DLCS 5000468

MASTER

DUQUESNE LIGHT COMPANY
Shippingport Atomic Power Station

Quarterly

OPERATING REPORT

Fourth Quarter
1968

Contract AT-11-1-292

United States Atomic Energy Commission

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Duquesne Light Company
Shippingport Atomic Power Station
Power Stations Department

QUARTERLY OPERATING REPORT

~~Fourth Quarter 1969~~ 1968

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Approved By

F. J. Bissert

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Superintendent

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Preface

This Quarterly Report is prepared and issued by the Duquesne Light Company to disseminate information relative to all significant activities conducted at the Shippingport Atomic Power Station. Consistent with the premise that Shippingport was built to provide information and not power at competitive costs, this report makes no effort to analyze power production costs and makes no deductions regarding costs which might be achieved if Shippingport had been built and operated solely to produce power.

In preparation of these reports, it has been presumed that the reader has a working knowledge of nuclear reactors, reactor technology and/or electric utility generating station operations. The reader is reminded, however, that this is an operating report rather than a technical report. Anyone desirous of obtaining advice on recent technical progress related to the nuclear portion of the Shippingport Atomic Power Station is therefore referred to the United States Atomic Energy Commission, Office of Technical Information Extension at Oak Ridge, Tennessee, where this information is readily available.

1. SUMMARY OF OPERATIONS

Operations at Shippingport Atomic Power Station during October, November and December 1968, principally involved extended core lifetime maximum power level operation for core depletion prior to scheduled refueling operations. Testing, training and maintenance were also performed as required during this phase of Station operation. The HDS remained shutdown during the report period.

The Station operated at 500° F average reactor coolant temperature with the 1A, 1C and 1D reactor coolant loops in service until October 12 when the Station was shutdown as scheduled. During the shutdown, the 1B reactor coolant loop was returned to service following extensive steam generator tube testing and repairs. The Station was returned to power operation at 5:31 AM, October 14, 1968.

A reactor scram occurred November 5 at 1:23 AM. The Station returned to power at 2:02 PM following the Xenon transient which prevented earlier criticality of the reactor. Since the origin of the scram, caused by NPS Channel 1A Power/flow circuitry, was unknown the protective function of this channel was disabled to permit further investigation. Subsequently, an investigation of channel components revealed a faulty trip bistable MB module which was replaced. Following a checkout and observation of the new module's performance, the channel 1A scram circuitry was returned to service November 16, 1968.

The Station was shutdown on December 13 for Operation Supervisor training. During the training cycle two incidents occurred. The first was due to inadvertently energizing the modified Core I 1B reactor coolant pump in fast speed at a coolant temperature below the allowable operating range for fast speed operation. Investigation indicated that no damage had occurred to the pump since it was operated in fast speed only a brief time prior to shutting it off. The second incident occurred December 15 when a steam leak was observed on the 1B reactor coolant loop 18 inch reactor inlet manual stop valve. The 1B loop was then isolated from the reactor and the main unit returned to power at 8:22 PM. (See Maintenance Section for details.) Following completion of weld repairs a hydrostatic test of the valve was successfully performed December 30. Preparations to return the loop to service were in progress at the end of this report period.

Generator Output, HDS Load and Reactor Coolant Temperature During
Fourth Quarter 1968

FIGURE 1

2. SUMMARY OF CORE 2 STATION PERFORMANCE

Electrical output (Gross) to date.....kwhr	1,893,805,300
EFPH to date (Blanket operating time).....hr	13,267.5
EFPH to date (Seed 1 operating time).....hr	13,267.5
EFPH for the quarterly period.....hr	786.3
Hours reactor critical to date.....hr	27,389.6
Hours reactor critical for the quarterly period....hr	2,110.4
No. 1 main unit service hours (quarterly period)...hr	2,100.9
Net Station output (quarterly period).....kwhr	95,466,100
No. of forced outages* (quarterly period).....	1

* Interruption of electrical output due to protective relay action and/or operator action as required to protect the Station.

3. CHEMISTRY

In the fourth quarter, the chemistry section maintained the required chemical specifications of the various plant systems and contributed to the test program through participation in the following tests:

DLCS 58001	Reactor Coolant Fission Product Activity
DLCS 59507	Investigation of the Effect of Hydroxide Ion Concentration on Core Pressure Drop

Reactor Plant

Operation at 500° F Tavg began September 29, with test DLCS 59507 in effect, and continued for all power operations until December 6, when the 500° F Tavg phase of the test was completed. During the period September 29 through December 6 the pH level was controlled at $9.90 \pm .05$ until October 30, after which the pH level was maintained at $10.05 \pm .05$ through December 6. After December 6, reactor coolant conditions were maintained in accordance with the Station Manual.

In the fourth quarter the 1A, 1C and 1D loops were in service during all power operations. The 1B loop was in service from October 12 until December 15 when it was taken out of service because of a leak at the manual loop isolation valve. Tables I and II summarize reactor coolant water conditions observed during power operation and Reactor Plant shutdown periods.

The Component Cooling Water System was maintained within specifications during the report period. There was one instance when the canal water was out of specification however, specifications were returned to normal by recirculation through the canal water demineralizer. A gradual improvement of primary storage tank water conditions was effected through dilution with make-up water until specifications were obtained November 2. The primary charging water remained within specification except for one 0.2 low pH due to CO₂. The water conditions of the Reactor Plant Auxiliary Systems are summarized in Table III.

The Cesium - 138 activity of the reactor coolant was determined on a routine basis during all plant power operations. The following tabulation lists the average Cesium - 138 values calculated for each month of the report period. All values in the average were corrected to 67 percent reactor power, four reactor coolant loops, two purification demineralizers in service at 33,000 lb/hr flow and 536° F Tavg operation.

Average Cesium - 138 Activity

<u>Month</u>	<u>dpm/ml</u>	<u>uc/ml</u>	<u>No. of Observations</u>
October	632	2.88×10^{-4}	23
November	658	2.99×10^{-4}	30
December	665	3.03×10^{-4}	27

At 12,585 EFPH on October 15, 1968 the reactor coolant tritium activity was 14 uc/liter. The values observed in the first, second and third quarters of 1968 were 20, 19 and 18 uc/liter respectively.

Activity calculations were completed during the fourth quarter from samples obtained during the eighth performance of test DLCS 58001, Reactor Coolant Fission Product Activity. The ninth performance of the test was performed during the Station start-up December 15. No evidence of fuel failure was found during either performance of the test.

The AC purification demineralizer was in service until October 13. The BD purification demineralizer was placed in service October 12 and remained in service through the end of the quarter. During a Station start-up October 14 with four loop operation, following the return to service of the 1B reactor coolant loop, a crud release occurred. Specific activities of crud samples indicated the release was from the core region. The gross non-volatile gamma activity at the inlet to the operating purification demineralizer after 15 minutes decay was approximately 35,000 cpm/ml at 37% reactor power after subtraction of the 120 hr gross non-volatile gamma activity. Sixty-two 120 hr gross gamma activities exceeded 2000 cpm/ml during the quarter. Twenty determinations of the 15 minute DF were obtained during the report period. The DF ranged from 60 to 260 for three observations of the AC purification demineralizer; and from 58 to 2103 for seventeen observations of the BD purification demineralizer. Two routine crud samples were obtained at the inlet of the AC purification demineralizer during the first two weeks of the report period. The observed crud concentrations were 12.9 ppb and 47.9 ppb. The specific activities of the cruds were 2.49×10^7 cpm/mg and 1.97×10^6 cpm/mg. Thirty-two crud samples were obtained at the inlet of the BD purification demineralizer beginning with the crud release observed October 14 through the end of the quarter. The highest crud concentration observed was 234 ppb and the initial specific activities were approximately 6.5×10^7 cpm/mg. At the end of the report period crud concentration and specific activities at the inlet to the BD purification demineralizer were approximately 10 ppb and 3.0×10^7 cpm/mg.

Turbine Plant

Control of boiler water chemistry continued according to Station Manual specifications. The 1A, 1C and 1D boilers were utilized for all power operations during the quarter. The 1B boiler was in service for all power operations between October 14 and December 13. The 1B boiler was under cold lay up specifications from October 1 through 12 and again from December 18 through the end of the quarter. The 1A, 1C and 1D boilers were maintained under hot lay up specifications during the short periods they were not utilized for power production. No evidence of primary to secondary leakage was detected throughout the report period. Several out of specification chloride values were observed in December. Reference water conditions were restored by blowdown.

Boiler water conditions observed during power operations are summarized in Table IV. Table V contains hot lay up water conditions observed for the 1A, 1B, 1C and 1D boilers. Also included in Table V are the cold lay up water conditions of the 1B boiler. Due to incomplete mixing one low hydrazine concentration was obtained upon cold lay up of the 1B boiler.

Radioactive Waste Disposal

Radioactive liquid waste was processed from ten surge and decay tanks during the quarter. All water processed was suitable for discharge to the environment. The tritium content of the processed water ranged from 7.2 to 13.7 uc/liter. The Xe^{133} activity of the Vent Gas System ranged from 3.5 dpm/cc (1.6×10^{-6} uc/cc) to 13.2 dpm/cc (6.0×10^{-6} uc/cc) in the report period.

TABLE I
Reactor Coolant System
Water Conditions and Chemical Adjustments
Operating Conditions

October 1 - December 31, 1968

Chemical Condition	Date (Note)	Specifications	Analytical Results Min. Max.		NH ₄ OH Additions Liters	Degasification Hours
1. pH @ 25° C	1	9.90 ± 0.05	9.80	9.98	36.4	7.3
	2	10.05 ± 0.05	9.97	10.13	54.1	
	3	10.20 ± 0.10	9.95	10.30	69.2	
2. Specific Conductivity umhos	1	---	18.9	31.0		
	2	---	27.0	39.5		
	3	---	25.3	53.5		
3. Ammonia - ppm	1	---	5.0	14.0		
	2	---	10.0	17.3		
	3	---	9.6	39.5		
4. Total Gas - cc/kg	1	125 Maximum	28	70		
	2	125 Maximum	65	89		
	3	125 Maximum	45	107		
5. Hydrogen - cc/kg	1		11	31		
	2	10 - 60	24	32		
	3		22	51		

Note 1 October 1 - October 30, 1968

Note 2 October 31 - December 5, 1968

TABLE II

Reactor Coolant System

Water Conditions and Chemical Adjustments

Shutdown Conditions

October 1 - December 31, 1968

Chemical Conditions	Temp.	Date (Note)	Specifications	Analytical Results Min. Max.	NH ₄ OH Additions Liters	H ₂ Additions cu. ft.
1. pH @ 25° C	>200° F	1	9.85 - 9.95	9.83 - 9.98	1.90	none
		2	10.10 - 10.30	10.15 - 10.16	none	none
2. Total Gas - cc/kg	>200° F	1	80 cc/kg max.	28 - 60		
		2	80 cc/kg max.	32 - 37		
3. Hydrogen - cc/kg	>200° F	1	10 - 60 cc/kg	11 - 21		
		2	10 - 60 cc/kg	17 - 19		

Note 1 - For Shutdown Period 10/12 - 13/68

Note 2 - For Shutdown Period 12/14 - 15/68

TABLE III

Reactor Plant Auxiliary Systems

Water Conditions

October 1 - December 31, 1968

System	Specific Conductivity umhos	pH at 25° C	Cond. - ppm			Gross Gamma* Activity-dpm/ml
			CrO ₄	-Cl	Dis. O ₂	
Component Cooling Specifications	none	8.30-10.50	500-1000	<1.0	none	***
Observed	1820-2150	8.45- 8.70	762- 979	0.05-0.65	-	Bkgd. - 26 ± 10
Coolant Charging Water Specifications	<2.5	6.00- 8.00	none	<0.1	**	none
Observed	1.10-6.10	5.80- 8.92		<0.05-0.05	2.4-9.8	-
Canal Water Specifications	<5.0	6.00- 8.00	none	none	none	none
Observed	1.55-5.60	6.70- 7.55	-	-	-	17 ± 11 - 37 ± 11

* Multiply tabular value by 4.55×10^{-7} to obtain uc/ml.

** Should be <0.14 ppm for reactor plant cold shutdown

*** Normally near background

TABLE IV

Operating Boiler Water Chemistry

Water Conditions

October 1 - December 31, 1968

Water Conditions	Specifications	Operating Boilers			
		1A	1B	1C	1D
1. Dis. Salts - ppm	Min. --- Max. 1000	40 147	43 250	28 177	40 161
2. Phosphate - ppm	Min. 5 Max. 100	14 92	8 100	8 100	16 100
3. Chloride - ppm	Min. 0 Max. 0.5	0.21 0.65	0.15 0.70	0.20 0.73	0.25 0.68
4. Hydrazine - ppm	Min. (residual) Max. (residual)	0.047 0.163	0.030 0.100	0.029 0.181	0.049 0.163
5. Silica - ppm	Min. 0 Max. 25	1.25 5.60	0.80 5.50	1.0 5.3	1.20 3.85
6. pH at 25° C	Min. Max. (>9.50)	9.61 10.55	9.55 10.85	9.50 10.65	9.70 10.60
7. Chemicals Used, lbs.					
Na ₃ PO ₄		33.5	16.5	32.5	32.3
Na ₂ HPO ₄		10.8	7.8	11.3	11.3
NaH ₂ PO ₄		0	0	0	0

TABLE V

Non-Operating Boiler Water Chemistry

October 1 - December 31, 1968

Water Conditions	Specifications*	Non-Operating Boilers			
		1A	1B	1C	1D
1. Dis. Salts - ppm	Min. -- Max. 1000	60 90	60 195	51 177	61 105
2. Phosphate - ppm	Min. 5 Max. 100	26 52	36 118	24 94	28 62
3. Chloride - ppm	Min. 0 Max. 0.5	0.21 0.40	0.10 0.45	0.17 0.39	0.17 0.40
4. pH at 25° C	Min. 10.00 Max. 11.00 **	10.10 10.40	10.25 10.93	10.00 10.60	10.10 10.50
5. Hydrazine - ppm (Hot lay-up)	Min. (residual) Max.	0.003 0.380	0.030 1.20	0.029 0.380	0.007 0.380
6. Hydrazine - ppm (Cold lay-up)	Min. 50 Max. 100	-- --	0.130 100.0	-- --	-- --
7. Chemicals used, Pounds Na ₃ PO ₄ Na ₂ PO ₄ NaH ₂ PO ₄ N ₂ H ₄			13 1 2 23.5		

* Specifications for items 1, 2 & 3 apply only to hot lay-up. The table includes values observed under both hot and cold lay-up conditions.

** The pH is maintained below the theoretical Na₃PO₄ - pH curve.

4. REFUELING PROGRAM

Preparation for the forthcoming PWR-2 Seed 1 - Seed 2 refueling operation continued throughout the quarterly report period. Refueling procedures were prepared and reviewed, the overall refueling plan and training documents were revised, and modification work in the Fuel Handling Building continued.

Refueling Procedures

The status of Duquesne Light Company prepared refueling procedures and the BAPL prepared procedures received by Duquesne Light Company for comment are summarized below.

Total number of procedures required for the PWR-2 Seed 1 - Seed 2 refueling operation.	71
*Procedures assigned to BAPL for preparation	37
Procedures assigned to Duquesne Light Company for preparation	34
BAPL procedure drafts received by Duquesne Light Company for comment and comments submitted	33
Duquesne Light Company procedures submitted to BAPL for comment and BAPL comments received	34
Duquesne Light Company procedures submitted to and approved by the U. S. Atomic Energy Commission	34
**Duquesne Light Company procedures to be revised	33
**Duquesne Light Company revised procedures resubmitted to the U. S. Atomic Energy Commission	30
*Three procedures required for loading and shipment of irradiated PWR-2 fuel assemblies will be prepared following completion of refueling operation.	
*These procedures, although approved by the U.S. Atomic Energy Commission, are subject to revision due to verification sign-off requirements required to perform certain refueling operations and to new technical information.	

All procedures will be reviewed and the approved for performance copies will be signed at least two weeks before the start of the refueling operation. Field changes, if any, will be incorporated into the procedure at the time.

Refueling Plan

The fifth issue of the refueling plan document, Section II, outlining the work required to be performed by Duquesne Light Company was being prepared at the end of this report period. The plan includes listing of Duquesne Light Company prepared procedures, training required for various operations and plant site operations required in preparation for the refueling operation.

Training Program

The training program for the refueling operation was started the latter part of this report period. The training consists of lectures, demonstrations, practice operations and review of procedures for supervisory, technical and skilled craft personnel.

Technical Support

In addition to the preparation of the technical programs discussed above, technical support was also provided, as required, for the work performed in the Fuel Handling Building as described in preparation of Fuel Handling Building which follows.

Preparation of Fuel Handling Building

During the report period, the wall and floor coating repair and the installation of the underwater storage racks required for the PWR-2 Seed 1-2 in the canal deep pit and dry pit were completed. As of the end of this report period, 80 percent of the underwater storage racks in the fuel storage pit were also completed.

5. MAINTENANCE

Routine repairs of major components, instruments and controls and preventive maintenance were performed during the quarterly period. Auxiliary equipment and instrumentation controls were also calibrated, lubricated, overhauled, repaired/or replaced. The repair of the major components are described below.

B Loop 18" Manual Valve

During normal plant operation a leak was discovered on the 1B reactor coolant cold leg manual isolation valve. The loop was isolated from the Reactor Coolant System and cooled down to allow for a more detailed investigation. A small leak was located in the bonnet seal ring. A liquid penetrant inspection revealed a 3/16 inch and a 1 inch long linear indication on the seal ring parent metal. Both indications were located midway on the width of and running circumferentially along the seal ring. The defective areas were ground out and welded. A hydrostatic pressure test was successfully performed on the seal ring. All wetted insulation was removed, then a liquid penetrant inspection of the pipe and valve was performed. No indications were revealed. New insulation was installed and after the successful hydrostatic test of the valve, the 1B reactor coolant loop was released to operations for return to service.

River Water Booster Pump

The river water booster pump was removed from service for a complete overhaul. A new shaft, impeller, wear rings, shaft sleeves and bearings were replaced. The pump was re-assembled and satisfactorily returned to service.

B Loop Heat Exchanger

The B loop heat exchanger was closed up and the strong backs were installed. The primary side of the heat exchanger was successfully hydrostatically tested. The loop was then returned to service on October 12, 1968.

During the installation of the manway strongbacks, the studs were overtorqued as a result of using an obsolete procedure. The tension was released on the studs and they were retorqued as per the updated procedure.

6. TEST PROGRAM

The primary objective of the test program during the fourth quarter report period was to continue reactivity depletion of Core 2 Seed 1 to determine irradiation lifetime properties, reactivity lifetime properties and the core power distribution as a function of lifetime with respect to extended life operations of Core 2 - Seed 1. A number of primary plant instruments were calibrated in order to make these parameters read out properly on the Data Acquisition System. Reactor coolant temperature instrumentation was also calibrated for operation at the reduced operating temperature of 500 F. Physics tests were performed with the average reactor coolant temperature of 500 F to determine the temperature coefficient of reactivity at power, the reactivity loss rate and to obtain axial flux measurements. Also performed were the Reactor Plant leak rate test and radiation surveys of the coolant loops and piping.

Twelve tests were performed during the report period. Nine tests were completed and three tests remained in progress at the end of the quarter. Table VI lists these tests and Figure 2 displays the actual performance dates. Specific information pertaining to the chemistry tests may be found in the Chemistry Section of this report.

The Periodic Reactor Plant Leak Rate Test (DLCS 56401) was performed December 2. During the four hour period of the test, the leak rate was found to be 41 gal./hr.

The Reactor Coolant Fission Product Activity Test (DLCS 58001) was performed December 15. The PWR-2 Seed 1 had accumulated 13,120 EFPM at the time of shutdown prior to the performance of this test. The reactor coolant fission product activity showed no evidence of fuel element failure.

External Radiation Levels of Reactor Coolant System Piping and Components, Purification System Demineralizer and Heat Exchangers (DLCS 58501) was performed twice during the fourth report period. Notable changes in the radiation levels occurred along the AC demineralizer even though the demineralizer was isolated throughout the period between surveys. Results of the radiation surveys DLCS 5850120 performed October 16 and DLCS 5850121 performed prior to resin discharge on December 12 show that the radiation levels obtained December 12 were considerably higher than those obtained October 16. These higher readings were attributed to a reduction in the shielding effect provided by water in the demineralizer which apparently drained out through the leaking AC purification relief valve during the time that the purification loop was isolated.

Calibration of primary plant temperature instrumentation (DLCS 60901) and the Data Acquisition System (DLCS 60401) tests were performed during this report period. All of the calibrations were within the prescribed limits.

The Axial Flux Measurement (DLCS 63502) test was performed December 12 and 13. The test was performed at 13,119.8 EFPH with the Group III control rods at 89.7 inches. The irradiation period for this performance was set at eight minutes and only the Zircaloy wires were irradiated. During the checkout of the drive system, difficulty was encountered at location G-7. This situation was rectified by using a smaller diameter wire at this location as well as at location D-7 which had exhibited difficulties in earlier performances.

TABLE VI

Tests Performed During Fourth Quarter of 1968

DLCS 5640106	Periodic Reactor Plant Leak Rate Test
DLCS 5800109	Reactor Coolant Fission Product Activity
DLCS 5850120, 21	External Radiation Levels of Reactor Coolant System Piping and Components
DLCS 5950701	Investigation of Effect of Hydroxide Ion Concentration on Core Pressure Drop
DLCS 6040107	Data Acquisition System Calibration Test
DLCS 6090107	Periodic Intercalibration of Temperature Sensing Elements
DLCS 6340106	Temperature Coefficient of Reactivity at Power
DLCS 6350221	Axial Flux Measurement Test
DLCS 6400107	Reactivity Loss Rate
DLCS 6590101	Reactor Pressure Drop and Coolant Flow Characteristics During Power Operation
DLCS 6600101	Reactivity Lifetime Test

Tests Remaining In Progress At End Of Report Period

DLCS 5950701	Investigation of Effect of Hydroxide Ion Concentration on Core Pressure Drop
DLCS 6590101	Reactor Pressure Drop and Coolant Flow Characteristics During Power Operation
DLCS 6600101	Reactivity Lifetime Test

FIGURE 2
PERFORMANCE DATES
OF
TESTS PERFORMED DURING FOURTH QUARTER OF 1968

* Performance incomplete at end of report period.

7. GLOSSARY

AEC.....	United States Atomic Energy Commission
AIX.....	after ion exchanger (outlet)
a/o.....	atomic percent
BAPL.....	Bettis Atomic Power Laboratory
BIX.....	before ion exchanger (inlet)
bkgd.....	background
CIC.....	compensated ionization chamber
DAS.....	Data Acquisition System
DE.....	demineralizer effluent
DF.....	decontamination factor
EFPH.....	equivalent full power hour
FEDAL.....	Failed Element Detection and Location System
FMI.....	flow measurement instrumentation
Hc.....	critical height
HDS.....	Heat Dissipation System
megamp.....	magnetic amplifier
MELBA.....	Multipurpose Extended Life Blanket Assembly
mr.....	milliroentgen
mrem.....	milliroentgen equivalent man
NPS.....	Nuclear Protection System
ORMS.....	Operational Radiation Monitoring System
PWR.....	Pressurized Water Reactor
R.....	roentgen
RC.....	resistance capacitance

Glossary

DLCS 5000468

μ C.....	microcuries
RCS.....	Reactor Coolant System
rem.....	roentgen equivalent man
RPC.....	Reactor Plant Container
RWDS.....	Radioactive Waste Disposal System
STP.....	standard temperature and pressure
su.....	smear unit (100 sq. cm.)
Tavg.....	average reactor coolant temperature
Tc.....	reactor coolant inlet temperature
Th.....	reactor coolant outlet temperature
Ts.....	time of sample isolation
v/o.....	percent by volume
VOS.....	Valve Operating System