3

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

✓
QUARTERLY OPERATING REPORT
Fourth Quarter 1977
DLCS 5000477

Approved by:

T. D. Jones
Superintendent

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

Contract E-(36-1)-292
United States Department of Energy

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Table of Contents

Preface	i
1. SUMMARY OF OPERATIONS	1
2. SUMMARY OF STATION PERFORMANCE	5
3. CHEMISTRY	6
4. MAINTENANCE	12
5. TEST PROGRAM	13
6. GLOSSARY	16

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 information on recent technical progress related to the nuclear portion of the Shippingport Atomic Power Station is therefore referred to the United States Department of Energy, Technical Information Center at Oak Ridge, Tennessee, where this information is readily available.

1. SUMMARY OF OPERATIONS

At the beginning of the fourth quarter of 1977, the Shippingport Atomic Power Station was in operation with the 1A, 1B, 1C and 1D reactor coolant loops and the 1AC and 1BD purification loops in normal service. The PWR Core 2 was in storage under shielding water in the deep pit of the Fuel Handling Building.

Main unit turbine-generator and reactor startups and shutdowns were performed for training of operating personnel during the first part of the quarter. All eligible supervisors and operators achieved full LWBR certification. The station was then operated to the Duquesne Light Company system grid for startup and acceptance testing, including base load and swing load operation. Forty-one swing load operations were performed during the quarter to meet the objective of the LWBR operating plan (a swing load cycle is defined as a power reduction from above 90 percent to operation in range of 30 to 60 per cent power for at least four hours and then a return to above 90 per cent power). The LWBR core has accumulated 1782.9 EFPD through the end of the quarter.

The 1A, 1B, 1C and 1D 991 psig self-actuated steam relief valves remained gagged during the quarter to prevent leakage through the valve seats. Gagging of redundant relief valves is permitted by ASME Code and approved operating procedures. The 1A, 1B, 1C and 1D flywheel generators were removed from service one at a time to inspect and repair faulty bearings. A reduction of reactor power to 90% was necessary during the outage of a flywheel generator until completion of revised analysis of core capability during loss of flow. Subsequent procedure changes allowed maximum power capability during an outage of a flywheel generator.

The LWBR core startup and acceptance test program formally ended on December 2, 1977 when President Carter, from the Oval Office in the White House issued the order to "Increase Light Water Breeder Reactor Power to 100% (signed) Jimmy Carter." This order was written on an "electronic blackboard" and transmitted by telephone lines to a TV monitor in the Shippingport Station control room. At the close of the ceremony, the President released the LWBR core for routine commercial operation providing power to the Duquesne power distribution grid. December 2, 1977 was the 35th Anniversary of the first self-sustaining chain reaction which was achieved by Enrico Fermi in Chicago, Illinois on December 2, 1942 and the 20th Anniversary of the achievement of initial criticality of the first core at the Shippingport Atomic Power Station.

Four inadvertent safety injection system operations occurred during the quarter which injected various amounts of boron into the secondary systems but no boron was known to be injected into the primary system on any occasion. There was no reduction of primary coolant pressure and no indication of need for safety injection during these events. The recovery from each inadvertent boron injection to the secondary system required numerous drainings, bleeding and feeding, flushing lines and boiler blowdowns to remove the boron.

1. Summary of Operations (cont'd)

The first inadvertent operation of safety injection occurred on October 19, 1977 which resulted in an automatic reactor scram from 96.5% reactor power and was attributed to an improper time delay relay setpoint. Corrective action was completed and the station returned to service on October 29, 1977.

The second inadvertent operation of the safety injection system occurred on November 11, 1977 during the performance of the station weekly checks and was attributed to presence of both initiation coincidence signals at same time during checks which resulted in an automatic reactor scram. The cause was evaluated and permanent corrective action recommended. The station was returned to service on November 12, 1977.

The third inadvertent operation of the safety injection system occurred on November 22, 1977 but did not result in a reactor scram because the alarm was evaluated and corrective action taken prior to actuation of the scram relays. The inadvertent operation signal was received during the operation of the No. 2 emergency diesel generator weekly check requirement and was later attributed to noise pickup by the load sequencer. An attempt to duplicate the problem was performed without success. The Safety Injection System was returned to normal service.

The fourth inadvertent operation of the safety injection system occurred on December 5, 1977 during the operation and adjustments of the No. 1 Diesel Generator for a training evolution and resulted in an automatic reactor scram. The initiation was attributed to electrical noise pickup on the input signal cables to the load sequencers. An electrical filter was installed on both load sequencers to prevent spurious initiation of load sequencers due to electrical noise. Additional design changes to improve load sequencer noise pickup and reliability will be implemented. The recovery from the inadvertent SIS initiation was completed and the station returned to service on December 10, 1977.

A total of five unplanned reactor scrams occurred during the quarter. This includes the three automatic reactor scrams resulting from inadvertent SIS operation already discussed. Two additional scrams occurred as follows:

An automatic reactor scram occurred on October 16, 1977 and was attributed to the Power Selector switch which was found in a position between Intermediate and High Power position which reduced the NPS setpoints to intermediate power limits. A protective cover was placed over the switch to prevent accidental bumping and the station was returned to service on October 17, 1977.

1. Summary of Operations (cont'd)

Finally, during a reactor startup with the movable fuel assemblies at 8 inches, a manual scram was purposely initiated on December 9, 1977 by operator action due to increases in main coolant pump bearing temperatures. The increasing bearing temperatures occurred when the river water flow to the Reactor Plant Component Cooling Water Cooler was lost due to the failure of the standby screenwash pump shaft. The casualty procedure, Loss of Reactor Plant Component Cooling Water, was implemented and the plant was returned to normal conditions when another pump was placed in service and valved to provide cooling water. The reactor was taken critical later on the same day and the station was placed back in service on December 10, 1977. The standby screenwash pump shaft was replaced.

In addition, spiking on 1A and 1D Nuclear Protection Channels caused several safety insertion alarms without any fuel motion during the quarter. Trouble shooting and replacement of components on these channels was implemented and further investigation on spurious spiking continued.

The Reactor Coolant System average leak rate for the quarter was 10 gallons per hour.

During the fourth quarter of 1977, 2406 cubic feet of radioactive solid waste was shipped out of state for burial. These shipments contained 0.037 curie of radioactivity which does not include irradiated components and irradiated fuel which was shipped offsite. (See Maintenance Section). There were no liquid discharges from the Radioactive Waste Processing System to the river this quarter. One gaseous discharge to the environment occurred which resulted in the release of 0.0002 curie over a period of 11.5 days.

FIGURE I
GENERATOR OUTPUT AND REACTOR COOLANT TEMP. DURING FOURTH QUARTER

2. SUMMARY OF LWBR STATION PERFORMANCE

Electrical output (Gross) to date	kwhr	134,797,000
EFPH to date	hr	1,782.93
EFPH for the quarterly period.	hr	1,523.46
Hours reactor critical to date	hr	2,461.4
Hours reactor critical for the quarterly period.	hr	1,819.5
No. 1 main unit service hours (quarterly period)	hr	1,778.6
Net Station Output (quarterly period)	kwhr	100,059,000
No. of forced outages*		4

*Interruption of electrical output due to protective equipment action and/or operator action.

3. CHEMISTRY

During the fourth quarter of 1977, the Chemistry section maintained specifications in the various plant systems and fulfilled the station manual requirements.

Reactor Plant

The reactor coolant system was maintained within all chemical specifications during operations and hot standby except for one occurrence of a low hydrogen concentration. The low hydrogen concentration occurred during plant recovery operations from an extensive hot standby period.* The subsequent addition of hydrogen to the primary system increased the concentration to within specifications. Refer to Tables I and II.

The only out-of-specification conditions which existed in the reactor plant auxiliary systems occurred in the coolant charging water system.* These conditions were that of high pH values and high specific conductances.* The high pH's and specific conductances were attributed to the presence of ammonia which entered the system during an ammonium hydroxide chemical treatment of the primary coolant system. The coolant charging water was returned to within specifications by the effects of dilution as additional make up water was added to the Reactor Plant Water Storage Tank. Refer to Table III.

During this quarter, test LWBR-DLCS 58001, "Reactor Coolant Fission Product Monitoring During Reactor Startup," was performed in accordance with test requirements. Samples of reactor coolant were drawn and analyzed for Gross Iodine and Iodine-131. The results showed no peaking of Iodine activities as the reactor power was increased in accordance with scheduled power range operations verifying the integrity of the core cladding. Additional testing during this quarter included LWBR-DLCS 59201, "Periodic Radiochemical Analysis of LWBR Reactor Coolant." At the time of this writing the results of test LWBR-DLCS 59201 were not yet complete. Results of the test will be included in the first Quarterly Operating Report of 1978.

Turbine Plant

At the beginning of the fourth quarter, the station was in operation for startup and acceptance testing including base load operation and swingload power transients. The safety injection system was inadvertently activated causing highly concentrated borated water to be injected into the boilers and feedwater systems. This resulted in the boilers experiencing high out-of-specification pH's, specific conductances, and boron concentrations as well as low morpholine concentrations.* All of the out-of-specification conditions were attributed to the presence of borated water except for the low concentration of morpholine which was a result of dilution from numerous drain and fill operations of the boilers. Following the reestablishment of boiler water chemistry control, the morpholine concentration was raised to within specifications by subsequent chemical treatments.

*All of the out-of-specification conditions were of short duration and are not expected to have had a detrimental effect on plant materials. Refer to Tables IV and V.

Radioactive Waste Processing

There were no liquid discharges from the Radioactive Waste Processing System this quarter. However, water having a total radioactivity, exclusive of tritium, of 0.00003 Curie, which is 0.002% of the allowable limit, was discharged from the secondary system during flushing. The radioactivity of the flush water, due to tritium, was 0.0005 Curie, which is 0.00006% of the allowable limit.

The radioactivity released from Shippingport is far too small to have any measurable effect on the general background environmental activity outside the plant.

TABLE I
 REACTOR COOLANT SYSTEM
 WATER CONDITIONS AND CHEMICAL ADJUSTMENTS
 HOT STANDBY (>200°F)

CHEMICAL CONDITIONS	SPECIFICATIONS	ANALYTICAL RESULTS		NH ₄ OH (liters)	H ₂ (cu. ft.)	DEGASSIFI- CATION (Hours)
		Min.	Max.			
pH @ 25°C	10.10 - 10.30	10.10	10.28			
Conductivity (μmhos/cm)	Consistent with pH	33.5	59			
Chloride	0.10 ppm max.	----	<0.10			
Total Gas	125 cc/kg max.	45	87			
Hydrogen	60 cc/kg max. 10 cc/kg min.	6.5*	36			
Chemicals added				16.5	16.0	0.0

*See Reactor Plant Section of QOR

TABLE II
 REACTOR COOLANT SYSTEM
 WATER CONDITIONS AND CHEMICAL ADJUSTMENTS
 OPERATING CONDITIONS

CHEMICAL CONDITIONS	SPECIFICATIONS	ANALYTICAL RESULTS		NH ₄ OH (liters)	H ₂ (cu. ft.)	DEGASSIFI- CATION (HOURS)
		Min.	Max.			
pH @ 25°C	10.10 - 10.30	10.10	10.29			
Conductivity (μmhos/cm)	Consistent with pH	29	60			
Chloride	0.10 ppm max.	----	<0.10			
Total Gas	125 cc/kg max.	53	122			
Hydrogen	60 cc/kg max. 10 cc/kg. min.	24	58			
Chemicals added				148.7	0.0	60.7

TABLE III

Reactor Plant Auxiliary Systems
Water Conditions

System	Conductivity $\mu\text{mhos/cm}$	pH at 25°C	Conc. - ppm			Gross Gamma Activity - $\mu\text{Ci/ml}$
			CrO_4^{--}	Cl^-	Dis. O_2	
Component Cooling Specifications	N.S.	8.30 - 10.50	500-1000	1 ppm max.	N.S.	N.S.
Measured	N.P.	N.P.	504-612	<0.10-0.70	N.P.	7.83×10^{-7} - 1.30×10^{-6}
Coolant Charging Water Specifications	2.50 max.	6.00 - 8.00	N.S.	0.1 ppm max.	Note	N.S.
Measured	1.25 - 22*	7.16 - 9.66*	N.P.	<0.10	N.P.	N.P.
Canal Water Specifications	5.00 max.	5.80 - 8.00	N.S.	N.S.	N.S.	N.S.
Measured	0.48 - 0.98	5.96 - 6.37	N.P.	N.P.	N.P.	<MDA - 2.54×10^{-5}

Specification is <0.14 ppm for reactor plant cold wet layup.

*See Reactor Plant Section of QOR.

MDA = 8.20×10^{-8} $\mu\text{Ci/ml}$

N.S.: No limit needed, therefore, no limit has been specified.

N.P.: Analysis is not necessary and not performed.

TABLE IV
OPERATING BOILER WATER CHEMISTRY
VOLATILE WATER CHEMISTRY

WATER CONDITIONS	SPECIFICATIONS	BOILERS			
		1A	1B	1C	1D
Conductivity	Min. ----- Max. 10 μ mhos/cm	5.0 20*	4.7 21*	4.6 22*	4.9 21*
Chloride	Min. ----- Max. 0.20 ppm	<0.10 0.10	<0.10 0.10	<0.10 0.10	<0.10 0.10
Hydrazine	Min. 0.005 ppm Max. 0.125 ppm	0.005 0.120	0.005 0.090	0.005 0.085	0.010 0.117
Morpholine	Min. 0.50 ppm Max. 6.0 ppm	0.10* 3.70	0.50 2.90	0.50 3.90	0.53 3.90
Silica	Min. ----- Max. 25 ppm	----- 1.4	----- 1.1	----- 3.1	----- 2.1
Boron	Min. ----- Max. 0.20 ppm	<0.10 0.54*	<0.10 0.50*	<0.10 0.95*	<0.10 0.90*
pH @ 25°C	Min. 8.50 Max. 9.30	8.50 9.24	8.50 9.27	8.50 9.29	8.51 9.30
Chemicals used in lbs.					
N ₂ H ₄		15.2	15.2	15.2	15.2
C ₄ H ₉ NO		16.2	16.2	16.2	16.2

*See Turbine Plant Section of QOR

TABLE V
NON-OPERATING BOILER CHEMISTRY
HOT STANDBY
WATER CHEMISTRY

WATER CONDITIONS	SPECIFICATIONS	BOILERS			
		1A	1B	1C	1D
Conductivity	Min. ----- Max. 30 μ mhos/cm	4.1 140*	4.8 235*	4.7 445*	4.1 180*
Chloride	Min. ----- Max. 0.20 ppm	<0.10 0.10	<0.10 0.10	<0.10 0.10	<0.10 0.10
Morpholine	Min. 0.50 ppm Max. 6.0 ppm	0.30* 3.7	0.30* 3.4	0.30* 3.8	0.30* 3.0
Boron	Min. ----- Max. 0.20 ppm	<0.10 31.3*	<0.10 48.0*	<0.10 88.6*	<0.10 8.5*
pH @ 25°C	Min. 8.50 Max. 9.30	8.51 9.35*	8.52 9.33*	8.52 9.37*	8.52 9.41*
Chemicals used in lbs.					
N_2H_4		0.20	0.20	0.20	0.20
C_4H_9NO		1.8	1.8	1.8	1.8

*See Turbine Section of QOR

4. MAINTENANCE

During this period, scheduled and unscheduled maintenance of plant systems and components was performed as well as major work listed below:

Operations Support for SIS Initiation Restoration

Maintenance support was provided to Operations during the plant recovery from inadvertant initiations of the Safety Injection System.

PWR II - Seed Shipments

Twelve PWR-II seed assemblies were shipped in an M-160 Irradiated Fuel Shipping Container to the Expended Core Facility in Idaho.

MELBA Shipments

Four Multi Purpose Extended Life Blanket Assemblies (MELBA) for PWR-II were shipped to the Expended Core Facility in Idaho.

Preconditioning Filter Shipment

The Shippingport Preconditioning Filter was shipped off-site for processing.

Oil Separator Installation

An oil separator was installed in a Turbine Plant Sump to prevent discharge of oil to the environment.

5. TEST PROGRAM

The primary objective of the test program during the quarterly report period was to continue reactivity depletion of the LWBR Core for proof of breeding.

Ten tests were performed during the report period. Seven tests were completed and three remained in progress at the end of the quarter. Table VI lists these tests and Figure 2 indicates the performance dates. Information pertaining to chemistry tests may be found in the chemistry section of this report.

The three required performances of test procedure LWBR-DLCS 55201 Safety Injection System Monthly Periodic Pump Tests were satisfactorily completed for this quarter.

The first two performances of test procedure LWBR-DLCS 58201, Delayed Neutron Monitoring System Checkout Test, which is required to be performed at approximately every forty five days to support test procedures LWBR-DLCS 58301 and 58401, were completed.

Five performances of test procedure LWBR-DLCS 58301, Delayed Neutron Loop Monitoring System Operation During Station Startup were satisfactorily completed during this report period as required for each reactor startup.

Four performances of test procedure LWBR-DLCS 58401, Delayed Neutron Loop Monitoring System Operational Test were conducted this quarter at approximately 500, 750, 1000 and 1500 EFPH. The last two performances of this test were conducted for only the Number 1 DN Loop Monitor, because the isolation valve for the redundant Number 2 Monitor was closed during testing and cannot be reopened due to a damaged valve stem. In the event both redundant monitors are out of service, increased primary coolant sampling and analysis would be required during operations.

Two special test procedures, LWBR-DLCS 76701, Flush of Charging System and LWBR-DLCS 76801, Flush of Primary Water Storage Tank - Condensate Tank Tie Line were conducted during the report period. These tests were performed on October 27 and 28 subsequent to an inadvertent operation of the Safety Injection System which partially charged borated water into the secondary system.

Test Procedures LWBR-DLCS 65901, Reactor Pressure Drop and Coolant Flow Characteristics and LWBR-DLCS 66001, Reactivity Lifetime Test which are on-going, continued through the report period.

TABLE VI

Tests Performed During Fourth Quarter of 1977

LWBR-DLCS 5520101-03	SIS Monthly Periodic Pump Tests
LWBR-DLCS 5800102-05	Reactor Coolant Fission Product Monitoring During Reactor Start-Up
LWBR-DLCS 5820101, 02	Delayed Neutron Loop Monitoring System Checkout Test
LWBR-DLCS 5830103-07	Delayed Neutron Loop Monitoring System Operation During Station Startup
LWBR-DLCS 5840102-05	Delayed Neutron Loop Monitoring System Operational Test
LWBR-DLCS 76701	Flush of Charging System
LWBR-DLCS 76801	Flush of Primary Water Storage Tank - Condensate Tank Tie Line

Tests Remaining in Progress at End of Report Period

LWBR-DLCS 5920101	Periodic Radiochemical Analysis of LWBR Reactor Coolant
LWBR-DLCS 65901	Reactor Pressure Drop and Coolant Flow Characteristics
LWBR-DLCS 66001	Reactivity Lifetime Test

PERFORMANCE DATES OF TESTS PERFORMED DURING FOURTH QUARTER

*Performance incomplete at end of report period

FIGURE 2

6. GLOSSARY

AIX	after ion exchanger (outlet)
a/o	atomic percent
BAPL.	Bettis Atomic Power Laboratory
BIX	before ion exchanger (inlet)
CIC	compensated ionization chamber
DAS	Data Acquisition System
DE	demineralizer effluent
DF	decontamination factor
DOE	Department of Energy
EFPH.	equivalent full power hour
Hc	critical height
HDS	Heat Dissipation System
LWBR	Light Water Breeder Reactor
magamp	magnetic amplifier
MDA	Minimum Detectable Activity
mR	milliroentgen
mrem	milliroentgen equivalent man
NIS	Nuclear Instrumentation System
NPS	Nuclear Protection System
ORMS	Operational Radiation Monitoring System
PWR	Pressurized Water Reactor
QOR	Quarterly Operating Report
R	roentgen

6. GLOSSARY (Cont'd)

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