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**Pacific Northwest Laboratory
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**DOUGLAS UNITED NUCLEAR
MONTHLY REPORT**

DECEMBER 1970

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DOUGLAS UNITED NUCLEAR, INC.

RICHLAND, WASHINGTON

MASTER

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January 20, 1971

DOUGLAS UNITED NUCLEAR

MONTHLY REPORT

DECEMBER 1970

DOUGLAS UNITED NUCLEAR, INC.

Richland, Washington

Work performed under Supplemental Agreement No. 1 to Contract
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SUMMARY

REACTOR PLANT OPERATIONS

Production Statistics

	<u>KE</u>	<u>N</u>
Input Production - Pu (KMWD)	91.6	52.9
Time Operated Efficiency - %	76.4	48.5
Steam Availability to WPPSS - %	-	47.4

KE Reactor

Equilibrium power level was restricted by administrative tube power limits for 75 percent of the operating period and by the 4000 MW administrative power level for the remainder of the time.

N Reactor

The reactor was operating at a power level of 3800 MWt at the beginning of the month. A total of three reactor shutdowns occurred as follows:

- The reactor was shut down for a scheduled refueling and maintenance outage on December 6.
- The reactor was manually scrammed on December 21 when temperature sensors failed on process tubes that had been refueled during the scheduled outage.
- The reactor automatically scrammed on December 22 due to a high flow trip on the flow monitor. This high flow trip resulted from a leaking toggle valve for process tube 1744.

The reactor was operating at a power level of 3,750 MWt at month end. The equilibrium power level was maintained about 250 MW below the administrative limit to provide additional margin between Zone Temperature Monitor tube temperatures and the trip limits.

Total outage hours for the month were 383.1.

FUEL FABRICATION

Production Statistics (tons)

	<u>KE</u>	<u>N</u>
Billets Extruded	-	34.6
Finished Fuel Produced	39.4	40.4

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KE Fuel

Production of K5E and K5N fuel continued on a partial-line basis.

N Fuel

Input production was held below forecast to achieve additional Zircaloy clad extrusions. Continuing high yields allowed full achievement of the output production goal.

TECHNICAL ACTIVITIES

A detailed leak inspection was made of the V-12 valves during the December N Reactor outage. It was found that some new valve packing leaks have developed, including three on the five bellows-packed valves. However, none of the valves with Grafoil packing had leak indications. The inspection also indicated that Grayloc hub leaks continue to be a major problem. On-reactor testing of six valves having Grafoil gaskets on the Grayloc hubs has been initiated.

As part of the V-12 valve evaluation, tests were made of valve divertability during the outage. These tests indicated that operability problems are developing with some of the V-12 valve operators previously replaced. However, with one exception, the prototype Inconel manipulator-equipped valves operated satisfactorily. Two additional prototype manipulators were installed during the outage as part of the evaluation program.

Tests were successfully completed using the N Reactor tube flow monitoring system for measuring process tube coolant flow rates of less than 20 gpm. The data indicate that flow rates as low as 5-7 gpm can be adequately measured.

The evaluation of a new chemical bactericide, "Elcide 75," for eliminating micro-organisms in the N Reactor fire-resistant HCR fluid has been initiated in the mockup. The initial test results have not indicated any significant reduction in organism count below the current stable level.

Four additional Ball Safety System channels were inspected during the month. The inspection of these channels, adjacent to the ten central channels resleeved in July, indicated that channel shifting and settling is continuing, but no significant new problems were noted.

The first two-tube in-reactor test of the recirculating decontamination process at N Reactor was conducted on December 12 and 13. This process is still considered to be promising for full reactor application; however, two problems were identified that will require resolution before the process can be applied to the full plant at the beginning of the 1971 maintenance outage. Under simulated plant application conditions, the present candidate process produces relatively high corrosion rates in carbon steel and low alloy steels; means for reducing the corrosion rate to more nominal rates are being established. Some redeposition of activity also occurred during the in-reactor test, a phenomenon which must be evaluated and corrective measures developed.

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An analysis of the N Reactor Fog Spray System, including a review of materials of construction and operational testing, has been concluded. System testing has demonstrated that the system starting pressure surge can be held to acceptable levels.

The seismic analysis studies of the 117-N 200-foot confinement stack have been completed by the structural consultant. The results of this analysis are being transmitted to the Division of Reactor Licensing for review.

Flow testing of the N Reactor circulating raw water system indicates that the 184 Building turbo-generator surface condenser flow instability is being caused by air accumulation in the system. An analysis of the data to establish corrective measures is under way.

GENERAL

The Company was advised on December 14 of a formal complaint filed by an exempt employee who had received a layoff notice to be effective January 4, 1971. The complaint, filed with the Washington State Board Against Discrimination, charges discrimination because of age. A field representative of the Board is investigating the charge, and a recommendation is expected in early January, 1971.

The exposure of one individual exceeded the annual DUN operational whole body control point of 5 rems by 20 mrems (5020 mrems), but was well within the AEC annual limit of 12 rems.

Charles D. Harrington
President

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REACTOR PLANT OPERATIONS - KE

PRODUCTION

General

Production (largely weapons Pu), power levels, efficiencies and related statistics for KE Reactor are tabulated below.

KE Reactor input production and time operated efficiency (TOE) for the past six months are shown on the following chart:

Statistical Summary

Input Production - Pu (KMWD)	91.6
Power Level (MW) - Maximum	4,000
- Average	3,866
Time Operated Efficiency - %	76.4
Number of Outages	1
Number of Startup Interruptions	1
Operating Coolant Flow - 1000 gpm	199.8
Fuel Charged (Tons) - 94 Metal	54.0
- Natural U	168.0
Fuel Element Failures	0
Helium Losses - 1000 cu.ft.	118.9

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OPERATING EXPERIENCE

Reactor Loading

The front face map showing the loading in KE is reproduced on page B-5. The tonnages listed are approximate; actual fuel charge totals are tabulated above.

Power Level

Reactor power level was limited by administrative tube power limits 75 percent of the operating period. The 4000 MW administrative power level was limiting the remainder of the operating period.

Reactor Outages

<u>Date Down</u>	<u>Outage Hours</u>	<u>Remarks</u>
December 1	174.3	Scheduled charge-discharge.
December 8	1.1	Startup interruption on Panellit 2977.

Utilization of Surplus Type "C" and Type "O" Fuel

During the past six months 3,780 C2N, 885 C3WM, 1,548 O3F, 14,387 O3N, and 746 O3WM (21,346 total) pieces of type "C" and type "O" fuel were charged into the reactor.

EQUIPMENT EXPERIENCE

Vertical and Horizontal Rods

There are currently no significant problems with the HCRs. All VSRs are serviceable with an average hot drop time of 1.77 seconds.

Resistance Temperature Detectors

Four more RTDs were found to have a low resistance to ground during the monthly EMS check.

Rear Crossheaders

Inspection and repair work continued on the rear face crossheaders where salt deposits formed by stress corrosion failure have been located. Salt deposits were removed from 16 locations and to date five "Loctite" patches have been installed on rear crossheaders pending a more permanent repair solution.

Front Crossheader Gasket Problem

A crossheader strainer gasket protrusion problem was corrected on the near side of headers 31 through 58 and modified screens were installed. The method

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employed was to cut out the major portion of the protruded gasket with a knife, then finish off the remainder with a rotary file in an air grinder. Debris was prevented from going down the header by replacing the crossheader screen with a sleeve made by wrapping fabric-backed tape around a screen. A short flush from the crossheader valve through this sleeve removed all debris from the system.

Blocked Ball 3X Channels

Work was continued on clearing the exit pipe on channels No. 25 and 71.

183-KE Acid Tank Replacement

The replacement head tank has been installed on the footings and the catwalk has been extended to the roof. The new French drain to handle overflows and minor drainage is complete, and the drain line has been extended under the railroad track.

Submersible Pumps - 181-KW

The rebuilt spare submersible river pump was installed in the No. 11 position at 181-KW. The pump was placed in service and is operating satisfactorily.

Turbo Generator - 165-KE

The No. 2 165-KE turbo-generator was placed into service. A rotating assembly from 165-KW was used to replace the 165-KE assembly which had a bent shaft.

Cold Start Tests

Cold start tests of No. 2 165-KW boiler, with support of the 105-KW diesel generator, were successfully performed on December 3. A report of these tests will be published in the near future.

Equipment Modifications

The following equipment modifications were completed:

DC-1284, "C Platform Weight Overload Device Replacement, 105-K."

DC-1304, "100-K Coolant Backup Annunciator 165-KE/182."

MDC-E70K-O-23, "Relocation of SSPT System Telephones 165 and 105-KW."

PROCESS ASSISTANCE AND CONTROL

Operational Physics

Reactor operating level efficiency during the first half of the month was influenced by a xenon cycle, which developed in the top near quadrant of the reactor with the use of inboard rods to minimize actual peaking. Excess control flexibility to combat the cycle was limited and the cycle was

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concurrent with a samarium reactivity dip; but the cycle was successfully damped by use of a partial spline and attention to graphite temperature trends.

The latter half of the operating period was routine with reactor power level at the administrative limit of 4000 MW.

Some operational physics parameters of interest are shown in the following table:

Effective Central Tubes*	2,137
Flattening Efficiency** - December	.682
- 12-Month average	.698
Maximum Operating Time Permitting Scram Recovery - Hours***	16
Average Critical Prediction Error - December (cmk)	73
- 12-Month Average	100

*Reactor power level divided by the average power of the ten most productive tubes which are representative of the reactor loading.

**ECT divided by the number of power generating tubes.

***The maximum operating time subsequent to a cold startup following which a scram recovery could be made using the currently approved startup procedure.

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<u>Zone</u>	<u>Tons</u>	<u>Material</u>
Central	229 58	Natural Uranium 94 Metal
Buckled	82	Natural Uranium
Fringe	54	Natural Uranium
Shield	23 .6	94 Metal (Lithium Support) Lithium

Loading Pattern - KE Reactor

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REACTOR PLANT OPERATIONS - N

PRODUCTION

General

Reactor production (largely fuel grade Pu), power level, and related statistics are tabulated below. Input production and time operated efficiency (TOE) for the past six months are shown on the following chart:

Statistical Summary

Input Production - Pu (KMWD)	52.90
Electrical Generation (KMW) - WPPSS	272.80
- 184-N	5.16
Power Level (MWt) - Maximum	3,800
- Average	3,516
Time Operated Efficiency - %	48.50
Steam Availability - %	47.40
Number of Shutdowns - Scheduled	1
- Unscheduled	2
Fuel Failures	0
Fuel Charge (Tons) - 94 Metal	328.51
- 125 Metal	64.68
- Natural Uranium	0.37
Total	393.56

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Helium Losses (1000 cu.ft.)

573

Fuel Oil Usage (bbl.)

22,365

OPERATING EXPERIENCE

Reactor Loading

The reactor loading at month end is shown on the front face map on page BN-7. A total of 199 tubes was charge-discharged during the month. Included in the charging were 18 columns of PT-NR-118 fuel, a MK-IV performance test.

Reactor Power Level

The maximum reactor power level attained during the month was 3800 MWt. This lower than maximum authorized level was maintained to provide larger temperature margins in the Zone Temperature Monitor System. On four occasions during CY 1970, the ZTM system was responsible for inadvertently scrambling the reactor. The lower power level provides for a substantial increase in margin between trip points and tube operating temperatures in the ZTM system.

The main steam header pressure was maintained at or above 123 psig during equilibrium reactor operation, permitting electrical generation by WPPSS of a nominal 800 MWe.

Reactor Outages

The reactor, in operation at the beginning of the month, was shut down at 0057 hours on December 7 for refueling and maintenance. After an outage of 361.9 hours startup occurred at 0255 hours on December 21. The reactor was manually scrambled at 0734 hours on December 21 when resistance temperature detectors failed on three freshly refueled process tubes; startup was effected at 1834 hours on December 21. The reactor was automatically scrambled at 0547 hours on December 22 by a high flow trip on the flow monitor on process tube 1744. The high flow trip was caused by leakage from a flow monitor system toggle valve. Startup occurred at 1602 hours on December 22 and operation continued through month end.

EQUIPMENT EXPERIENCE

Primary Loop

A total of 84 V-11 valves was worked on by construction forces during the month. Of this number, 63 were repacked, 21 had manual operators only installed, and 11 had Grayloc hub leak repairs. Twenty V-12 valves were replaced, ten of which were replaced by spool pieces.

Four flow monitor sensing lines were repaired to correct leaks, all of which were at the sensing line connection to the venturi.

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All primary loop piping that was exposed to the freeze technique for coolant flow stoppage during the outage was ultrasonically tested to check for damage; all freeze affected piping at the CV-2 valves was also checked. No faults were detected.

During pre-startup flow monitor system checks, an abnormally high flow was indicated for one process tube. Inspection of the flow monitor venturi in the front connector for the tube revealed a piece of metal about 3/32" x 5/8" x 8" stuck in the venturi. Flow indications returned to normal following removal of the piece. Source of this extraneous metal is not known.

Graphite Cooling System

GCS heat exchanger No. 3 was removed from the auxiliary cell during the scheduled outage, transported to 189-F, decontaminated and turned over to Combustion Engineering for retubing. The newly retubed No. 2 heat exchanger unit was installed in the No. 3 position in the auxiliary cell, tested, and placed in service at the conclusion of the scheduled outage. Radiation levels in the No. 3 unit were reduced to ~2 mR/hr. from 25 mR/hr. Three leaking tubes were plugged in the No. 1 heat exchanger (which has not been retubed) during the scheduled outage.

A brief "dump" of the graphite cooling system occurred during power ascension following the scheduled outage startup. The dump resulted from an incorrect trip setting on the temperature monitor of 75 F rather than 250 F. The reactor was not shut down as a result of the dump and post-dump monitoring indicated no graphite tube flow changes.

Steam Generator Cell 1

The in-cell recirculation test was completed satisfactorily on December 15. The pre-filming operation was initiated on December 23, but was aborted due to high O₂ in the primary loop water. The application of the N₂ blanket on the demineralized water (DW) tank is expected to reduce the O₂ content of the Cell 1 makeup so that the prefilming can be resumed at a later time.

Ball Safety System

Four ball channels were inspected during the scheduled outage to determine channel status. Separations in the channel liners were found in two of the channels; number 39 had a 1/2" separation located 11 feet 8 inches down from the top and number 40 had a 3/4" separation two blocks down from the top. Both of these channels were taken out of service. The two other channels inspected were in acceptable condition.

Confinement System

A confinement system leakage test was performed during the scheduled outage. Results of the test indicated several leaks, of which all significant ones were repaired.

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The following 117-N Building filter work was accomplished during the month:

1. Replaced particulate and charcoal filters in "C" cell. All tested satisfactorily.
2. Replaced charcoal filters in "A" cell. Iodine test of in-place filters was acceptable.
3. DOP tested "B" cell particulate filters with acceptable results.

A damaged section of the Zone I confinement wall elastomer coating in the right outlet pipe space was repaired.

Reactor Gas System

Gas leaks were repaired in the damaged portion of the right rear reactor gas seal. Prior to the repair, daily gas losses averaged 34,800 cubic feet. After repairs the daily gas loss averaged 18,100 cubic feet as compared to 32,000 cubic feet in November, and 20,000 cubic feet in October.

Combustion Engineering Boilers

The warranty work recommended by Combustion Engineering was completed on CE-1 and -2 boilers on December 4. Other work, in addition to the warranty items, completed on the boilers was as follows:

- A new electromatic relief valve was installed on #2 CE to replace the original valve which had a casting flaw.
- The heating steam coil in the mud drum of the #2 boiler was moved approximately one foot east to permit unrestricted opening of the manhole door.
- The last six inches of each oil gun barrel was replaced with a stainless steel tube in both boilers to upgrade the original carbon burner barrels that had burned off. New burner diffusers were also installed on both boilers.

The newly-installed refractory in each boiler was dried for a one-week period with burner throat temperatures monitored and recorded. Inspection of #2 unit on December 9 showed no evidence of refractory spalling or cracking. Full load tests were performed on each boiler to assure that the new feedwater valve internals would maintain sufficient water flow to the boilers at maximum load. Sufficient feedwater flow can now be maintained through either the primary or bypass valves.

On December 8, a leak was detected in the front "D" tube of #1 CE boiler. The leak was created by removal of an old repair weld during installation of the reinforcing pad. Grinding off of the old weld had thinned the tube wall in a weld flaw. Following refractory pad installation and boiler startup, the tube began to leak. Combustion Engineering personnel cut off the pad, rewelded, examined the repair with liquid penetrant, and pressure tested the completed repair. The new brickwork was not dampened by the repair.

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Equipment Modifications

The following equipment modifications were completed:

MDC-N-69-34, "Evaporative Cooler for 184-N Ammonium Hydroxide Annex," provided for installation of an evaporative cooler to prevent vapor lock in the ammonium hydroxide pumps for the 184-N Building.

MDC-N-70-58, "Feedwater Valve Air Lock," provided for installation of higher range pressure springs in the air lock valves serving the Combustion Engineering boiler feedwater valves to assure that upon loss of the instrument air supply the valves will lock in the "as-is" position.

MDC-N-70-80, "Diesel Lube Oil Heater and Centrifuge Filter Removal," provided for removal of the permanent lube oil filter and heater assembly, as a more efficient portable unit is now used when required.

MDC-N-70-85, "Winterizing of Instrumentation for Temperature and Level," provided for winterizing the instrumentation on the emergency dump tank until permanent instrumentation is installed.

DC-3044, "Removal of Unused Piping - 109-N Roof," provided for removal of 64 pipe runs and associated valves, traps, hangers, and control hardware associated with the unused high pressure return system.

DC-3080, "CRWP Motor Slip Ring Brush Holder Revision - 181-N," provided for installation of brush holders in the motors that have constant pressure brush boxes and better insulators to protect against shorts with carbon dust buildup and to provide for improved motor reliability.

DC-3132, "ECW Valve V-4 to V-3 Close Power Feed Jumper," provided for correction of a wiring deficiency that prevented power from being applied to the "close" solenoid in the automatic selector position.

Manufacturing Engineering Activities

N Recertification

All written and oral examinations have been completed by shift managers and control room supervisors whose recertification was required by January 1, 1971.

N Equipment Maintenance Standards

One new N Reactor Standard was issued and seven are routing for approval.

The first draft of EMS N-206, "Primary System Rotating Equipment," was completed.

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Of the 42 new standards to be prepared, 21 have been issued, seven are routing for approval, eleven are being prepared and three have not been started.

N Area Water Treatment Activities

An evaluation of water treatment chemical usage for FY 1971 to date has shown the cost savings that can be achieved through lower regenerant rates on the primary demineralization units. In the first five months of FY 1971, the chemicals used per regeneration averaged 1,625 pounds of acid and 1,562 pounds of caustic as compared to the FY 1970 average of 1,949 pounds of acid and 1,962 pounds of caustic. Although these lower regenerant rates produced somewhat shorter runs, the net effect was a significant reduction in chemical cost per million gallons of demineralized water produced.

PROCESS ASSISTANCE AND CONTROL

Operational Physics

Reactor operation continued to be excellent. The reactor was shut down December 6 for a scheduled charge-discharge of 199 tubes.

Upon resumption of operation after the outage, the reactor rode through a partial dump of the graphite cooling system. A small rate of rise was observed due to a small reactivity increase as was expected for the specific loading and exposure at the time of the dump.

Maximum power level during the month was 3800 MWt.

Some operational physics parameters* of interest are shown in the following table:

Effective Central Tubes	812
Flattening Efficiency - December	0.810
- 12-Month Average	0.812
Maximum Operating Time Permitting Scram Recovery - Hours	25
Average Critical Prediction Error - December (cmk)	193
- 12-Month Average	128

*For definitions see page B-4.

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	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	
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Fuel Code	No. Tubes	Description	PT-NR No.	No. Tubes	Description
E	216	Mk-IC (94 Metal - Fringe)	94*	8	Mk-IV Demonstration
F	20	Mk-IV (94 Metal - High U-236)	113	5	Evaluation of the
G	498	Mk-IV (94 Metal - Central)			End Spider Inner
N	1	Mk-1B (Natural U)			Support System
X	230	Mk-1A & Mk-IV (125 & 94 Metal)	136	9	Mk-IV Non-bonded
	965	Total			End Closures
	39	Total PTs	118	16	Mk-IV Performance
					Test
				1	Graphite Sample Channel
1004	Grand Total			39	Total PTs

*Includes Mk-IV high U-236 content fuel and 5 tubes with Mk-IV-AA 125 Metal and Mk-IV 94 Metal.

Loading Pattern - N Reactor

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FUEL FABRICATION - KE REACTOR

PRODUCTION

General

Production of AlSi bonded fuel for KE Reactor was 115.9 percent of forecast. All of the elements produced had self-supports attached.

Acceptable Fuel Elements Produced

Tons	39.4
Yields: Current Month - %	95.6
FY to Date - %	93.9

Month-End Inventories - Tons

Bare Uranium Cores	897*
Finished Fuel: AlSi-Bonded	1,008*
Hot-Die-Sized	9
Thoria Elements	14

*These totals include 79 tons of bare and 104 tons of finished fuel in sizes used in the smaller reactors.

OPERATING EXPERIENCE

The overall operating efficiency for the month was 97.8 percent. Seventy-seven percent of the downtime was charged to equipment malfunctions and 23 percent to operations.

EQUIPMENT EXPERIENCE

Nothing significant to report.

PROCESS ASSISTANCE AND CONTROL

Nothing significant to report.

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FUEL FABRICATION - N REACTOR

PRODUCTION

Input Production

Total Billets Extruded	194
Tons Extruded	34.6
Percent of Forecast	69.2

Output Production

Total Finished Fuel Assemblies	1,842
Tons Output	40.4
Percent of Forecast	101.0

<u>Uranium Utilization - %</u>	82.2
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Month-End Inventories - Tons

Bare Uranium Billets	156
Finished Fuel	239

OPERATING EXPERIENCE

Input production was again intentionally held below forecast, but continuing high yields allowed full achievement of the output production goal. The input deficiency resulted from insertion of a commercial extrusion campaign and two days of zircaloy clad extrusions into the original schedule.

EQUIPMENT EXPERIENCE

Zirconium Warp Problem

In an effort to determine the cause of bent or warped zirconium extrusions experienced on December 8, a series of Loewy hydropress alignment checks and component changes were made. Inspection and alignment checks were made on the press stem, container-liner assembly, die, bolster, sub-bolster, and die carrier. The press alignment was found to be satisfactory; however, the die and bolster were exchanged because the die was found to be slightly oversize. This exchange corrected the problem and all subsequent extrusions were within warp specifications.

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PROCESS ASSISTANCE AND CONTROL

Reactor Decontamination Test Fuel

Four fuel assemblies were specially prepared and provided to N Reactor for a recirculating decontamination test to be performed during a charge-discharge outage in December. All fuels supports and steel shoes were carefully prepared to enable assessment of excessive corrosion by the decontaminate. The results of this test will supply information for a full pile decontamination test in the summer of 1971.

The fuel assemblies supplied to the reactor were prepared from good production fuel with the following special characteristics:

- Four Mark IV assemblies at 23.2 inches with autoclave surface.
- White oxide staining of welds, supports, or clad.
- Two marred surface areas on each outer clad.
- One marred surface area on each weld.
- Steel shoes with pre-weights and thicknesses recorded.

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TECHNICAL ACTIVITIES

N REACTOR OPERABILITY PROGRAM

Primary Coolant System

V-12 Valves

Leak Inspection

A leak inspection on December 7 disclosed 48 leaking V-12 valves. Examination of the data revealed the following:

- Thirty percent of the valve packing leaks are new.
- Three of five bellows-packed valves are now leaking.
- There are no packing leaks on valves packed with Grafoil.
- Each successive leak inspection shows an increase in leak severity. Of the 13 valves which had increased severity during the inspection, ten involved Grayloc hubs.

Valves on which work was done during the summer outage continue to develop an excessive number of Grayloc hub leaks. About 35 percent of the Grayloc hub leaks were predominantly new C hub leaks.

Operability Status

Divertability testing of the V-12 valves on December 5, prior to the scheduled shutdown, revealed that about 30 percent of those replaced during CY-1969 and CY-1970 failed to operate when actuated remotely from the control room. Five percent still failed to operate when tested further with a higher control air pressure. One of the complete failures was equipped with an Inconel manipulator installed during the extended 1970 summer outage. Prior to this December shutdown, the six Inconel manipulator-equipped prototype valves were operated via the normal air supply (275 psi). Five of the six diverted and returned to normal as designed. The sixth required 450 psi air pressure for successful operation. A visual examination after shutdown failed to reveal the cause of the diversion failure. Operation of the valve from a temporary air supply (200 psi) in the pipe space was successful, and the valve will be left in place for further testing prior to the next scheduled shutdown.

Two additional prototype manipulators were installed during the outage making a total of eight prototype manipulators installed to date.

V-11 and V-12 Valve Development Effort

Development effort has been initiated to demonstrate a concept utilizing Grafoil gasket material for sealing damaged Grayloc hubs. Preliminary off-reactor tests continue to be successful. Production Test NR-261, "Grafoil Gasketing of V-11 and V-12 Valve Grayloc Joints," has been approved and

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authorizes installation of a limited number of test joints. Six reactor valves (four V-11 B hubs and two V-12 C hubs) have been fitted with the Grafoil gasket configuration.

Temperature Monitoring System

An interim report summarizing development work on the sensors and cabling in the All Tube Temperature Monitoring (ATTM) and Zone Temperature Monitoring (ZTM) systems has been issued as DUN-7299, "Interim Report on PT-NR-146 and Associated N RTD Development Work," November 5, 1970.

Measuring Low Process Tube Flows

An evaluation of using the process tube flow monitor system for measuring low process tube coolant flow rates (< 20 gpm) was summarized in a recently issued report, DUN-6830 B, "Final Report to DT-211, Use of Present Flow Monitor for Measuring Low Flows," November 19, 1970, Confidential. The general conclusion was that the flow rates can be measured fairly accurately down to at least 5-7 gpm.

Fire Resistant Hydraulic Fluid - HCR System

Observation continued on the left rod hydraulic system and 1705-N Laboratory mockup. In view of continued, but stabilized, bacterial contamination in the reactor left rod system, plans were made to schedule a changeout of fluid using the 300 gallons of oil available on plant. The stored oil has been monitored on a monthly basis and appears to be unchanged in quality. The changeout will allow a thorough inspection and cleaning of system components such as filters, strainers, and the reservoir. The micro-organisms have remained at a steady plateau for several months. The coliforms have essentially disappeared, but the pseudomonas appear to have survived, though in an inhibited state. A mockup test has been initiated using a new chemical bactericide, "Elcide 75," which is highly recommended in the literature. To date, no marked reduction of the organism count has occurred, but testing will be continued to observe effects on system components and the characteristics of the fluid.

FUEL PERFORMANCE PROGRAM

Reactor Fuel Performance

No fuel failures occurred during the report period. Two previously failed N Reactor fuel elements were shipped to the WADCO Radiometallurgy Laboratory for examination.

PLANT LIFE PROGRAM

N Graphite - Ball Channel Inspections

Inspections were made on N Reactor Ball Safety System channels 19, 39, 40, and

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50, with the following results:

Channel 19 - The top liner block is down 3-7/8 inches due to accumulative block contraction. There were no visible signs of block breakage, shifting, or separations between liner blocks.

Channel 39 - The top block is down 4-1/2 inches and the male collar is sheared from the bottom of the second block with an approximate 1/2 to 3/4 inch ledge or offset showing. The vertical separation at the break is about 3/8 inch, giving total contraction in the liner column of 4-7/8 inches. The channel is very similar in appearance to that of channels 48, 49, 51, and 57 before they were resleeved in July. Eight or ten balls were seen on the ledge.

Channel 40 - The top block is down 3-3/4 inches and there is a separation of 3/4 inch between the third and fourth blocks. Since the liner blocks have not fractured, the separation is not sufficient to allow ball loss to the stack. This is the first channel observed to date with separation at the junction between the third and fourth liner blocks. Apparently, the third block has become wedged, possibly by a ball or chip of graphite between it and the surrounding blocks, and is not free to settle as the blocks contract. No balls were seen in the gap between the third and fourth liner blocks, but radioactive balls were dislodged from this channel when the channel was being opened for examination.

Channel 50 - There had been no changes in Channel 50, which was resleeved in July.

Additional channels are scheduled to be examined in the February outage to determine when additional resleeving work should be planned.

DECONTAMINATION PROGRAM

Recirculating Decontamination Process Development

An in-reactor test of the recirculating decontamination procedure, PT-N245, was run on December 12 and 13 to evaluate the operability and effectiveness of the recirculation approach. The test involved circulating the EDTA-citric acid-hydrazine solution through the V-11 valves, front connectors, front nozzles, process tubes, and rear nozzles of tubes 3058 and 3059. The decontaminant was applied at 185 $\pm$ 5 F for two periods, one of two hours followed by one of eight hours duration.

Although evaluation of the test results is incomplete, the following have been tentatively concluded:

- The recirculating process appears feasible from an operating standpoint. Provisions for venting gases would be required. Gas evolution rates were in the range predicted during the test.
- Effectiveness of the recirculating procedure was not conclusively demonstrated. The first two-hour run reduced connector radiation readings to background. The second acid application, terminated after eight hours, could not be discharged from the loop because of a frozen drain line. After an additional four hours of low temperature recirculation, redeposition of activity had occurred. Activity redeposition apparently resulted when the solution temperature was decreased from 185 F to about 155 F; however redeposition needs to be better understood before a decision is made to apply the process to the full reactor.
- Corrosion rates of carbon and low alloy steels were too high for a full plant process. The test itself was terminated after ten hours because the corrosion of connectors had reached the pre-determined limit of 2 mils.

The corrosion problem had been identified prior to the test. In earlier screening tests, it appeared that low alloy and carbon steels would experience very little corrosion from the EDTA-citric acid-hydrazine solution. However, as more materials were tested and test conditions more closely approached actual plant conditions, the corrosion problem became apparent. Typical performance of four alloys in three different out-of-reactor loop tests is shown in Table I. All tests were run on a 20 gm/l EDTA-13 gm/l citric acid-12 gm/l hydrazine solution at 180-185 F and a pH of 7.0.

Although the variation in corrosion rates of the several materials with different exposure conditions has not been explained, additional testing indicated that the corrosion rates of the low corroding alloys were accelerated by the presence of high corrosion rate alloys (SAE 4140 and ASTM A 216) in the system. The corrosion rates of all alloys were increased by repetitive exposure to fresh decontamination solution.

Two 16-hour, stirred beaker tests at 80 C were completed to determine if the corrosiveness of the EDTA-citric acid-hydrazine decontamination formulation could be reduced by adding an inhibitor. One test was conducted using ASTM A415, ASTM A515, SAE 1030, and ASTM A516 steels and the other using these alloys plus ASTM A216 and SAE 4140 steel alloys. In a previous test, the presence of the latter two alloys had caused a very significant increase in the corrosion rates of the other alloys.

In the test without ASTM A216 and SAE 4140 alloys, 5 gm/l of diethylthiourea reduced the rates of ASTM A415, ASTM A515, SAE 1030, and ASTM A516 by factors of 2 to 32 after one and four hours' exposure, while in the presence of

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ASTM A216 and SAE 4140 alloys the rates were reduced by factors of 3 to 80 during the same time periods. Inhibition continued after 16 hours in the solution containing the two high-corroding alloys.

TABLE I

Test Duration, Hours	8	48	45
Solution Makeup Rate, % System Volume per day	25	25	100
Carbon Steel Surface to System Volume Ratio, Cm^{-1}	0.06	0.06	0.06
<u>Corrosion Rate, Mils/Day</u>			
SAE 1030 (Grayloc Hub)	0.7	3.7	5.3
ASTM A212 GR70 (Primary Pipe)	1.3	3.6	5.0
SAE 4140 (Grayloc Seal Ring)	15.4	9.9	10.2
ASTM A216 WCB Cr-B (V-11 Valve Body)	6.7	9.9	9.9

These tests indicate that inhibition of this decontamination solution can be achieved. Future tests must determine which inhibitor is the most effective, the radiation stability of the inhibitor, and the effect of the inhibitor on the effectiveness of the decontamination solution on radioisotope removal.

OPERATIONAL SUPPORT PROGRAM

105-109 N Fog Spray System

The fog spray system supplies the gamma monitor system and the Zone V air conditioning during normal operation; and on emergency demand supplies graphite cooling backup, 109-N fog spray, 105-N fog spray, 105-N fire protection, and backup to the control rod and thermal shield cooling systems. Normal demand is supplied by the electric high pressure raw water pumps, while the emergency demands are supplied by the diesel-driven fog spray pumps.

During routine testing of the diesel-driven fog spray pumps in the latter part of the 1970 summer outage, high speed cycling of one of the diesel drives occurred with the simultaneous failure of a cast iron reducing flange in the 105-N fire protection system. A review of the system revealed that on one other occasion, a similar flange on the fog spray system had failed under similar circumstances and that there were six more cast iron reducing flanges still in the system. These flanges were replaced with higher rated steel flanges.

A series of tests were run to determine the surge effect of various starting modes of the diesel drives on the system. The tests simulated loss of BPA power, overloading of the high pressure raw water pumps, and operation of the

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system without the fog spray accumulator. It was determined that the present automatic start mode for the diesel-driven fog spray pumps met the objective to limit the resulting pressure surges to about 1.5 times the cold water pressure rating of the system.

REGULATORY PROGRAM

Seismic Studies - N Reactor

The documented results from Dr. C. V. Chelapati's dynamic seismic analysis of the N Reactor 200-foot confinement exhaust stack have been received. This latest work evaluated effects of damping factor assumptions, soil load bearing assumptions, and vertical acceleration effects. It is planned to transmit this report, plus supplemental information on stack safety margins for failure as a draft for review, to AEC-DRL during the next report period.

Confinement System Studies

All Confinement System subtasks considered necessary to identify system functional performance and reliability deficiencies are complete, including modifications required to remove these deficiencies with the associated high-spot modification costs.

To identify performance deficiencies, technical studies were initiated to determine the ability of the confinement facilities and equipment to handle the Design Basis Accident without exceeding 10 CFR 100 limits. System reliability and availability deficiencies were identified using fault tree analysis techniques against a criterion which required a minimum system reliability of .9 and a minimum system availability of .999. Achievement of these parameter values was considered to meet the intent of providing a highly reliable reactor safeguard system.

NUCLEAR SAFETY ASSURANCE PROGRAM

N Reactor Ball Trip Mechanism Improvement

The prototype of the improved ball safety trip mechanism which makes use of an electromagnet as the holding medium was completed early this period. Testing to date leads to the conclusion that the electromagnet approach is feasible and meets all the criteria of an adequate trip mechanism.

N Reactor Zone I Confinement Coating

Test procedures and application specifications have been prepared for evaluating methods of repairing the confinement coating.

The coating, a 20-mil neoprene-5-mil Hypalon elastomeric sealant, has been badly deteriorated in several locations of the 105-N and 109-N Zone I confinement areas. A test application has been made to an area in the 105-N

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Building where the wall coating had been severely damaged. Surface preparation and primers will be evaluated on both concrete and steel to determine an optimum approach to full scale renovation.

N Reactor Circulating Raw Water System Instability

Tests were performed to further examine the cause of the unstable flow of circulating raw water through the surface condenser at the 184 Building turbo-generator. Additional instrumentation had been installed in the system for this testing. Preliminary results indicate that the cause of the flow instability is an accumulation of air in the system, and the source of air appears to be the air ejection system. Analysis of test results is in progress to determine whether corrective action can be defined from the currently available results.

Analysis of N Reactor Ball Safety System Scram

As previously reported, N Reactor was shut down on September 30 by the ball safety system, which was actuated by failure of the rod safety system to function. The scram signal was initiated by low flow trips that had been actuated by trip-off of No. 6 primary pump drive turbine.

Because the reactor was at low power at the time of the incident, there was no question with respect to adequacy of cooling during the scram, and the ball safety system provided a fully satisfactory backup for the rod system. However, the question was raised as to the potential consequences if the same situation occurred at full power.

The concern stemmed from the time delay between activation of the rod safety circuit and actuation of the ball system. Because of this delay, the reactor power would not change significantly for over three seconds after the initial turbine trip, during which time automatic actions would be initiated to reduce the rate of primary loop heat dissipation (to counteract shrinkage of the water). Consequently, analysis was carried out to determine whether or not fuel damage would be expected under the higher power operating conditions.

It was determined that boiling would occur at the bottom of the outer annulus and in the inner annulus of the fuel column during the postulated transient. However, it was calculated that no fuel surface burnout would occur; thus it is concluded that no fuel overheating would take place. Consequently, it can be assumed that, under the accident conditions considered, the ball safety system would adequately serve as a backup to the safety rod system under full power operation.

WASTE MANAGEMENT PROGRAM

Contaminated Coolant Treatment Facility (CCTF) Pilot Plant

The first test in the CCTF Pilot Plant was terminated prematurely due to leakage of ion exchange resin past the retaining screens. These screens were

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redesigned and preparations made to conduct the second scheduled test.

The first test consisted of passing N Reactor primary system bleed water through ion exchange columns containing Duolite ARC-358 cation resin, Duolite ARA-371 anion resin, and Duolite ARM-381 mixed bed resin in series. Two sets of columns were employed, one set with prefiltration and one set without. Isotope analyses were made on samples withdrawn from the outlet of each column, but these may not be meaningful for the first columns in each set due to the resin loss. Isotope concentration data on samples after passing through the entire series of columns indicate that over 90 percent of the amount of the major short half-life isotopes are removed and 98 percent of the amount of the major long half-life isotopes are removed.

Testing resumed in late December with startup of N Reactor.

SPECIAL IRRADIATIONS PROGRAM

Ninety-one activation analysis capsules were irradiated in the KE Quickie and Pneumatic facilities for WADCO, BNW, and the Universities of Washington and Utah. One (U-Pu) O_2 fuel development capsule was irradiated in the KE Reactor Snout Facility for WADCO in support of the LMFB Program. A NASA fuel development capsule was charged into a side general purpose facility at KE Reactor.

TECHNICAL ACTIVITIES - FUEL FABRICATION

Dual Electrode for N Fuels End Cap Welding

The use of a dual electrode head for welding the ends of N Reactor fuel elements offers a potential reduction in welding manpower requirements and a doubling of existing welder capacity.

A short production run on X09 fuel pieces during the latter part of November provided an opportunity to test the new inner fuel dual electrode weld head. These small diameter fuels had never been welded in production quantities before with a double pass dual electrode process. Acceptable welds were produced at the start of the welding run. However, after a four-hour run, and as the weld head and welding chamber became more and more contaminated with beryllium, it became very difficult to strike an arc on the step cut weld lines at the tip of each electrode. A corona discharge would appear between the ends of the electrode holders, and this corona cloud would travel outward toward the tips of the two tungsten electrodes. As the corona struck the electrode tips, it would explode into the weld lines and spatter molten metal over the weld chamber. The reduced welding arc and the explosive discharge would result in a ruined weld and a rejected fuel piece. The problem was quickly rectified by using two short lengths of heavy wall quartz tubing to insulate the electrodes. The dual electrode welding operation was then able to proceed without further trouble, and the welds generated meet process specifications. The diffused argon gas coverage designed into the weld head

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is fully effective as the welds and the zirc cladding in the weld area show no oxide formation. Although the newly designed system is acceptable, some additional improvements are being investigated. It is believed that dimensionally correct quartz tubing may be inserted in the lavite insulator surrounding the electrode holder and that a small stream of argon gas may be passed down through the center of the electrode holders to blanket the tungsten electrodes and prevent contamination buildup on the inactive portion of the two electrodes. In addition, the stream of argon will help cool the electrode holders and the shank of the electrodes, thus improving the effectiveness of the cover gas and the life of the electrodes.

The use of this process on the larger outer fuel elements will be tested in early January. No problems are expected. The installation of these new procedures on all welders is expected in the near future.

ADMINISTRATION - GENERALEMPLOYMENT SUMMARY

DUN personnel totals and employee allocations as of November 30 and December 31 are shown in Appendix B.

AFFIRMATIVE ACTION PLAN

Campus recruitment was conducted at two predominantly Black colleges, Fisk University and Tennessee A & I. There was little student interest, as evidenced by only two candidates interviewed at Fisk and none at Tennessee A & I.

The fourth of a series of Racial Awareness sessions was held in early December. To date, about 300 exempt employees have attended one of the scheduled sessions.

UNION RELATIONSArbitration Cases

Normal A. Stoll, a Portland attorney, has been selected as the neutral arbitrator in a case which arose out of the charging to "Red 8's" to electricians who participated in a concerted refusal to accept overtime in July, 1970. A "Red 8" is a method used to post the overtime distribution record of an employee who declines an overtime assignment. Tentative arrangements are in process to schedule the arbitration hearing in the latter part of January, 1971.

A Submission Agreement, prepared by the Company and approved by the Hanford Atomic Metal Trades Council, was submitted on December 9 to the arbitrator in a case involving Pro Rata Vacations. This case arose from an interpretation of the contract by the Union which, contrary to many years of past practice, would provide laid-off employees with a pro rata part of the ensuing year's vacation.

DISCRIMINATION CHARGE

On December 14, DUN was advised of a formal complaint filed by one of its exempt employees who was given a layoff notice to become effective January 4, 1971. The complaint was filed with the Washington State Board Against Discrimination and charges discrimination on account of age. Investigation of the charge is being conducted by a field representative of the Board and a recommendation is expected in early January 1971.

SAFETY

No personnel radiation exposures exceeded operational control.

Month-end safety statistics were:

Disabling injuries - December	0
- CY to date	3
Days since last disabling injury	176
Man-hours since last disabling injury	1,179,406

APPENDIX A

PROJECT STATUS SUMMARY - REACTOR FACILITIESAUTHORIZED PROJECTS

<u>Number & Title</u>	<u>Authorized Funds - \$</u>	<u>Percent Complete</u>		<u>Remarks</u>
		<u>Design</u>	<u>Construction</u>	
<u>Single-Pass Reactors</u>				
DAP-526, Deactivation of Hanford Production Reactor C	105,000	100	89	Installation of the fire protection equipment has continued at 181, 182, and 183-B
<u>N Reactor</u>				
GCP-411, Effluent Control Program - 100-N Area	1,960,000	90	96	Revision #3 to the project proposal was approved by AEC-RL November 27, 1970. Design and construction per- centages reflect the current status of the project, incorporating Revision #3.
DCE-519, Replacement of Bridge Crane and Hoist System with New Crane System - 105-N Storage Basin Area	465,000	100	88	The two east cranes were used during the scheduled December outage. Opera- tion of the cranes revealed problems with the R-1 rail supports and opera- bility of the turntables. The vendor is working on these problems.
DCP-528, Fire Protection System Improvements - 100-N	30,000	10	0	Design is continuing.
DCE-539, Upgrade Flux Monitor System - N Reactor	335,000	50	0	Detail design has continued. The order for offsite fabrication (steel work) of the instrument panels has been placed.

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Number & Title	Authorized Funds - \$	Percent Complete		Remarks
		Design	Construction	
DAE-540, Smoke Density Monitors for DUN-Operated Facilities - 100 Areas	55,000	93	0	The procurement package for the engineered equipment has been assembled.
DCP-542, High Pressure Injection System Improvements - N Plant	138,000	0	0	Directive authorized December 12, 1970.

PROJECT PROPOSALS AWAITING AUTHORIZATION

Number & Title	Funds Requested	Date to AEC-RL
DCE-519, Rev. 4, Replacement of Bridge Crane and Hoist System with New Crane System - 105-N Storage Basin Area	Requests extension of time only	12/11/70
DCP-525, Fire Protection Improvements - KE	\$ 225,000	5/2/69
DCP-527, Graphite Cooling & Fog Spray Improvements - 100-N ¹	97,000	5/9/69
DCP-528, Rev. 1, Fire Protection System Improvements - 100-N	394,000	3/31/70
DCP-529, Gravity Drainage System and Disposal Basin for 100-N Area ¹	200,000	7/9/69
DAP-530, Upgraded Electrical Services & Lighting 1100-N & 1101-N Buildings	78,000	8/12/69
DCP-538, Heat and Ventilation System Improvements 105-N & 109-N Buildings ¹	330,000	5/18/70

¹To be returned to DUN by AEC-RL because of long holding period.

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<u>Number & Title</u>	<u>Funds Requested</u>	<u>Date to AEC-RL</u>
DCE-544, Critical Instrument Power Supplies - N Reactor	\$ 65,000	6/15/70
DAP-547, Permanent Markers for Buried Wastes in Terminated 100-D, 100-F and 100-H Sites	28,000	10/29/70

PROJECT PROPOSAL PREPARATION

<u>Number & Title</u>	<u>Design Criteria</u>	<u>Project Proposal</u>
Export Water System Backup - 182-D (for 200 Areas)	Completed	Completed. Held by sponsor (ARHCO).
Stack Monitoring Improvements - 100-N Plant	Completed	Prepared. Held for later submission.
Irradiation Test Facility - N Reactor	In preparation	In preparation.

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APPENDIX BEMPLOYMENT SUMMARY
(with employee allocations)

	<u>11/30/70</u>	<u>12/31/70</u>
<u>CONTRACT PERSONNEL</u>		
<u>02 Programs</u>		
Douglas United Nuclear	1258	1242
Assisting Other Contractors	<u>16</u>	<u>16</u>
Total - 02	1274	1258
<u>Other Programs Under AEC Contract</u>		
Assisting Other Contractors and WPPSS	35	39
Special Irradiations	<u>14</u>	<u>14</u>
Total - Other Programs	49	53
Total Contract Personnel	1323	1311
<u>COMMERCIAL ACTIVITIES PERSONNEL</u>		
	<u>24</u>	<u>23</u>
TOTAL FORCE	1347	1334