0	20.0
	AC-BIX	25.0	
5-6-59	AC-AIX	27.0	20.0
	AC-BIX	25.0	
5-7-59	AC-AIX	28.0	20.0
	AC-BIX	25.0	

TABLE V (cont'd)

Date	Source	Conductivity Mmho	pH 25 C	Purification Loop Flow lb/hr x 10^3 AC
5/8/59	AC-AIX	27.0		21.2
	AC-BIX	25.0		
5/9/59	OOS	-		20.0
		-		
5/10/59	OOS	-		20.0
		-		
5/11/59	OOS	-		19.8
		-		
5/12/59	OOS	-		19.8
		-		
5/13/59	AC-BIX	-	10.92	19.8
	AC-AIX	23.0	10.65	
	AC-BIX	20.0	9.50	
5/14/59	AC-BIX	1	10.95	19.5
	AC-AIX	1	10.22	
	AC-BIX	1	10.45	
5/15/59	AC-BIX	-	11.00	19.5
	AC-AIX	25.0	10.20	
	AC-BIX	24.0	10.05	
5/16/59	AC-BIX	-	9.5	19.4
	AC-AIX	-	10.15	
	AC-BIX	24.0	9.40	
5/17/59	AC-BIX	-	10.85	19.2
	AC-AIX	23.0	10.10	
	AC-BIX	32.0	9.25	
5/18/59	AC-BIX	1	10.90	19.5
	AC-AIX	1	10.60	
	AC-BIX	1	9.50	
5/19/59	AC-BIX	1	10.70	20.4
	AC-AIX	1	10.00	
	AC-BIX	1	9.20	
5/20/59	OOS			20.0
5/21/59	OOS			20.4
5/22/59	OOS			20.0

TABLE VI

Crud Characteristics
Specific Activity dpm/mg

Source	Period	Fe^{59}	Co^{58}	Co^{60}	Hf^{181}	Zr^{95}	Cr^{51}	Mn^{54}
BD-BIX	10/6-10/20/58	5.9×10^5	4.6×10^6	1.4×10^7	1.5×10^5	1.7×10^5	2.1×10^6	
AC-BIX	10/20-10/27/58	3.2×10^5	2.7×10^6	1.1×10^7	3.0×10^5	2.6×10^5	2.1×10^6	
AC-BIX	10/27-11/3/58	5.8×10^5	2.2×10^6	1.3×10^7	4.6×10^5	6.7×10^5	2.8×10^6	
AC-BIX	2/3-2/9/59	1.3×10^6	1.7×10^6	1.1×10^7	2.3×10^5	8.6×10^4	2.7×10^5	1.4×10^6
AC-BIX	2/20-2/27/59	3.5×10^6	3.5×10^6	1.3×10^7	1.0×10^5	2.7×10^5	3.7×10^6	1.4×10^6
AC-BIX	3/2-3/9/59	4.0×10^6	4.7×10^6	1.6×10^7	1.5×10^5	1.8×10^5	5.6×10^6	1.8×10^6
*								
AC-BIX	5/18-5/22/59	1.46×10^6		1.4×10^7				1.26×10^6
AC-BIX	5/6-5/11/59			1.5×10^7				1.69×10^6
AC-BIX	4/20-4/27/59			1.6×10^7				1.3×10^6

* Samples were counted in September and corrected back to 120 hrs. after sampling.

TABLE VII

AC Hairpin Loop Analysis 11-3-58

Gross Gamma Activity cpm-cm^2 1.16×10^5

Isotope	Fe^{59}	Co^{58}	Co^{60}	Cr^{51}	Hf^{181}	Zr^{95}
Activity	1.94×10^4	1.03×10^5	1.65×10^5	4.4×10^3	2.6×10^3	3.5×10^3

AC Hairpin Loop Analysis 5-21-59

	*Section No. 7	*Section No. 2
Isotope	dpm-cm^2	dpm-cm^2
Fe^{59}	9.69×10^3	1.56×10^4
Co^{60}	7.82×10^4	2.1×10^5
Mn^{54}	1.14×10^4	2.8×10^4

* See Figure 1

TEST RESULTS DLCS 2130101
T-641124
MODIFIED PURIFICATION SYSTEM PERFORMANCE TEST (cont'd)

Results Prepared By Ralph L. Nelson

Results Reviewed By Ralph L. Nelson

Approved (Duquesne Light Company) E. J. Jones Date 8-16-60