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MONTHLY REPORT

MARCH 1969

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DOUGLAS UNITED NUCLEAR, INC.

RICHLAND, WASHINGTON

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April 18, 1969

MONTHLY REPORT

MARCH 1969

DOUGLAS UNITED NUCLEAR, INC.

Richland, Washington

Work performed under Contract No. AT(45-1)-1857 between the Atomic Energy Commission and Douglas United Nuclear, Inc.

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REACTOR PLANT OPERATIONS

Production Statistics

	C	KE	KW	N
Input Production - Pu (KMWD)	51.2	99.5	84.3	65.0
- U-233 (Equiv. KMWD)	1.3	15.4	12.3	-
Time Operated Efficiency - %	75.6	84.7	74.5	56.1
Steam Availability to WPPSS - %	-	-	-	55.9

C & K Reactors

Maximum power levels at KE (3870 MW) and KW (4055 MW) continued to be limited by inlet water piping brittle fracture considerations.

The nondefense plutonium program to produce Pu-240 in the 8-12 percent range is continuing, and E-Q core loadings are being irradiated at KE and KW to make U-233. The latter program is being reevaluated in the light of monitor column data which indicate that at least one additional E-Q core loading will be required. Weapons grade plutonium is being produced from natural uranium at C Reactor.

N Reactor

Reactor power level was administratively limited at the design rating of 4000 MW.

Four reactor outages occurred: one scheduled, for charge-discharge and plant maintenance, and three unscheduled. The latter were due to a tube leak in the Foster Wheeler boiler, a flow monitor trip, and a malfunction of the pressurizer level control system.

Operational testing of the two package boilers was successfully completed March 6. These boilers are now being utilized for nuclear safety back-up. Work on steam generator retubing in Cell 2 continued on schedule.

A task force of four Section Managers was established to emphasize and coordinate efforts to solve the problems that are detracting from N Reactor availability and those that are adversely affecting cost.

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FUEL AND TARGET FABRICATION

Production Statistics (tons)

	For C & Ks	For N
Billets Extruded	-	37.7
Finished Fuel Produced	214.8	34.2
Thoria Canned	10.6	-

C & K Fuels

AlSi canning operations continued on the basis of three lines on the day shift, five days per week. Bumpers or self-supports were attached to 88 percent of the fuel elements produced.

N Fuels

Finished fuel production was slightly below forecast due to a problem with outer supports which was resolved before month-end.

TECHNICAL ACTIVITIES

C & K Reactors

Fracture toughness test samples have been obtained from the KE-D, KE-A and KW-B risers. To provide greater assurance of meeting test schedules, a large part of the fracture testing work has been diverted from the Lawrence Radiation Laboratory to Battelle-Northwest.

The analytical method developed for the evaluation of K Reactor tube power limits was reviewed with the Division of Reactor Licensing on March 12. Although the method was generally accepted by DRL, additional supporting information was requested. This information is to include the time of fuel column coolant voiding under accident conditions, and further substantiation regarding the heat transfer film coefficients utilized in the fuel temperature calculations.

Data have been analyzed from a monitor column charged to check and permit adjustment of exposure of the thoria target elements in the K reactor E-Q loadings to permit production of U-233 containing a maximum of 8 ppm U-232. Results indicate that the goal exposure to obtain 8 ppm U-232 should be 15 percent below that indicated by the prediction curves utilized in the 1966 production campaign, and the yield of U-233 for a given target exposure is 7 percent below that predicted on the basis of 1966 experience.

Investigation continued in the KE half-plant test on the influence of higher process water turbidity on effluent water radionuclide concentration. After five weeks of testing, the results indicate a slight reduction (15 to 25 percent) in effluent activity from the high turbidity side of the reactor.

Installation of the prototype smoke monitor in the stack of one boiler at 165-KW was completed. The initial checkout of equipment operation is in progress. This work, which has application of all fossil-fueled boilers in DUN, is in response to AEC Immediate Action Directive 0510-13 on air pollution.

N Reactor

Mark IV demonstration test fuel elements have been irradiated successfully to goal exposures up to 3120 MWD/T. The elements examined to date appear to be swelling at a slightly lower rate than that of Mark I fuel at the same exposure. No indication of local hot spots or local corrosion was observed in the vicinity of the supports and support contact areas.

In the Zircaloy process tube monitoring program, the third precracked tube section failed after about 300,000 cycles. To effect the breakthrough, the cyclic stress was increased from 25,000 to 31,000 psi for the last several thousand cycles. A small increase in hydrogen content has been observed in the upstream spacer section of the tube. The distribution of the hydrogen through the wall indicates a maximum in both the inner and outer tube surfaces. No mechanism has been discovered to explain this greater hydrogen content in this localized portion of the tube.

Full-scale shakedown tests with unirradiated fuel in the 324-D cell have now demonstrated the suitability of this new equipment to support studies of metal-water reactions and fission product release.

An engineering program has been initiated to develop a new ball trip mechanism with primary objectives of achieving increased reliability, maintainability, and elimination of the "stop-gap" purge air system to the ball hopper enclosures. Secondary objectives are elimination of the solenoid pull-in and holding coils and the original design latching mechanism.

FEATURE REPORT

This month the appended summary report covers the environmental control program which Douglas United Nuclear administers in the 300 Area. The bases and present scope of this program are described, and plans intended to be responsive to indicated future needs are noted.

GENERAL

The Company has earned the National Safety Council's "Award of Merit" based on CY 1968 performance. The award certificate is expected in April.

There were no disabling injuries in March, and no radiation exposures exceeded operational control.

Charles D. Harrington

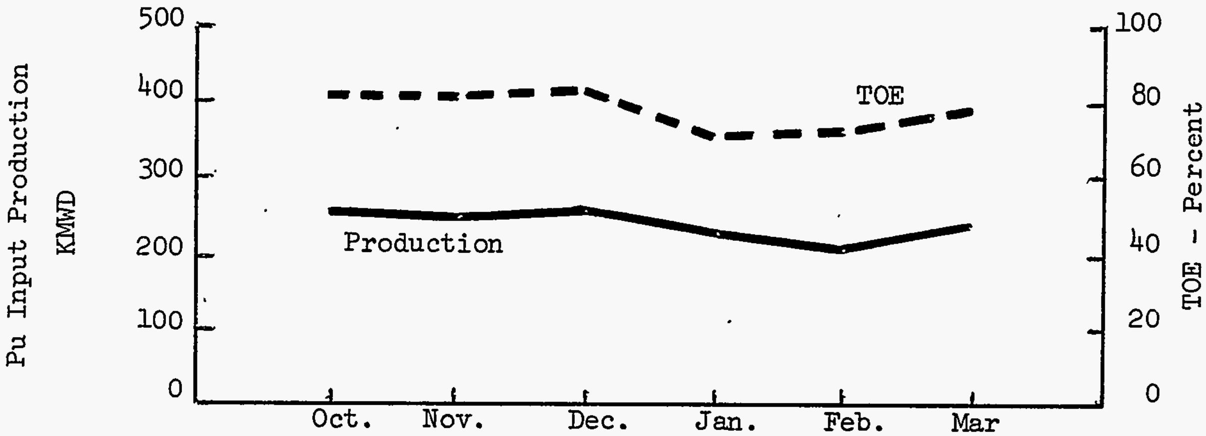
Charles D. Harrington
President

REACTOR PLANT OPERATIONS - C & Ks

PRODUCTION

Reactor production, power levels, efficiencies and related statistics are tabulated on the next page.

Overall reactor input production and time operated efficiency for the past six months are charted below:



The production of nondefense plutonium in the 8-12 percent Pu-240 range is continuing with both natural and enriched uranium at the K reactors. The C Reactor natural uranium load is now programmed for weapons grade material.

The E-Q irradiation program in the K reactors is being reevaluated on the basis of yield and quality data obtained from a test monitor column (see page B-6). It appears that at least one core E-Q loading will be required in addition to those shown in latest study forecast. Preliminary material balances for thoria indicate that total requirements will not exceed original tonnage estimates by more than a few percent.

OPERATING EXPERIENCE

Reactor Loadings

Front face maps showing the loadings at C, KE and KW Reactors are reproduced on the three pages which follow page B-7. The tonnages listed are approximate; actual fuel totals are given on page B-2.

PRODUCTION REACTOR STATISTICS — MARCH 1969

REACTOR	C	KE	KW	TOTAL
INPUT PRODUCTION — PU — KMWD	51.2	99.5	84.3	235.0
— U-233 — EQUIV. MWD	1,257	15,448	12,344	29,049
POWER LEVEL (MW) — MAXIMUM	2,305	3,870	4,055	10,230
— AVERAGE	2,183	3,792	3,652	9,627
TIME OPERATED EFFICIENCY — %	75.6	84.7	74.5	78.3
OUTAGE TIME ALLOCATION — %				
CHARGE — DISCHARGE	3.3	4.1	13.2	6.8
FAILED FUEL REMOVAL	1.3	0	0	0.4
WATER LEAKS	2.3	0	0	0.8
TUBE REPLACEMENT	0	0	0	0
OTHER MAINTENANCE	2.6	3.9	7.1	4.5
STANDARDS CHECK	1.3	0.1	0.9	0.8
PRODUCTION TESTS	13.6(1)	0	2.9	5.5
PROJECT WORK	0	0.2	0	0.1
OTHER	0	7.0(2)	1.4	2.8
TOTAL	24.4	15.3	25.5	21.7
NUMBER OF OUTAGES	2	1	2	5
NUMBER OF STARTUP INTERRUPTIONS	1	0	2	3
WATER LEAKS — TUBE	0	0	0	0
— VAN STONE	0	0	0	0
NEW TUBES INSTALLED	0	0	0	0
FUEL CHARGE — (TONS) — NATURAL URANIUM	139.5	3.5	2.9	145.9
— ENRICHED URANIUM	76.2	355.0	360.0	791.2
FUEL ELEMENT FAILURES	2	0	0	2
HELIUM CONSUMED — M CU. FT.	314.2	62.4	115.3	491.9
WATER TO REACTOR				
NORMAL OPERATING FLOW — GPM	99,600	187,300	189,600	476,500
pH	6.56	6.69	6.70	-
DICHROMATE — PPM	0.49	0.50	0.90	-

(1) Removal of failed overbore fuel element (PTA-103).

(2) Decontamination of unit for the installation of discharge chute clearing equipment (DAP-510).

Power Levels

A maximum power level of 4055 MW was achieved at the K reactors while operating under continuing precautions to insure adequate coolant flow in the event of a brittle fracture failure of inlet piping. The 3870 MW maximum at KE reflects the further limitation by material charged under PTA-150, "Pu-Al Irradiation"; several loading changes have been made to correct this condition (see Operational Physics, page B-4).

At C Reactor the power level was limited by nine-pump operation the entire period, by low reactivity until late in the month, and by the 95 C bulk outlet water temperature limit during the last few days of the month.

Fuel Failures

Two natural uranium fuel failures occurred in C Reactor. One was a regular size production element at 2184 MWD/T, the first failure in such material at C Reactor since December 1967. The other was a one-inch overbore element (PTA-103) at 1866 MWD/T. Both failures required above-normal forces for removal and were of the "side-unclassified" type.

Removal of failed elements from the overbore tubes has been complicated by the inability to flush the metal downstream of the failed piece. This means the exact location of the rupture cannot be determined. The problem is further complicated by the fact that the inner rod of the rod-in-tube fuel can flush leaving the tubular element in place. Consequently no more flushing of one-inch overbore fuel is planned. When an overbore fuel failure is experienced in a ribbed aluminum tube, the charge will be backseated 45", and the tube ribs will be cut the length of the rear gunbarrel to provide the necessary clearance.

Reactor Outages

Five reactor outages were experienced as summarized below. In addition the C and KW Reactors were down 86.7 and 19.5 hours, respectively, on outages initiated in February.

Date Down	Reactor	Outage Hours	Remarks
March 16	KW	129.2	Scheduled outage for charge-discharge, replacement of B riser dome, repair of HCR No. 8, and miscellaneous maintenance work.
March 20	C	47.0	Removal of a failed fuel element. Also completed a small charge-discharge and process tube leak testing.
March 22	C	44.9	Removal of a failed one-inch overbore fuel element. Miscellaneous maintenance work was performed.

Date Down	Reactor	Outage Hours	Remarks
March 26	KW	40.1	High speed scanner trip caused by a self-test failure. EMS checks were performed.
March 27	KE	114.0	Scheduled outage for charge-discharge, installation of wide-mesh venturi screens, and installation of "Discharge Chute Clearing Equipment" (DAP-510). Reactor continued down at month end.

EQUIPMENT EXPERIENCE

B Riser Dome - KW Reactor

The B riser dome at KW was replaced to allow further study and analysis of the inlet piping as related to the brittle fracture evaluation. Following the replacement, all crossheader screens on B riser were removed and inspected. The only problem noted was a piece of welding slag about 1/4" in diameter and 3/4" long in No. 39 screen.

Gamma Monitor System - KW Reactor

The copper lines in the KW gamma monitor system had deteriorated to the point where excessive radiation exposure was required to maintain the system. Replacement of the copper with Inconel lines, started in November 1968, has now been completed.

K Reactor Boilers

Control adjustments have been made on the No. 1 KW boiler (Boiler Control Modifications) and its performance has been significantly better than that of the other two boilers now in service. After final acceptance tests are made, the No. 1 KW boiler will be placed in service and the No. 2 unit will be made available for this modification.

On March 5 control modifications were started on No. 2 KE boiler and the work is progressing satisfactorily.

PROCESS ASSISTANCE & CONTROL

Operational Physics

The 225-tube PuAl test block in KE Reactor increased in power slightly due to long-term reactivity gains, but the powers were still 20-25 percent lower than desired when the reactor was shutdown on March 27 for a scheduled outage. Efforts were made through the operating period to force the block to run at the highest power possible. The rod configuration was modified somewhat, and all splines used to compensate long term reactivity gains were inserted outside of the block. Total reactor power increased from 3750 MW at the first of March to 3870 MW at the end of the month. Ten thoria columns in the block will be replaced with 94 Metal this outage in an effort to raise the power generation rate of the 13 PuAl target columns.

Operational physics aspects of the 94 Metal-thoria (E-Q) loads in the K reactors have been as expected, and no significant problems have evolved to date.

About 1300 tubes were charge-discharged during the C Reactor outage which started on February 21. The fuel charges utilized were a combination of C Reactor and B Reactor fuel elements, and a higher than normal number of water mixer elements were required. Startup physics predictions indicated the excess reactivity, which was estimated for the upcoming samarium dip, was marginal. Additional spike columns could not be charged, since the fuel was not available. The actual excess reactivity for the samarium dip proved to be 1.5 mk lower than calculated, with the result that the excess reactivity was to be 2 mk lower than ever previously experienced.

However, a rod configuration which had been previously formulated for such a contingency was implemented, and the reactor was quite adequately controlled through a reactivity low point of 7 mk. The tactic used to maintain operational control flexibility was to withdraw the half rods on the second and fourth banks, and cover the far side by inserting the half rods on the first, third and fifth banks. Although the half rods are normally positioned to the right side of center, between the near and far E-rings, this rod configuration did not cause a significant decrease in reactor flattening, and operational control was maintained. The flattening did drop 5 percent to 0.83 initially, but has improved steadily with the long-term reactivity gain.

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

	Reactor		
	C	KE	KW
Effective Central Tubes (ECT)*	1580	2150	2267
Flattening Efficiency** - March	0.84	0.69	0.72
- 12-mo. average	0.84	0.72	0.70
Maximum Operating Time Permitting Scram Recovery - Hours***	10	10	11

*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 procedures.

Product Accountability

Tables for the C overbore self-support fuel enriched to 0.80 percent, CMIE, have been added to the accountability manual.

Equation fits for U-236 buildup utilizing the LEARN code have been developed for several K and N fuel models and will be applied to the remaining fuel models as MOFDA and DCODE data become available. To maintain consistency with the AEC definitions for "Gratuitous" and "Incremental" neptunium, tables will be written to show the Np-237 buildup in material with 0 ppm U-236 (virgin uranium) as gratuitous and all other U-236 input as the incremental contribution.

U-233 Yield and Quality Observations

A thoria element from the 2886-KW column discharged in October 1968 was sent to the BNW Radiochemistry Laboratory during March to provide a redundant sample for U-233 and U-232 determinations essentially free of the complication of the 27-day mother isotope Pa-233. The results supported the earlier laboratory results, which, though not completely understood, have been consistent among the samples themselves. Good agreement also was obtained between "weasel" data and radiochemistry data on adjacent driver pieces from which the exposure of the adjacent target column was calculated.

The samples from which these data were obtained were from a PTA-137 monitor column, charged to check and permit adjustment of exposures during the E-Q loadings as necessary to meet the product specification for 8 ppm U-232.

Production Fuel Performance

The production fuel element failure which occurred at C Reactor is described as follows:

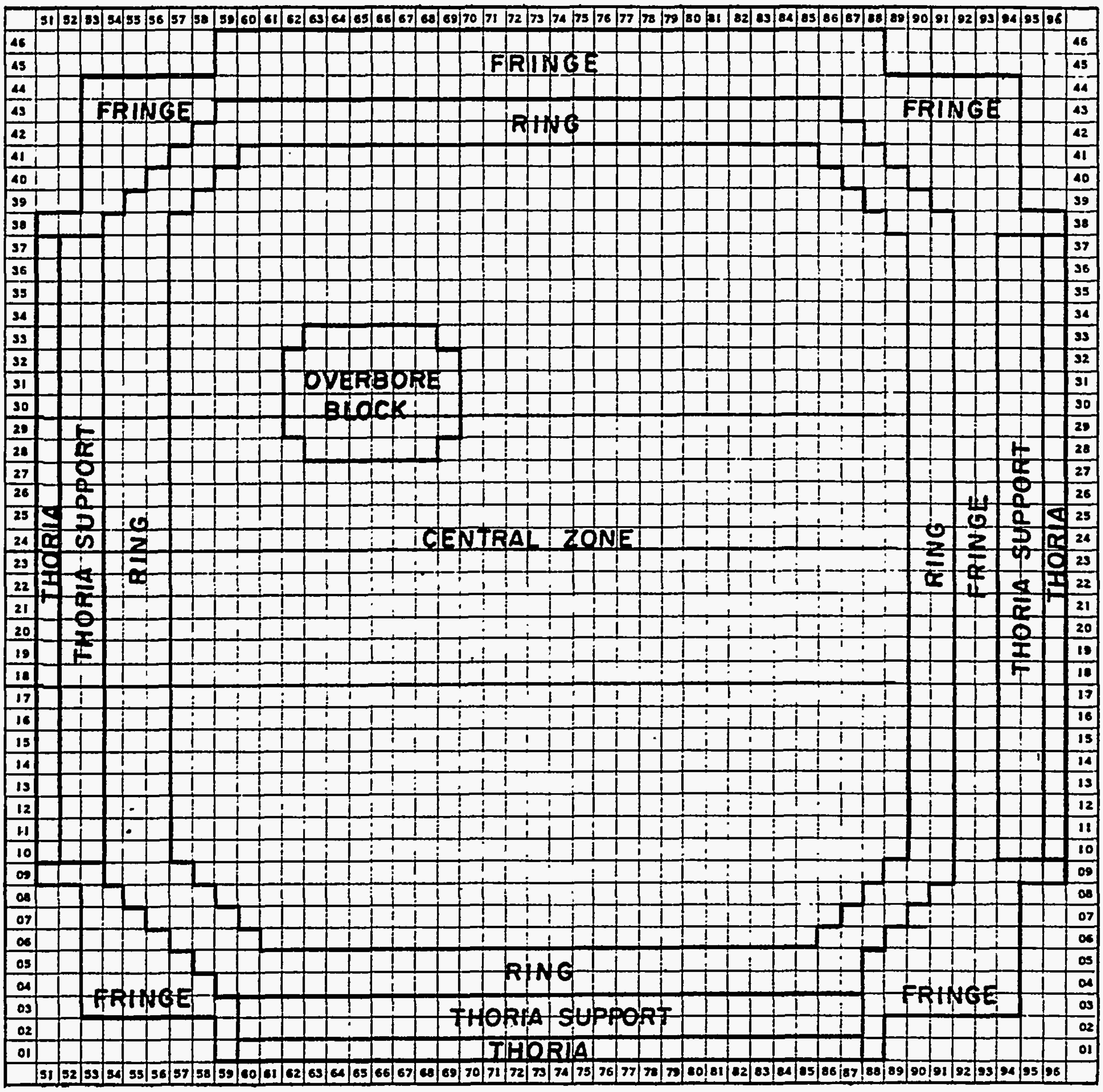
Tube No.	Charge Date	Failure Date	Exposure (MWD/T)	Failure Type
2690-C	6/10/68	3/20/69	2184	Cladding

This failed element was a C2N model in a mixed charge of equal numbers (15) of C2N and C3N models with 2 mixers of each model type. The failure was a longitudinal crack in the external cladding which may have been caused by either core cracking or corrosion.

The following table shows production fuel failure frequencies, as number per million elements discharged, for the 12- and 24-month periods ending Feb. 20:

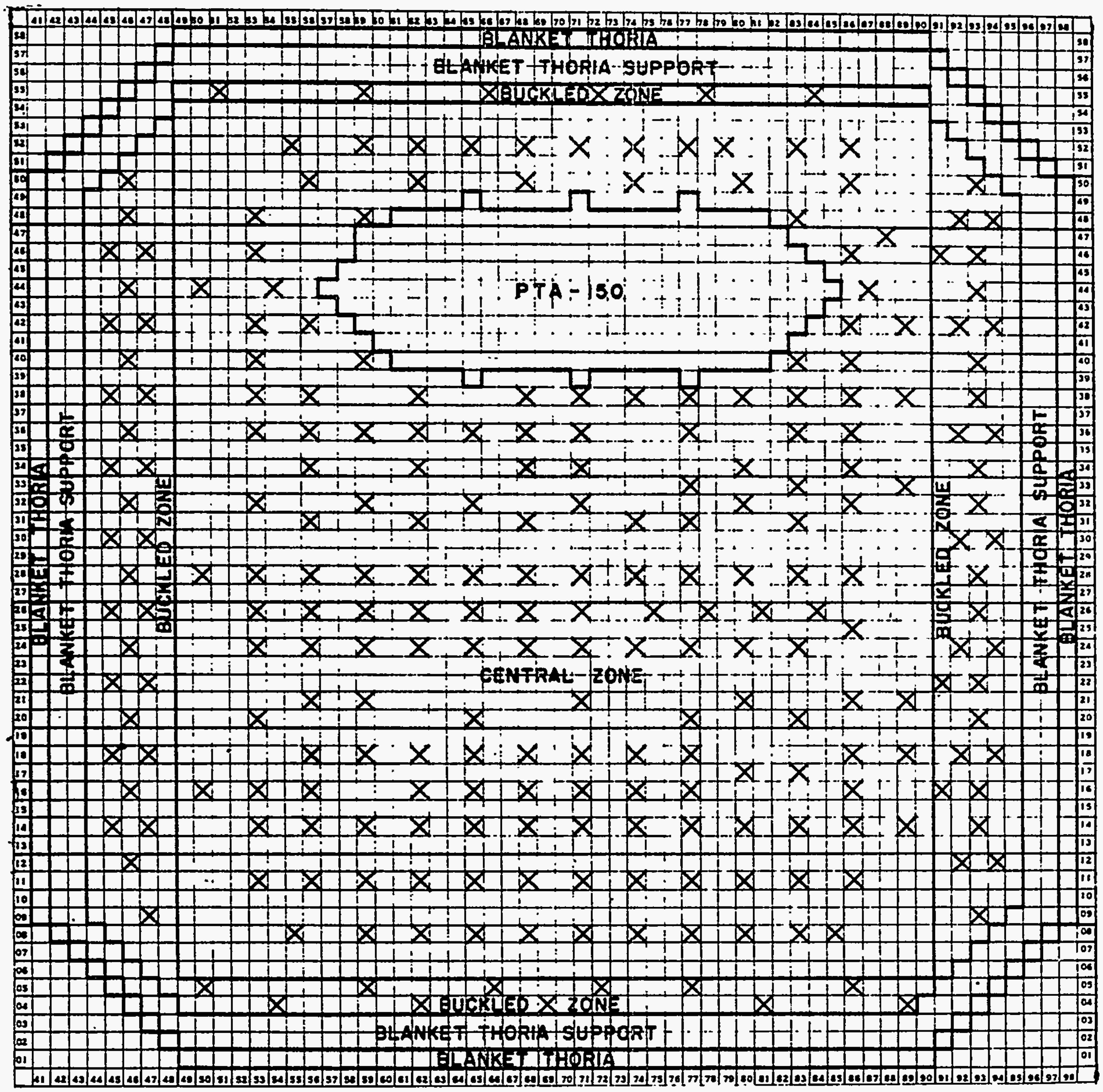
	12 Months	24 Months
C Reactor - Natural Uranium	25	34
- 94 Metal	67	34
K Reactors - Natural Uranium	4	6
- 94 Metal	5	8

The discharge goal for 8 ppm U-232 material indicated by these results is about 15 percent below that indicated by prediction curves utilized in the 5 ppm production program in 1966, and the U-233 yield is about 7 percent lower than shown on the earlier prediction curves for the same target exposure. Thus, to produce a given quantity of U-233 at 8 ppm U-232, more thoria would be required. The detailed data and analyses have been documented in an interim PTA-137 report (DUN-5625).



Zone	Tons	Material
Central	98	Natural Uranium
	41 (Includes 14 in overbore block)	94 Metal
Ring	12	Natural Uranium
	20	94 Metal
Fringe	25	Natural Uranium
Thoria Support	19	94 Metal
Thoria	4	Thoria

Loading Pattern - C Reactor



Zone	Tons	Material
Central	237	94 Metal (for Thoria Support)
	2	Natural Uranium
	19	Thoria ("X" Designates Tubes)
	1	Special Depleted Uranium (PITA-048)
Buckled	65	94 Metal (for Thoria Support)
	6	Thoria ("X" Designates Tubes)
Blanket	55	94 Metal (for Thoria Support)
	11	Thoria

Loading Pattern - KE Reactor

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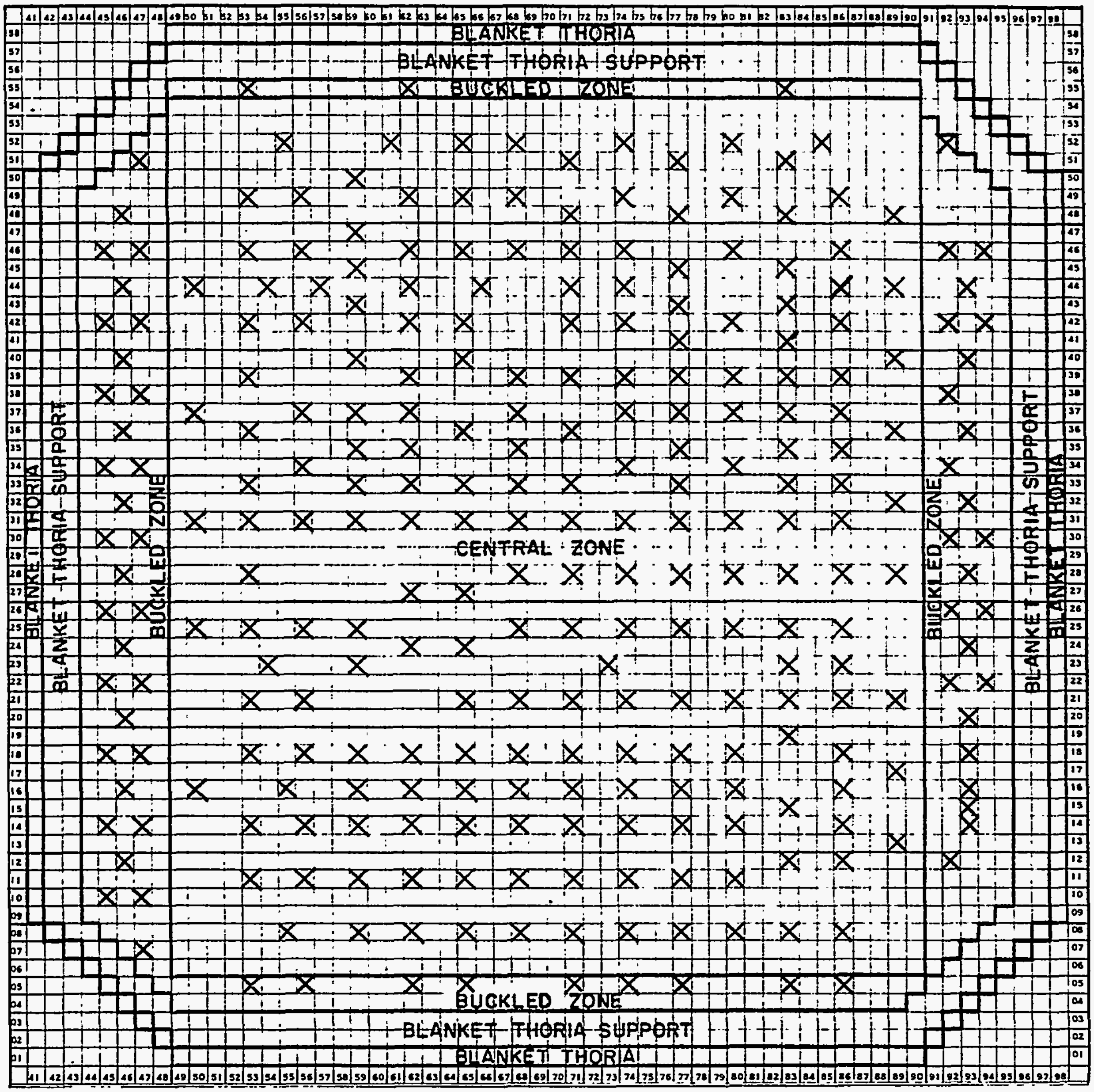

Zone	Tons	Material
Central	237	94 Metal (for Thoria Support)
	1	Natural Uranium
	18	Thoria ("X" Designates Tubes)
	1	Special Depleted Uranium (PITA-048)
Buckled	66	94 Metal (for Thoria Support)
	6	Thoria ("X" Designates Tubes)
Blanket	53	94 Metal (for Thoria Support)
	11	Thoria

Loading Pattern - KW Reactor

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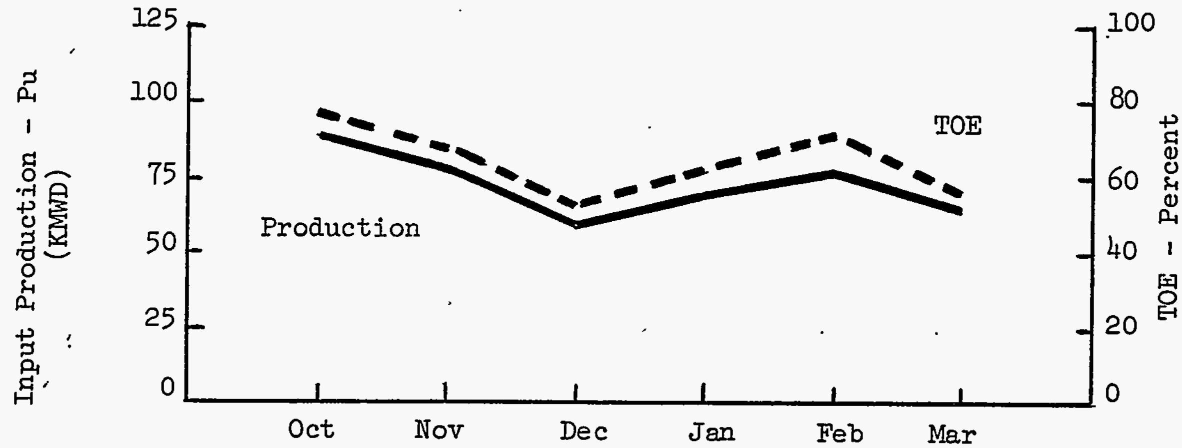
REACTOR PLANT OPERATIONS - N

PRODUCTION

General

Reactor production, 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	64.95
Electrical Generation (KMWH)	- Total	308.2 (per WPPSS)
Power Level MW	- Maximum	4,000
	- Average	3,735
Time Operated Efficiency	- %	56.1
Steam Availability	- %	55.1
Number of Shutdowns	- Scheduled	1
	- Unscheduled	3
Fuel Failures		0
Fuel Charge (Tons)	- 94 Metal	301.8
	- 125 Metal	67.3
	- Natural U	0.4
	Total	369.5

[redacted]

[redacted]

Helium Losses	- M cu.ft.	371.0
Fuel Oil Usage	- bbl	17,363

N Plant Problems Task Force

This special task force has been established jointly by President C. D. Harrington, and Assistant General Managers C. W. Kuhlman and O. C. Schroeder. The task force consists of four Section managers:

T. W. Ambrose, Process & Programs
G. O. Amy, Manufacturing Engineering
R. E. Dunn, N Plant
R. T. Jessen, Engineering

Its mission is to give increased emphasis to, and coordinate, efforts to solve the problems that are detracting from N Reactor availability and those that are adversely affecting cost. An N Plant Senior Engineer has been assigned full time to assist the task force, which is expected to complete its work within five to seven months.

OPERATING EXPERIENCE

Reactor Loading

The reactor loading at month end is shown on the front face map which follows page BN-6.

Two hundred and two tubes were charge-discharged during the scheduled outage starting March 20. Three columns required higher than normal machine pressures for charging and the fuel was subsequently removed for fuel and tube inspection. Zirconium shavings were found in each tube charge with an unusual amount in column 2472. This tube was borescoped and found to have several scratches and some galled areas; the latter were honed and the tube recharged. The other two tubes were recharged without honing.

Power Level

Power level was administratively limited at 4000 MW throughout the month.

The main steam header pressure (MSHP) continued to be limited to some degree because of the reactor reactivity being much lower than normally experienced. However, it was possible to maintain the MSHP near 123 psig for a large part of the month, thus maximizing the electrical generation capability of WPPSS.

Reactor Outages

The four reactor outages and their principal causes were as follows:

Date Down	Outage Type	Outage Hours	Cause
March 3	Unscheduled	46.2	Foster Wheeler boiler leak (in a floor tube).
March 7	Unscheduled	49.8	Loss of level control in primary loop pressurizer.
March 20	Scheduled	227.7	Refueling and maintenance.
March 31	Unscheduled	2.9*	Flow monitor trip.

*The reactor was down through month end.

EQUIPMENT EXPERIENCE

Package Boilers

Time delay relays were installed on Combustion Engineering boilers fuel-air ratio circuitry to reduce boiler flameouts caused by momentary oil pressure surges. Both of these boilers (CE-1 and CE-2) completed all remaining requirements of the operational test procedure on March 6, and then became available for use as backup to the Foster Wheeler boiler during reactor operation. During the March scheduled outage, a leak was located and repaired in a DE-2 steam drum tube connection.

Equipment Modifications

The following equipment modifications were completed:

- EMP-202 - Provision of a burner light-off logic monitor which enables personnel in the 184-N control room to monitor the status of critical logic points, and to reset memory logic in order to recover from a control system lockup.
- EMP-370 - Provision of a bias control for each of the FPDV-6203 valves to permit balancing of secondary system inventory while on automatic control.
- DC-3000 - "105-N Lift Station Motor Starters", has been completed on No. 1 lift station pump. This pump is now operating on the new starter with no difficulties or interruptions having been experienced.

GCP-411 - Effluent Control Project

The tie-in of the starting air piping modifications was completed under this project. These modifications provide for isolation of air receivers and diesel starting accumulators such that loss of any one starting air accumulator, and accompanying loss of the supply air receiver, will not result in loss of starting air to more than one diesel. The backup cooling water supply to the jacket and lube oil water for each diesel engine was also modified so that each diesel provides its own cooling supply from the discharge of its related pump.

Primary Loop Equipment

Process tube connector valves (V-11 and V-12) continued to give difficulty. Two of the V-12 (diversion) valves were replaced and twenty-eight V-11 (inlet throttling) valves were repacked and equipped with manual actuators. J. A. Jones was contracted to do this work on the two V-12 valves and twenty-five of the V-11 valves.

A number of other primary loop leaks were repaired. This work included repacking of the V-4-6 valve (emergency dump valve) and a number of pressurizer pressure relief valves.

The pressurizer level control system loss which occurred on March 7 was found due to the accumulation of moisture in junction boxes. The system was dried out, recalibrated and returned to service.

Steam generator retubing in Cell 2 continued on schedule with completion scheduled for July. Some weld repair work on the tube sheet cladding has been required.

Ball Safety System

All serviceable ball hoppers tripped following the March 7 shutdown due to a slow delay on the intermediate flux monitor channel No. 1. One channel was out of service at the time so the trip logic was one out of two. Also, thirty hoppers were functionally tested during the scheduled outage as part of the continuing test program. A total of 136 hoppers was tripped during the month with no hopper trip failures. Ball hopper 52 channel was found to be filled with balls during the scheduled outage. The "hot" balls were removed and the ball drain valve was repaired.

Confinement System

The "A" cell filter at 117 Building was DOP tested and reported to have 99.95 percent efficiency. "C" cell was also DOP tested. Seven filter units were replaced in cell "C" and all four cells are now in conformance with Equipment Maintenance Standards.

Flux Monitors

New chambers were installed in both subcritical monitor channels. No. 64 galvanometer chamber was repaired. At month end both subcritical monitor channels, and all three intermediate flux monitor channels had operating chambers.

Testing

HCR-27, which contains isotope production material under PT-NR-6, was discharged. Borescopic examination of the interior of the rod tip indicated the rod to be in good condition with little evidence of corrosion.

The variable orifice on test in process tube 0250 was slightly damaged when it was removed during the scheduled outage. A connector orifice (Zone III) was installed to replace the damaged unit.

Fog spray diesel engine functional testing on March 26 resulted in a pressure surge which caused failure of the 23-inch cast iron closure plate on the fog spray header strainer at the +60 foot level in the 105 Building. A new steel plate was fabricated and installed.

Collection of temperature data for Development Test 45 was continued to check the Zone I concrete temperature at the piping penetrations, with and without cooling water. Modifications were incorporated into the test during the scheduled outage to determine whether the penetrations could be successfully air cooled. The test is continuing.

Removal of Pressurizer Heaters

In response to a Naval Reactors request through AEC-RL, all 96 of the cycle and backup heaters for the pressurizers were checked for insulation resistance between the element and sheath and found to meet specifications. Also four cycle heater assemblies were removed, decontaminated, and shipped to the Naval Reactors Representative, U. S. AEC Mao Site, for destructive testing. The removed heaters were replaced with spare new units.

PROCESS ASSISTANCE & CONTROL

Operational Physics

Although the excess reactivity compensated by controls dropped to a low of about 2.5 mk prior to the scheduled shutdown of March 20, reactor and power generation levels were maintained near normal. The loading pattern was optimum for flattening and, although inserted controls were marginally adequate for operating flexibility, no significant operating problems were experienced. An outboard rod pattern (see the February Monthly Report) was utilized to have more control rods inserted for trend control than would be available with the standard inboard pattern.

The inboard pattern was reinstated for the higher excess reactivity condition for the operating period which began March 29. The rod pattern cannot be modified significantly during equilibrium operation, but the rod withdrawal sequence (for startup) and projected equilibrium condition rod pattern can be prescribed during an outage for the conditions expected in the ensuing operating period.

Special startup procedures were provided for two early March startups when both of the two Low Level Neutron Monitors were unserviceable. A rod withdrawal rate was calcuated such that the period would be greater than 60 seconds when the first indication was obtained with the next most sensitive flux monitoring system (Intermediate Range Flux Monitors). Sepcial startup procedures for these conditions are specified in Process Standards for the single-pass reactors, but had not previously been used at N Reactor.

Some operational physics parameters of interest were:

Effective Central Tubes (ECT)	817
Flattening Efficiency - March	0.82
- 8-mo. average	0.82
Maximum operating time permitting scram recovery - hours	24

Product Accountability

Mark I and Mark IV accountability tables have been prepared and are awaiting reproduction.

The combined version of the curve-fitting programs GEORGE and GENTAB (called SSAGEN) has been largely completed. This simplified method for obtaining data tabulations was utilized for running the Mark I and Mark IV tables.

Flow Interruption to Process Tube 0864

Fuel and tube temperature calculations were made for the flow interruption which occurred on process tube 0864 during the scheduled outage in February. The reactor had been down about 24 hours when the tube flow was interrupted inadvertently for an estimated 45 minutes. The fuel was discharged, the process tube was examined visually, and new fuel was charged into the tube.

A modified version of the MELT code was used to determine the maximum temperature the fuel and process tube could have attained before coolant flow was restored.

These calculations were based on the assumptions that (1) the previous operation of the fuel column had been at the maximum allowable tube power of 5000 KW, and (2) the flux distribution was a chopped cosine with a peak-to-average ratio of 1.35. The calculations for the center of the column indicate the maximum temperatures may have reached 260 F for the inner cylinder, 1085 F for the outer cylinder, and 310 F for the process tube.

	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	
34																																			34
33							C	C	C												C	C	C			C	C	C							33
32						C	C		C				C		C	76			C				76	C	C		C	C	C						32
31								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		C	C					31
30				C	C	C	X	X	X	X	X	X	X	E	X	X	X	X	X	X	X	X	X	X	X	X	X	X		C	C				30
29			C	C		X	X	X	X	X	E	E	E	C	C	C	C	E	E	E	E	E	E	E	94	X	X	X	X		C	C			29
28		C	C		X	X	X	X	E	C	C	C	C	E	E	E	07	E	E	E	E	E	E	E	E	E	E	X	X	X	C	C	C		28
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26	C	C	X	X	X	X	C	C	E	C	C	C	C	E	E	E	E	C	E	E	E	C	E	C	C	94	94	94	X	X	X	X	C	C	26
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22	C		X	X	X	C	C	C	C	C	96	96	E	96	C	C	E	96	96	96	C	C	E	C	E	E	96	C	C	X	X	X	C	C	22
21	C		X	X	X	07	C	07	C	C	C	07	E	07	E	94	E	E	E	07	94	E	E	07	E	07	C	94	C	X	X	X		C	21
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19	C		X	X	X	96	96	96	E	E	E	E	E	C	E	E	E	E	96	C	E	96	C	96	E	E	E	E	E	X	X	X		C	19
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12	C		X	X	X	07	E	C	E	E	E	07	C	07	C	E	C	E	94	E	E	E	E	07	E	07	E	E	C	X	X	X	C	C	12
11	C	C	X	E	X	C	E	E	E	E	C	C	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	X	X	X	C	C	11
10	C	C	X	X	X	C	E	C	E	E	E	E	E	E	E	E	E	E	E	C	E	E	E	E	E	E	E	E	E	X	X	X	C	C	10
09	C	C	X	X	X	X	C	E	E	C	C	07	E	07	C	C	E	94	94	07	E	E	E	07	94	07	E	E	X	X	X	X	C	C	09
08	C	C	C	X	X	X	X	E	C	C	C	E	E	C	C	C	E	C	E	E	C	C	C	C	E	E	E	X	X	X	X	C	C	C	08
07		C	C		X	X	X	X	C	E	C	C	C	E	E	E	07	C	E	C	E	E	E	E	E	E	X	X	X	X	C	C	C		07
06			C	C		X	X	X	X	C	E	07	E	07	C	E	C	E	C	07	E	E	E	E	X	X	X	X	X	C	C	C			06
05				C	C	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	C	C	C				05
04					C	C	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	C	C	C					04
03							76	C			C	C			C	C	C	C	76	C			C			C	C	C	C						03
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01																																			01
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Fuel Code	No. Tubes	Description
	62	Mk-IC (94 Metal Fringe Normal)
C*	312	Mk-IC (94 Metal)
E	277	Mk-IC (94 Metal - High U-236)
X**	242	Mk-ICA (125 - 94 Metal)
D	1	Mk-IC (Natural U)
	894	Total
	110	Total PT's
	1004	Grand Total

PT-NR No.	No. Tubes	Description
76	4	Fuel Meltdown Test
94+	23	Mk-IV Demonstration
96	22	Mk-I from Upset-Forged Billets
01	12	Mk-I from Direct Cast Billets
07	48	Initial Full Length Mk-IV Columns
■	1	Blank Channel or Empty Tube
	110	Total

* 100% NFS, ** 94 Metal - 25% NFS

\+ Includes Mk-IV High U-236 Content Fuel and 2 Tubes w/Mk-IA 125-94 Metal and Mk-IV 94 Metal.

FUEL AND TARGET FABRICATION - C & K REACTORS

PRODUCTION

General

Production of AlSi-bonded and hot-die-sized fuel for the C and K reactors was 98.5 percent of forecast. Eighty-eight percent of these elements had bumpers or self-supports attached.

Acceptable Elements Produced

	Finished Production (tons)	Yield - Percent	
		Current Mo.	FYTD
AlSi-Bonded Fuel	212.4	95.5	96.2
Hot-Die-Sized Fuel	2.4	92.1	82.0
Thoria	10.6	95.8	95.6

Month-End Inventories

		Tons
Bare Uranium Cores		1,051*
Finished Fuel:	AlSi-Bonded	1,320*
	Hot-Die-Sized	33
Thoria Elements		42.1

*These totals include 124 tons of cores and 138 tons of finished fuel made for the smaller reactors.

OPERATING EXPERIENCE

Overall operating efficiency of the AlSi-bonding lines was 99.1 percent. Downtime was assigned 45 percent to equipment malfunctions and 55 percent to operations. AlSi canning operations continued on the basis of three lines on the day shift, five days per week.

EQUIPMENT EXPERIENCE

Hot-die-size production facilities were shutdown for two weeks for alteration of the nickel plating machine and general maintenance of the press and end bonder. The electrochemical plating machine was modified to increase its throughput and to permit the machine to accommodate changes for the various fuel models.

PROCESS ASSISTANCE AND CONTROL

A statistical test of 15,000 tapered-base cans used in the AlSi process was completed using the standard cap and can etch solutions to evaluate the base closure void areas. Results indicated that this cleaning process provides an adequate etch and removes contaminants from the galled areas of the can base. Since a satisfactory braze bond was found in the can base region, these components are acceptable for cladding of reactor grade fuel elements.

FUEL AND TARGET FABRICATION - N REACTOR

PRODUCTION

Input Production

Total billets extruded	229
Tons extruded	37.7
Percent of forecast	99.2

Output Production

Total finished fuel assemblies	1,348
Tons output	34.2
Percent of forecast	92.4

Uranium Utilization - %	71.2

Month-End Inventories - Tons

Bare uranium billets	272
Finished fuel	302

OPERATING EXPERIENCE

Suspension of Operations on March 31

All fabrication operations in the Fuels Section were suspended on March 31, the Day of Mourning for ex-President Eisenhower.

Low-Strength Supports

Output production was below the official forecast principally because of a problem with outer supports. The supports on hand were found to be below specification in compression strength. When testing indicated that the slightly increased deflection exhibited by these supports was not sufficient to cause an enthalpy imbalance in-reactor, the Engineering specification was changed to permit their use.

Purchase of Beryllium Braze Rings

AEC-RL approved the procurement of approximately one year's supply of cast beryllium braze rings. Purchasing a year's requirement, with the vendor supplying all the material, departs from previous practice of buying for six months with DUN furnishing the basic Zircaloy starting material. This change in both the quantity purchased and the source of part of the material will result in annual savings of $35,500 at present volume.

EQUIPMENT EXPERIENCE

Nothing significant to report.

PROCESS ASSISTANCE AND CONTROL

Components from copper-silicon alloy are etched in a nitric acid solution and often display a black, smut-like residue on the etched surface which could result in poor welds at the billet assembly step in the coextrusion process. Tests indicated that an aqueous solution containing 4-5 pounds of HNO_3 and 0.150-0.160 pounds of HF (added in the form of liquid hydrofluoric acid) per gallon eliminated this residue. From the safety standpoint, it would be preferable to add HF in the form of a salt such as ammonium bifluoride. Twelve different solutions, containing the fluoride ion (from ammonium bifluoride) in concentrations between 0.088 and 0.277 pounds per gallon in nitric acid solutions of 3.10 to 5.72 pounds per gallon, were tested. However, none of these solutions produced results as effective as the use of HF in the acid form.

TECHNICAL ACTIVITIES - C & K REACTORS

RESEARCH AND DEVELOPMENT

Mission 1 - Basic Production

1-A. Brittle Fracture Program

Fracture Mechanics Testing Program

The piping materials testing program includes (1) fracture toughness, (2) fatigue crack growth rate, and (3) crack growth under steady stress. Fracture toughness tests will continue at the Lawrence Radiation Laboratory and include samples from the KE-D, KE-A and KW-B risers. The temperature range has been extended to examine the crack initiation and propagation behavior from -80 F to 212 F. To speed up the testing program, a large share of the fracture testing work has been diverted to Battelle-Northwest.

Recent ASTM recommendations regarding WOL specimen testing have resulted in revision of the test procedure. The recommended practice for pre-cracking the specimens by fatigue specifies a lower load than initially planned to provide assurance of a sharp-edged crack. The recommended cracking rate is being adopted in the DUN program.

In addition to the fracture tests, a program was initiated to measure the effect of environment on fatigue crack growth rates. A total of seven samples of base and weld metal from the three riser sections will be fatigued in process water at a variety of stress intensities and at different cyclic rates to determine the da/dN versus ΔK curve. It has been decided to use large single-edge crack (SEC) specimens for these tests to provide stress relationships which more nearly correspond to those in the pipe. The sample specimen has nominal dimensions of 4.25"w x 8.5"l x 0.75"t. The initial notch is applied by electric discharge machining (EDM).

To determine whether environmental effects of process water contribute to crack growth under steady stress conditions a dead-weight tester will be utilized. Ten samples will be loaded to various fractions of the breaking load in a circulating process water bath and the time to failure will be determined. The data will be used to determine the threshold stress intensity below which environment is not a factor in crack growth. These tests may be repeated to evaluate the effects of decontaminating solutions as well as process water.

Equipment to detect crack growth, if any, in all 24 x 36 wye joints at the K reactors has been assembled. The KW-B joint has been instrumented with seven piezoelectric transducers and the A joint will be instrumented shortly. Two joints will be monitored each shutdown and suspect areas examined with an ultrasonic detector. The program should be completed in two to three months.

Riser Proof Tests

A document reporting on the results of the K riser pressure and leak tests has been issued (DUN-5578). When the A and B risers are isolated by eliminating the cross-tie line and inserting new check valves, these risers will also be leak-tested. The outcome of these tests will determine the actual equipment to be used for a higher pressure test on the coolant supply piping and risers after all of the proposed modifications are completed.

1-B. Technical Bases for K Reactor Tube Power Limits

Document DUN-5362, which defines the analytical method developed for the evaluation of tube power limits for the K reactors, was reviewed with Division of Reactor Licensing personnel on March 12. The information presented was generally accepted by DRL although it will be necessary to submit additional supporting information regarding the timing of fuel column coolant voiding under accident conditions, and the development of additional substantiating information regarding the heat transfer film coefficients utilized in the fuel temperature calculations.

In response to questions received from AEC-RL, additional information on K reactor tube power limits (supplementing that in DUN-5362) has been prepared and submitted in DUN-5565. This information was related to the scram delay times and power decay curves employed in the BNW laboratory simulations.

A preliminary technical bases document for the revised tube power limits has been prepared and is being circulated for internal review. This document is based upon the E-Q type of loadings and considers only the dual riser failure case.

DUN-5042, "PTA-161, Operation Test of 190-K High-Lift Pumps" has been approved. This test will establish the cavitation cutoff flow for the high-lift pumps at three different speeds. Testing is scheduled for an April outage. Inspection has confirmed that these pumps have Meehanite cast-iron wear rings. The vendor has indicated that this material is adequate and the test can be run with confidence.

1-C. Zircaloy Process Tube Hydriding

Analysis of the three "sandblasted" tubes removed from KE Reactor in December 1968 is now complete. These tubes were treated by sandblasting in March 1967 to remove the case layer of zirconium hydride on their inner surfaces. Since that time, they have operated with anodized aluminum spacers to determine if this approach would stop further hydriding of the tubes. Results of the metallurgical examination have led to the following conclusions:

- The sandblasting treatment did not completely remove the case layers from each tube. Tube 1966-KE had a continuous case of zirconium hydride over most of the downstream 96 inches, with complete removal noted only at the 48-inch point. Tube 1968-KE had numerous scattered areas of remaining case layer but apparently the bulk of the case layer had been removed. Tube 2163-KE was completely free of case layer except for one isolated area near the rear Van Stone flange.

- Transverse metallurgical sections through the tube indicate that the sandblasting treatment did not remove the case layers uniformly. It appears to have left longitudinal ridges of zirconium hydride on the surface. In some instances, these ridges are surrounded by areas where several mils of base metal (Zircaloy 2) appear to have been removed. This leads to the conclusion that once the grit blast penetrates the case layer it abrades the base metal more rapidly than the case layer. This is undesirable since it would require excessive base metal removal to insure complete case-layer removal.

- At no point was there any evidence from either metallographic examination or chemical analysis that the formation of new hydride case layers, or an increase in the base metal hydrogen content, had occurred where the case layer had been removed. In other words, where the case layer had been removed, these tubes were indistinguishable from the two companion tubes, 1960- and 1972-KE, which had been removed and analyzed immediately after sandblasting in March 1967.

Work is continuing on the electrolytic method for removing zirconium hydride case layers. Most recent findings indicate that it may be feasible to remove the final traces of the case layer using higher voltages during the final few minutes of the process. Higher voltages cannot be used throughout the entire cleaning operation since they would induce pitting of the tube.

1-D. Physics Code Development

Errors in applying the fission source term to the code which were reported last month have been corrected and the new version is on PCF017. The new libraries contain so many new isotopes that complete checkout by case running is not feasible. A compromise was made by putting the new libraries on a user tape, U1392, and modifying only the libraries on PCF017. The PCF version contains the new thermal library, THERMS/U0026, and the old HAMLET library plus additions to make the libraries compatible. These changes were written and distributed to HAMMER users in DUN-4829 ADD1. The HAMMER card deck was updated to include all changes in the code since October 1968.

1-E. Corrosion Studies

Production Test 159, "Corrosion Comparison Universal Core", has been issued and the test fuel will be charged in the central zone of KE Reactor during early April. The objective of the test is to evaluate the corrosion performance of the K5AE-A hot-die-size universal core fuel by comparing it to AlSi universal core and K5AE large-core HDS fuel. The test will determine whether temperature alone is responsible for the higher incidence of groove corrosion on the large-core HDS pieces or whether the HDS fabrication process causes the fuel to be more susceptible.

Operation of a Battelle-Northwest laboratory facility to investigate mechanisms of erosion on Hanford aluminum alloy fuel cladding has been started. Initial experiments have shown grooving effects on 8001 alloy in water adjusted to pH 10 and lesser effects at pH 8.

1-F. Graphite Studies

Irradiation of graphite samples removed from KW Reactor is continuing in the ETR. Turnaround has now been observed on the samples which had been operating at nominal K reactor graphite temperatures; it occurred at an exposure of 10^{22} nvt and a total contraction of 3.36 percent. Equating these data to the K reactors, a decrease in contraction rate would be expected within the next several years followed by turnaround in 1975 or 1976 at a total contraction in the top center of the reactor of 12 to 13 inches. Previous predictions based on data from small virgin-sample irradiations indicated turnaround would occur in the 1972-1973 period.

Mission 3 - Transplutonium Technology

3-A. Ten-Kilogram Plutonium Irradiation

The 225-tube zone containing the 10 kg PuAl layer was charged into KE Reactor in late February under PTA-150 (DUN-4747). Initial reactivity conditions were sufficiently conservative that the local power in the PuAl fuel was in the range of half to three-fourths that intended. Loading changes have been recommended for the next outage to increase the tube power in the enriched driver zone surrounding the thoria-sandwiched PuAl columns to near normal central zone values and thereby increase the power of the PuAl columns.

Subcritical count rates during the charging of the test block were in good agreement with expectations based on HFN code calculations. The normalized results were as follows:

	Chamber			
	4277		4664	
Event	Act.(%)	Predict.(%)	Act.(%)	Predict.(%)
Prior to charge/discharge	100	100	100	100
94 Metal discharged	43	44	28	45
Thoria charged	41	35	28	25
PuAl charged	55	41	42	32
94 Metal charged	64	65	50	53

3-B. Plutonium Burning

The calculation of yields of plutonium and americium and curium is in progress for 70 percent Pu-242 assays. The major change from the earlier studies is that the plutonium columns are assumed to be short-charged (two-thirds column) in order to obtain a higher average flux per unit of plutonium charged.

3-C. Criticality Studies

As noted in last month's report, an effort is underway to verify HAMMER calculations of the reactivity of plutonium alloys in light water. Some experimental work with 1.8 w/o Pu-Al alloys was presented by C. L. Brown in 1962. Additional experimental results were reported by Gast at a meeting on light water lattices in Vienna in 1962; his report includes Brown's work on 1.8 w/o alloys and data on 5.0 w/o alloys. The HAMMER calculations compare with the experimental data as follows:

	Kg Alloy for MCM*		Kg Pu for MCM	
w/o Pu Content	Experiment	Calculation	Experiment	Calculation
1.8	126	92.33	2.29	1.68
5.0	31.28	24.68	1.53	1.23

*Minimum critical mass.

The calculation is apparently conservative by a rather wide margin; approximately 27 percent for the 1.8 w/o and 21 percent for the 5.0 w/o alloys.

From these comparisons it is apparent that the calculations which have been made for single-pass reactor plutonium-aluminum fuels are conservative. The margin of conservatism is somewhat larger than desired, but with test quantities of fuel causes no great inconvenience.

Mission 4 - Pu-238

4-A. Medical Grade Pu-238

The design of a four-column test irradiation for the production of medical grade Pu-238 is under study. A series of calculations using HAMMER-EXTERMINATOR examined the flux profile for the four-tube neptunium block to determine the extent of any flux peaking in the 94 Metal support columns. Calculations of the driver-to-target ratio for this irradiation are required because the target charge length is half that of previous tests. The neptunium irradiation test was completed and is being reviewed.

4-B. Americium Irradiation

Buildup calculations for the americium irradiation have been completed and alpha heating and dosimetry cacculations are underway. The americium irradiation test authorization has been prepared and is being reviewed.

Fabrication of the primary capsules, and their characterization by colorimetry and radiography, was completed at Livermore. They were received from there in late March, and by month end their secondary encapsulation had been completed in the 300 Area Transuranium Pilot Plant facility. Specifications for encapsulation have been issued as DUN-5604, "Design Specifications for Americium Oxide Target Elements".

Mission 7 - Target Space Enhancement

7-A. Large Channel Facility - C Reactor

The fuel element which failed in process channel 3364 of the C overbore test block on February 21 was a CM2E fuel model in a ribbed aluminum process tube, and it occupied position 4 in the tube. The rupture occurred on the top of the element at the cap (welded) end and appeared to be due to mechanical damage. Scratch marks similar to those near the rupture site were also noted on elements from positions 2, 3 and 5. The failed element is in the Radiometallurgical facility awaiting further examination to determine the cause of failure.

Investigation was completed on the Zircaloy overbore tube (2868-C) which was penetrated in conjunction with a fuel failure on December 22, 1968. Chemical and metallurgical analyses indicate no serious overheating at the point of failure and no hydride buildup. It is concluded from the information available that failure of the tube resulted from local distortion of the tube resulting from localized failure of the fuel. Laboratory tests have shown this tube geometry to be no more susceptible to this type failure than the K Zircaloy geometry. The following table gives the load and distortion at failure when a 5/8-inch diameter, completely-rounded punch was pressed into the inner surface of two different Zircaloy tubes:

Tube Type	Displacement	Load
K standard	210 mils	3040 lbs
1" overbore welded	300 mils	2900 lbs

On March 22 a one-inch overbore (PTA-103) fuel element of natural uranium failed in tube 2864-C at 1866 MWD/T. The usual examination is planned.

PTA-103, SUP2, which provides for extended exposure (up to about 1600 MWD/T) of the overbore fuel currently in C Reactor, has been approved. PTA-103, SUP3, which will authorize charging of the enriched-natural uranium follow-on loading, is now being drafted.

7-B. Corrosion Testing of Oralloy Fuels

Five columns of oralloy fuel elements charged into C Reactor on January 27 are continuing to operate satisfactorily. Tube outlet temperatures continue to run 5 to 10 C less than adjacent tubes. Lower temperatures are obtained because the total fissionable material in these oralloy columns is less than that in a natural uranium column. The downstream end of the columns consists of alternating oralloy elements containing 4 and 7 percent U-235 in an aluminum matrix.

Mission 10 - Columbia River

10-A. Corrosion and Water Quality Studies

Zeta Potential Test

A Production Test is being prepared which will authorize testing to determine the effects of Zeta potential on filming and defilming characteristics in in-reactor tubes of the 1706-KE Water Treatment Test Facility (WTTF). Plans are to control the Zeta potential in either the negative or positive regions by additions of alum or bentonite to filtered process water. Previous tests have shown that the major source of the effluent activity is from the dissolved salts which absorb into the films deposited on fuel elements. It may be possible to reduce effluent activity if the amount of deposited film can be controlled.

Effect of Ionic Impurities on Effluent Activity

A series of tests to evaluate the effects of individual ionic impurities in reactor coolant on effluent activity has been authorized under PTA-154. In these tests reactor process water will be reconstituted by adding the major ionic constituents to demineralized water, treating the resultant water in the Water Treatment Pilot Plant, and passing this treated water through the WTTF in-reactor tubes. Preliminary work is in progress whereby all the constituents are being added to the demineralized water and the out-of-reactor portion of the system is being checked for operational and chemical stability. Subsequent tests will involve the deletion of specific ions to determine their effect on effluent activity.

10-B. High Turbidity Coolant

The influence of higher process water turbidity on effluent water radionuclide concentration is continuing to be investigated in a half-plant test at KE Reactor. Tests are currently being conducted with 0.3 JTU on the test side of the reactor. Data after five weeks with this high turbidity water indicate there might be a slight reduction (15 to 25 percent) in effluent activity with it as compared to the control side (0.05 to 0.1 JTU) of the reactor. The higher turbidities are being obtained by feeding less filter conditioner.

Average conditions obtained to date are given in the following table:

Parameter	Test Period		
	8/26/68 to 11/11/68	11/11/68 to 1/27/69	1/27/69 to 3/3/69
Turbidity, JTU			
Control	0.07	0.07	0.08
Test	0.10	0.19	0.26
Filter Conditioner, ppm			
Control	0.013	0.016	0.013
Test	0.008	0.008	0.004

[redacted] [redacted]

Parameter	Test Period		
	8/26/68 to 11/11/68	11/11/68 to 1/27/69	1/27/69 to 3/3/69
Arsenic-76, µCi/ml			
Control	74	81	75
Test	70	75	56
Phosphorus-32, µCi/ml			
Control	7.5	7.0	10.1
Test	6.3	6.7	7.7

ENGINEERING & TECHNOLOGY - REACTORS

Smoke Density Monitor Prototype

The design for the prototype smoke monitor for the 165-K boiler stacks is complete. A Development Test Authorization for the prototype installation was approved and issued. Equipment installation on the No. 1 KW boiler is in progress and nearing completion. The initial checkout of equipment operation will begin in early April.

Project Engineering - Reactor Facilities

The status of approved construction projects relating to single-pass reactor facilities is summarized in Appendix A.

ENGINEERING & TECHNOLOGY - FUELS & TARGETS

Components for Thoria Wafer Target Elements

Axial load and bursting tests indicated that the components for the thoria wafer target elements met the engineering requirements of 1500 pounds and 300 psi, respectively. The actual values were greater than 2000 pounds and 1400 psi. The first-run yield on 300 simulated wafer elements using these components was 91.7 percent, with rejects of 1.9% at weld inspection, 4.8% at radiograph, and 1.6% at helium leak test.

Technical Basis for Fuel Criticality Limits

A technical basis for criticality safety for all production reactor fuels has been written. Included are limits for the following single-pass reactor fuels:

- 94 Metal w/o I&E designs
- 125 Metal w/o I&E designs
- 210 Metal w/o I&E designs
- 94 Metal overbore elements
- 111 Metal overbore elements
- U-Al alloy elements
- Pu-Al alloy elements

In addition to presenting the specific criticality limits for fuels, the document outlines the application of safety limits.

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TECHNICAL ACTIVITIES - N REACTOR

RESEARCH AND DEVELOPMENT

Mission 1 - Basic Production

1-A. Mark IV Fuel Development

Irradiation Testing

Irradiation of the Mark IV demonstration test fuels will be terminated by discharging the remaining seven columns during the March outage. A summary of the irradiation testing program is shown below:

Test Fuel Description	No. of Columns Irradiated	Discharge Exposure Ranges, MWD/T
Thick clad (94 Metal)	6	635 to 2900
Base clad (94 Metal)	7	615 to 2700
Base clad (125 Metal)	11	590 to 3120
Base clad (94 Metal) (alternate alloy)	9	1050 to 3115
Base clad (94 Metal) (modified design)	2	2265 , 2645

Evaluation of the discharged monitor columns is continuing. Swelling data to date have shown the Mark IV fuels to be swelling at a slightly lower rate than that of Mark I fuels. Examinations in the Radiometallurgy facility have not shown any signs of local hot spots occurring in the vicinity of support contract points.

During the examination of fuel from column 2662, which was discharged in February (base clad, 94 Metal), the outer tube from position 10 (fifth piece from upstream end) showed a crack in the inner cladding and gas bubbles were being released from the crack. Two small blisters were also found at about the same axial position but oriented 120° and 180° away. The cause for this apparent incipient fuel failure is unknown. This column had an average exposure of 2690 MWD/T.

N Reactor now contains a total of 61 Mark IV columns; 21 are short-length columns (13 pieces per column) charged last July, and 40 are full-length columns charged in January 1969. Two of the short-length columns have been discharged for examination, one in November (882 MWD/T exposure) and one in February (1530 MWD/T exposure). Preliminary examination of the data from the lower exposure column has shown that the standard Mark IV fuel design is swelling at a lower rate than that of Mark I. The second discharged column is presently being examined.

Flow Loop Testing

Life testing of Mark IV test fuels is continuing in the flow loop:

[redacted]

Fuel Type	Support System	No. of Elements	Loop Time, Hours
26" Mark IV	End-spiders	8	3960
26" Mark IV	End-spiders with one or two legs removed	4	2710
12" Mark IV	Spring-stop	6	700
		4	100

Two of the end-spider supported fuels were removed from the loop on March 4. An end-spider that had two legs previously removed was found broken due to fatigue cracking after 1170 hours of testing. A second assembly from the group of as-fabricated end-spiders was removed after enduring 3855 hours loop time because it appeared to show signs of fatigue crack initiation. Examination of these two test fuels is in progress.

The remaining eight end-spider supported fuels have endured a total of 8.5×10^8 hydraulically induced cycles.

Mark IV Physics Studies

Power distribution calculations for a Mark IV loading supported by a Mark IV-A ring have been attempted with the EXTERMINATOR code with partial success. Further modification of poison distribution assumptions is being made to force the calculation to agree more closely with empirically determined distributions.

1-B. Zircaloy Process Tube Monitoring

Evaluation of process tube 2455, removed from N Reactor in November 1967, is in its final stage. The final fatigue sample, notched prior to the initiation of pressure cycling by milling a 0.35-inch slot 80 percent through the wall thickness, failed after about 300,000 cycles. To effect the breakthrough, an increase in the cyclic stress--from 25,000 to 31,000 psi--was employed for the last several thousand cycles. A measurement of the crack length at failure is being made.

Hydrogen distribution through the wall thickness in the upstream and downstream spacer sections of tube 2455 was measured. The preliminary results suggest that hydrogen uptake in the upstream section of the tube may be occurring from both sides of the wall. The maximum hydrogen contents occurred at the OD and ID with a minimum concentration near the center. No buildup beyond that which can be explained by corrosion was observed in the downstream specimen. The results are being studied to determine mechanisms which would explain this behavior.

Process tube 0758, removed from N Reactor during February for this continuing program, is currently being cut into testing specimens.

1-C. Graphite Studies

The graphite burnout samples discharged during the January outage were measured. The samples which had been charged into the reactor on March 7, 1968, and discharged on January 20, 1969, exhibited a burnout rate of less than 0.2 percent per thousand operating days (KOD) which is well within the 2.0 percent/KOD control limit.

1-D. Primary Pipe Monitoring

Three lengths of primary pipe in steam generator Cell 3 and four lengths in Cell 2 were examined ultrasonically to detect and measure weld flaws or cracks. None were found.

1-E. Code Development

A digital computing program for analysis of control systems was acquired from the McDonnell-Douglas Astronautics Company and has been modified here for use by DUN. This is program CA-48, Linear System Transforms, which does the following:

- Calculates transfer functions (frequency response) of open and closed loop systems.
- Calculates the response of linear systems to step functions and impulse functions.
- Solves for roots of characteristic equations.

The program is used for the evaluation of stability and performance of linearized models of control systems and subsystems.

Mission 2 - Coproduct

An item under this heading on page DN-4 of the January report, regarding a substitution involving lithium aluminate target material being shipped to the Savannah River Plant for coproduct conversion information, left a mis-impression which is clarified in the following paragraph:

The substitution of targets was made in Mark II-A cores rather than in Mark II cores; the Mark II-A data would have applied only to conversion efficiency within the spike ring rather than being characteristic of the core as a whole. The Mark II targets shipped to SRP were irradiated in an all-coproduct reactor loading during a higher percentage of the time than were the originally selected targets. The latter were "essentially unidentifiable" only in that they were mixed with other target elements in the storage basin, and the substitution of other targets of equivalent or improved representation was considered preferable to detailed sorting of the initial samples.

Mission 8 - Nuclear Safety

8-A. Metal-Water Reactions and Fission Product Release Studies

Full-scale shakedown tests in the 324-D cell with unirradiated fuel have now demonstrated the suitability of the new equipment in that cell for the planned metal-water reaction and fission product release tests. The cell will be sealed prior to the tests with irradiated fuel.

8-B. Noble Gas Release Studies

To provide a rough estimate of the amount of noble gas expected to be rained-out by a fog spray in a confinement vessel, a calculation was made based solely on reported xenon and krypton partition coefficients. Figure DN-1 (below) shows the percent of gas rained-out of the air space as a function of atmospheric pressure in the confiner. It is assumed that there is no runoff of spray water and condensed steam. The inclusion of runoff to a crib will be provided in an overall systems model.

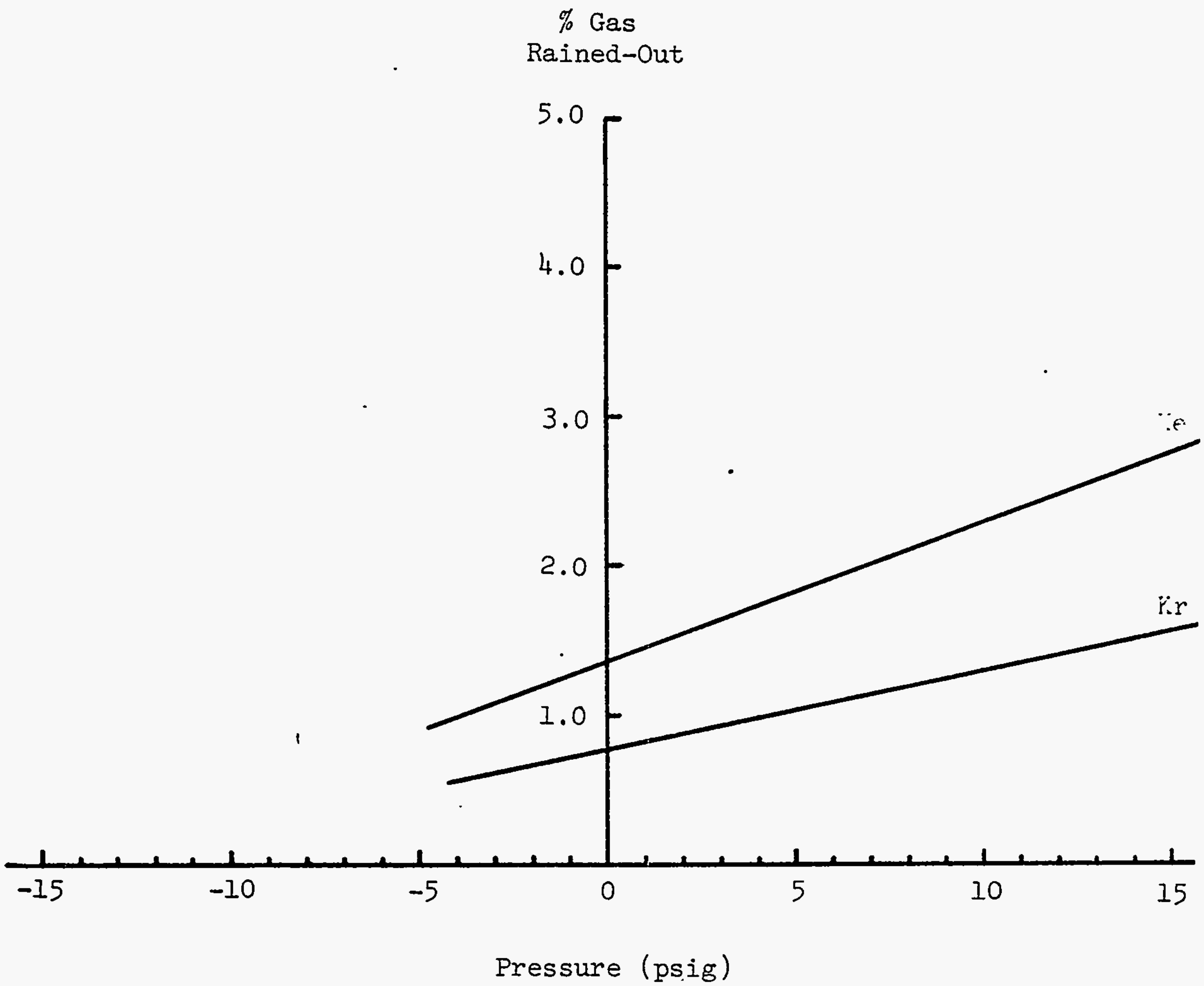

Figure DN-1. Percent of Noble Gas Rained-Out by Fog Sprays (Based solely on gas partition coefficients between air and water at 80 C)

ENGINEERING & TECHNOLOGY - N REACTOR

Ball 3X Trip Mechanisms

An engineering program has been initiated to develop a new ball trip mechanism with primary objectives of achieving increased reliability, maintainability, and elimination of the "stop-gap" purge air system to the ball hopper enclosures. Secondary objectives are the elimination of (1) the solenoid pull-in and holding coils, and (2) the original design latching mechanism.

Two design approaches are being scoped with the ultimate selection to be based on the results of testing and reliability studies, and comparative conversion costs. The first design, which is relatively far advanced, will employ a single solenoid-operated, air pilot to cock, control valve mounted on the existing cocking and lock-out air motor. Extensive testing has demonstrated that drop times equal to or faster than with the presently installed trip mechanisms are obtainable using the lock-out cylinder.

The other approach being pursued is a lever-operated cocking and trip mechanism employing a simplified latching device with no moving parts other than a type of solenoid detent. Work has just started on this design, beginning with a review of the 105-N confinement latching mechanisms.

Iodine Removal from Primary Loop Bleeds

A preliminary engineering study has been completed and documented (DUN-5609) for a facility to remove iodine from the N Reactor primary loop bleeds. The study assumes that high specific flow rate anion exchange will be a suitable treatment process, but cautions that pilot plant testing will be necessary to confirm this.

Project Engineering - Reactor Facilities

The month-end status of approved construction projects relating to N Reactor facilities is summarized in Appendix A.

ENGINEERING & TECHNOLOGY - FUELS & TARGETS

Zircaloy Component Manufacture

Thirteen Zircaloy ingots, 11 inches in diameter, 22 inches long, and weighing approximately 485 pounds each were extruded successfully into both 7 1/2-inch and 6-inch diameter billets to be sectioned and re-extruded into various component sizes. The 7 1/2-inch billets will be used to make outer-inner components and inner-outer components, for both Mark I and Mark IV fuel geometries. The 6-inch billets will be extruded to produce inner-inner components, also for both Mark I and Mark IV geometries.

Eleven of the above primary ingots were drilled to produce an ID of 2.125 inches and then extruded at 1200 F over a mandrel into the 7.350-inch OD by 2.070-inch ID size, an area reduction of 2.34:1. Lubrication was provided by a thin copper plate on the OD and head end, and by a thin-walled (0.020-inch) copper sleeve in the ID.

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Two of the ingots were extruded into 5.850-inch solid logs, a reduction in area of 3.53:1. Again, a copper coating approximately 0.007-inch thick provided lubrication during extrusion. Because of the higher reduction ratio, these ingots were heated to 1450 F to facilitate extrusion.

Technical Basis for Fuels Criticality Limits

A technical basis for criticality safety for all production reactor fuels has been written. Included are limits for the following N Reactor fuels:

Mark I
Mark I-A
Mark II
Mark IV
Mark IV-AA
(196 Metal) initial coproduct design

In addition to presenting the specific criticality limits for these fuels, the document outlines the application of safety limits.

IRRADIATION SERVICES

FUEL TECHNOLOGY

Swelling of Irradiated Fissionable Materials - Battelle-Northwest

The pressurized tandem uranium swelling capsule was discharged from a front-to-rear test facility at KW Reactor.

MATERIALS DEVELOPMENT

Irradiation Damage to Reactor Metals - Battelle-Northwest

Two creep-rate measurement capsules, one from each side of the test facility, were discharged from a side General Purpose facility at KW Reactor.

One tensile specimen capsule was discharged from a downstream position of the Snout facility at KE and one capsule was removed from the Snout facility spider at KW Reactor.

Nuclear Graphite - Battelle-Northwest

A controlled-temperature capsule containing size-effect graphite samples was irradiated in the Snout facility in KW Reactor.

Corrosion Product Transport - Battelle-Northwest

In February, during the facility shutdown, all module heaters were checked for corrosion and wear from vibration. A considerable amount of foreign material was noted in the heater wells which turned out to be Graphitar bearing material of the recirculation pumps. Consequently, all three of these pumps were removed and checked. Module 3 pump was replaced and the piping of all three modules was flushed. The facility was put back into operation on March 11. Sampling for this run continued through the month.

ROUTINE IRRADIATIONS

Eighty-six Quickie activation analysis capsules were irradiated in the K and C facilities for Battelle-Northwest.

IRRADIATIONS STATUS SUMMARY

The quarterly report on the status of all in-reactor service irradiations is presented on the next two pages.

STATUS OF SPECIAL IRRADIATIONS
(As of 3/24/69)

Test No.	Material or Capsule Content	Experimenter	No. of Samples or Capsules	Date Charged	Test Facility	Accumulated Exposure-ntv
006	Graphite Burnout Samples	DUN	20	10/15/68	1880-KW	1.7×10^{21}
				11/20/68	1889-C	8.0×10^{20}
				12/8/68	3066-KE	9.5×10^{20}
023	Cobalt - Co-60 Production	DUN	15	12/6/65	1459-C	8.6×10^{21}
037	Thulium Oxide - Tm-170 Prod'n	DUN	4	2/12/68	1464-C	2.7×10^{21}
041	Haynes Metal - Tensile Specimens	DUN	2	1/8/68	2B-KE	4.2×10^{21}
053	Graphite Coating Studies	DUN	2	Short Term	2B-KW	Various
172	Various Activation Analysis	BNW	134	Short Term	2D-KE 2A-KW A-C	Various
184	Washington-designated Program	BNW	99	Short Term	2D-KE 2A-KW A-C	Various
177	Graphite Samples	BNW	8	9/13/68	B-C	2.8×10^{21}
			3	9/20/67	3A-KE	3.9×10^{21}
			9	1/25/69	4B-KE	5.0×10^{20}
			1	3/14/69	2B-KW	1.1×10^{19}
222	Uranium Swelling	BNW	2	11/28/68	3674-KW	1.0×10^{21}
236	Structural Materials - Creep-Rate Tests	BNW	1	4/1/68	3A-KW	2.1×10^{21}
			1	8/13/67	3A-KW	3.8×10^{21}
			1	6/11/68	3C-KW	2.3×10^{21}
			1	1/14/68	3C-KW	4.5×10^{21}
			1	1/14/68	3D-KW	2.8×10^{21}

DUN-5256

[redacted]

Test No.	Material or Capsule Content	Experimenter	No. of Samples or Capsules	Date Charged	Test Facility	Accumulated Exposure-nvt
243	Irradiation of Various Reactor Structural Materials	BNW	1	11/8/68	2B-KE	1.5×10^{21}
			1	7/30/68	4C-KW	1.3×10^{21}
			3	10/24/68	4C-KW	9.0×10^{21}
259	Hastelloy - Tensile Specimens	BNW	2	12/25/64	E-C	4.4×10^{21}
			1	2/12/68	E-C	1.0×10^{21}
271	Various Calibration Standards	BNW	9	Short Term	2D-KE 2A-KW	Various
376	Potassium - K-40 Production	BNW	16	9/22/67	2D-KE	3.8×10^{21}
510	Uranium-Zirconium Hydride NAA-121-1 SNAP-8 Prototype Fuel	NAR	4	10/17/68	0074-KE	4.7×10^{20}
603	Potassium Chloride - Cl-36, S-35, & K-40 Production	ORNL	80	1956 to 1967	2D-KE	3.2×10^{22} to 3.1×10^{22}
604	Beryllium Nitride - C-14 Production	ORNL	40	10/15/68	1949-KW	1.7×10^{21}
			40	7/11/67	1791-KW	6.7×10^{21}
			32	2/13/67	2081-C	8.3×10^{21}
			40	11/26/67	2160-KE	5.6×10^{21}
			32	12/1/67	2360-C	3.3×10^{21}
			32	12/1/67	2781-C	3.3×10^{21}
			40	12/2/67	2864-KE	5.5×10^{21}
			40	11/26/67	4268-KE	5.5×10^{21}
			144	3/5/66	V-C	5.5×10^{21}
605	Thallium Oxide - Tl-204 Production	ORNL	12	11/3/63	2D-KE	1.4×10^{22}
			12	10/22/66	2D-KE	6.6×10^{21}
700	Molybdenum-Uranium Cermet Fuel Specimens	NASA-LRC	3	7/29/68	2C-KE	2.1×10^{21}
			1	6/13/68	2D-KW	1.6×10^{21}
			1	11/21/68	2A-KE	7.5×10^{20}
			1	12/3/68	4B-KW	8.5×10^{20}
807	U-PuC Irradiation	UNC	4	2/8/69	0065-KW	1.0×10^{20}
			5	2/8/69	0074-KW	1.0×10^{20}

[redacted]

ADMINISTRATION - GENERAL

APPROVAL LETTERS

At the close of the reporting period, final AEC-RL action was pending for the following requests:

ATD Number	Subject	Date of Transmittal to AEC-RL
AP-39	Pension Plan portion of letter entitled "Pension Plan, Salaried Savings Plan, and Wage Savings Plan"	January 12, 1966
AP-59 Add. #1	Salary Structure for Exempt Salaried Personnel	February 12, 1969
ATD-130	Exempt Overtime, Appendix "B" Modification MO-13	December 11, 1968
ATD-148 Add. #1	Merit Salary Budget for Exempt Salaried Personnel - CY 1969	March 14, 1969
ATD-178	Increase in Per Diem Rate Appendix "B" Modification MO-22	February 11, 1969
ATD-180	Lay-Off for Lack of Work	February 24, 1969

EQUIPMENT USAGE REVIEW

As a result of DUN's in-depth review of spare equipment held for future use, in-service spares, and portable and shop equipment, it appears that a reduction of 10 to 15 percent in total equipment holdings can be achieved.

PAPER CLEANOUT CAMPAIGN

To reduce the volume of records in office files, and improve control over paperwork, a Company-wide paper cleanout campaign has been started. This campaign is being conducted in the Finance and Administration Division during the period

March 10 to April 15, and will be conducted in the rest of the Company during April and May.

EQUAL EMPLOYMENT OPPORTUNITY

Two Negro high school graduates will be added to the Company's Cooperative Education Program operated in conjunction with Washington State University. They will report for work in June and plan to enter the University in September. Two other minority group employees will complete their first college year on the program this June.

Probabilities for increasing the percentage of minority group employees of our work force continue to be low due to the continued indeterminate status of future production requirements.

SAFETY

The Company has been notified that it has earned the National Safety Council's "Award of Merit" based on calendar year 1968 performance. The award certificate is expected in April.

No personnel radiation exposures exceeded operational control.

Month-end safety statistics were:

Disabling injuries - March	0
- Year to date	0
Days since last disabling injury	151
Man-hours since last disabling injury	1,500,000

EMPLOYMENT SUMMARY

DUN personnel totals and employee allocations as of February 28 and March 31 are shown in Appendix B.

APPENDIX A

PROJECT STATUS SUMMARY - REACTOR FACILITIES

Number & Title	Authorized Funds - $	Percent Complete Design	Percent Complete Construction	Status
Single-Pass Reactors				
DCE-505, Boiler Control Improvements - 165-KE & KW	410,000	100	56	Equipment installation completed on No. 1 KW boiler. Cold boiler acceptance testing completed and hot fired boiler testing in progress. Control system modification on No. 2 KE boiler was started the week of March 3.
DAP-510, Discharge Chute Clearing Equipment - K Reactors	190,000	100	70	Fabrication and ATP testing (off-reactor) are complete. Equipment ready for installation.
DAP-516, Storage Building Addition - 105-KE & KW	142,000	5	0	No progress since January 17 when design was halted because of anticipated production cutback.
DAE-518, Effluent Radio-iodine Monitor - C, KE & KW Reactors	100,000	96	0	Vitro/HES completed incorporation of comments to the K construction drawings and they are being issued. Contrary to previous reporting, AEC-RL has directed the architect-engineer to incorporate comments on the C Plant drawings.

PROJECT STATUS SUMMARY - REACTOR FACILITIES (contd.)

Number & Title	Authorized Funds - $	Percent Complete Design	Percent Complete Construction	Status
DCP-522, Modification of Reactor Coolant Crosstie Piping - 105-KE & KW	105,000 (interim)	99	5	With the exception of the ATP, design is complete. Removal of pipe and valves from 190-H is complete. Shop fabrication is underway. Funding increased $70,000 by AEC-RL Directive dated March 20 to cover installation of crosstie piping revisions at KE only.
N Reactor				
GCP-406, Improved Safety Platforms and Accesses - 100-N Area	300,000	100	94	Installation of reactor platforms continued during March outage. Criteria for increased scope being prepared.
GCE-408, W, C & D Elevator Safety Improvements - 105-N	90,000	100	30	Comments were obtained on revised design by Vitro/HES, drawings being prepared for final approval.
GCP-411, Effluent Control Program - 100-N Area	1,780,000	100	3	Work progressing on Sections I and III. First foundation pour for Section I tank made March 21. All bids canceled for the Diesel Fire Protection lump-sum work. Bid opening for the Emergency Dump Tank lump-sum was March 25. Low bid was from George A. Grant Construction Company at $358,000, and next lowest was $367,000. The fair cost estimate was $275,327. Revised proposal increasing total funding authorization to $1,830,000 sent to AEC-RL on March 14.

Number & Title	Authorized Funds - $	Percent Complete Design	Percent Complete Construction	Status
DCE-519, Replacement of Bridge Crane and Hoist System with New Crane System - 105-N Storage Basin	269,000	40	0	A new project cost estimate of $400,000 was obtained from Vitro/HES on the basis of quotations on preliminary crane design. Design has been stopped.

APPENDIX B

EMPLOYMENT SUMMARY
(with employee allocations)

	2/28/69	3/31/69
CONTRACT PERSONNEL		
02 Programs		
Douglas United Nuclear	1814	1802
Assisting other Contractors	15	14
Total - 02	1829	1816
Other Programs under AEC Contract		
Assisting other Contractors and WPPSS	60	45
Special Irradiations	11	9
Total - Other Programs	71	54
Total Contract Personnel	1900	1870
COMMERCIAL ACTIVITIES PERSONNEL	8	17
TOTAL FORCE	1908	1887

FEATURE REPORT

THE 300 AREA ENVIRONMENTAL CONTROL PROGRAM AS ADMINISTERED BY DOUGLAS UNITED NUCLEAR

INTRODUCTION

The goal of the subject Program is to minimize exposure to any potentially toxic substance, and to conform with requirements established in AEC Manual Chapters 0510 and 0524 and other pertinent Government regulations concerning air, ground, and water pollution.

The 300 Area (see Figure 1, appended) comprises about 450 acres of industrial and laboratory facilities, including adjacent environmental control features such as ponds, trenches, burial and burning grounds. This area, which is located about seven miles north of Richland, has been considered isolated from the general population.

DUN has the responsibility for planning, operating, maintaining, and controlling the area process and sanitary sewer systems and connecting process ponds and leaching trenches which serve all 300 Area contractors. This responsibility also includes burial grounds for contaminated waste, a burning ground, and boiler ash disposal facilities. Battelle-Northwest (BNW) controls its own gaseous effluents and sends its high-level solid and liquid radioactive wastes directly to the 200 Areas.

This report summarizes the administration and scope of the 300 Area Environmental Control Program, and presents information and data showing current program effectiveness. Plans intended to be responsive to indicated future needs also are briefly described.

PROGRAM ADMINISTRATION

Control is exercised through the review of all sample data, performance of special studies, periodic internal audits, AEC-RL audits, and a Procedures and Practices Manual, DUN-4957. From evaluation of sample data and other information, budgetary recommendations are made to correct situations that are identified as potential environmental pollution problems. These are reflected in PACE budgets if capital facilities or equipment are required.

Water sample analytical results are exchanged between DUN (who does the chemical), BNW (radiological), and the Hanford Environmental Health Foundation (air and water quality). The BNW reports on radiological surveillance and HEHF reports on water and gaseous effluents are available to all three contractors. This exchange of information and related discussions result in substantial integration within the 300 Area.

Based on sample analyses, BNW wastes which are potentially high in toxicity are transported to the 200 Areas, and engineering evaluations are made in the

300 Area to further minimize exposure and evaluate the practicality of reducing any releases. For instance, during 1968 the average level of Cr^{+6} in the process ponds was reduced from 0.100 ppm to less than 0.050 ppm.

CONTROL OF SOLID WASTES

Radioactive and nonradioactive solid wastes are segregated into separate containers for disposal. The controls for these two categories of waste are summarized below.

Nonradioactive Solid Wastes

Combustible

Combustible, nonradioactive wastes are placed in 57 portable load-luggers located throughout the 300 Area. The average container holds about eight cubic yards. When the lugger is picked up for transport to the burning ground, the truck driver records the load volume and the date. These records are compiled and reported annually.

The annual loose volume of combustible trash is about 360,000 cubic yards. The burning ground, which is located due east of burial ground No. 1, contains approximately 1600 square feet of fenced and locked area.

The segregation of waste placed in luggers is audited periodically to assure that no contaminated waste or black-smoke producing material (such as tar, rubber, etc.) is included in the combustible trash. Additional comments are given in the later section on Gaseous Wastes.

Noncombustible

Solid, noncombustible, nonradioactive wastes are placed in a separate disposal site consisting of a large open pit located south or burial ground No. 8. No volume records are currently maintained on the material disposal into this pit.

Reclaimable, nonradioactive, solid metallic scrap (principally metals from maintenance shops) is placed in 14 conveniently located load luggers for transport to excess yards operated by ITT/FSS in the 1100 Area. About 170 cubic yards of loose ferrous and nonferrous metallic scrap are excessed annually from the 300 Area complex.

Two thousand tons of coal ash from the steam generating facility are deposited annually via the ash sluice method into the two ash basins. These are used alternately and exclusively for ash disposal; the ash is removed from them periodically with a bulldozer and spread onto nearby open ground.

Radioactive Solid Wastes

A fenced and locked burial ground (No. 8 on Figure 1) is maintained about one-quarter mile west of the 300 Area. All of the other burial grounds shown on

Figure 1 are out of use and are monumented. The south trench of the No. 8 site is for thoria contaminated material, and the north trench is for wastes contaminated with uranium. These burial facilities are available to all 300 Area contractors; access is controlled by the steam plant supervisor.

Nine load luggers, appropriately located, are specifically identified for use in transporting these contaminated materials to the burial ground. Thoria waste is securely packaged prior to placement in the luggers. About 50,000 cubic feet of dozer-compacted contaminated material are buried annually. The total activity represented is considerably less than one curie.

The very small amount of plutonium- and beryllium-contaminated waste from DUN operations is packaged and taken to the 200 Areas for burial.

Selected aluminum and AlSi scrap, contaminated with less than 0.01% uranium (nonsmearable), is sold to offsite customers. The weight of this material accumulated in 1968 was 435,000 pounds.

CONTROL OF LIQUID WASTES

Sanitary Sewer System

Sanitary wastes are collected in a separate sewer system for delivery to septic settling tanks which outfall to leaching trenches (see Figure 1). Three septic tanks with a total capacity of 36,000 gallons receive 200 to 400 gal/min of liquid waste from the sewers. Holding capacity is about two hours. When excess solids have accumulated, they are pumped from the tanks as necessary and deposited in a nearby location where solidification and drying occur. Some solids carry over into the leaching trenches which are 500 feet long. It is noteworthy that two of the septic tanks were installed in 1944 and the third in 1956. These initially served a much smaller area population than is now present.

Samples are taken and analyzed (by BNW) for coliform bacteria, biochemical oxygen demand (BOD), and turbidity. Routine sample locations include: head and river end of the leaching trench being used, and the river bank seepage upstream and downstream of the trench. Average analyses for the five-month period of September 1968 through January 1969 compare with State standards as follows:

	Coliform Per 100 ml	BOD Per 100 ml	Turbidity JTU*
Leaching Trench Composite	62,500	11.0	17.4
Riverbank Seepage Composite	62	1.0	1.6
Washington State Water Quality Standards	240	8.0 mg/l (Dissolved Oxygen)	5.0

*Jackson Turbidity Units

Releases to the river are within standards, and efforts will continue to maintain them at the lowest practical level.

The 300 Area sewage disposal facilities are isolated from public access. Loss of this isolation, or continued area growth, could require substantial system revisions in the future.

Process Sewer System

Approximately 4,000,000 gpd flow through the process sewer and discharge alternately into one of the two large process ponds (see Figure 1). In general, all nonsanitary wastes such as effluents from manufacturing facilities and laboratories enter this system. Very small quantities of radioactive material from both DUN and BNW enter the system along with the industrial chemical wastes (see table below). Potentially radioactive waste from the BNW laboratories is collected in the BNW retention system (307 Basins) for monitoring prior to release into the ponds. If concentrations are more than 50 pCi/ml this waste is sent to the 200 Areas for disposal.

Control of other waste discharged into the process sewer is effected through radiological, chemical, and water purity samples taken from the ponds, the adjacent test wells, and the seepage into the river. Total radioactivity released into the ponds is less than one Ci per year.

Chemical Analysis

A proportional sequential effluent sampler operates continually at the inlet of the pond being used, and a composite weekly sample is submitted for chemical analysis. In addition, riverbank seepage samples are taken and analyzed monthly. Average 1968 sample results (as ppm) were as follows:

	Cl	Cu	Fe	F	NO_3	SO_4	Cr^{+6}	U	pH
Pond Samples	2.04	0.024	0.025	2.98	136	30	0.047	0.16	8.5
Riverbank Seepage Samples	2.6	0.01	0.10	3.1	128	39	0.024	0.28	7.6

Routine monitoring of the Columbia River at Richland shows its chemical analysis to be within U. S. Public Health Service limits for drinking water.

Radiological Analysis of Water

The BNW analyses of pond and adjacent test well water for radioactivity (as µCi/ml) compared with the AEC Guide as follows: (data show ranges of weekly averages for September 1968 through January 1969)

	Beta	Alpha
Pond Samples	0.144-2.600	0.046-0.620
Test Well Samples	0.015-0.576	0.033-0.820
RL App. 0510 Guide	50.0	50.0

Routine analysis by HEHF shows the Columbia River at the Richland water plant to be well within drinking water limits.

Chemicals into Process Sewer

Uranium-bearing acids are neutralized and the uranium is recovered prior to discharge into process sewers. Principal chemicals in the recovery process are HNO_3 and NaOH.

Reports are issued annually showing chemical discharges into the process ponds. In FY 1968, about 900 tons of chemicals were discharged into these ponds via the process sewer from DUN facilities.

Chemical storage tanks in the Manufacturing Area are so-located that an accident would not permit chemicals to enter the process or sanitary sewers, or otherwise directly enter the ponds or river, in quantities that would exceed standards.

CONTROL OF GASEOUS WASTES

Steam Generating Facility

Twenty thousand tons of coal and 1,300,000 gallons of oil are burned annually in the steam generating facility (Bldg. 384) to produce steam for building heat, processes, and emergency electrical power. Six boilers are in use, ranging in steam capacity from 12,500 to 100,000 lbs/hr. The four stacks range in height from 50 to 150 feet above ground level. Two Breslove fly ash collectors are utilized.

Ambient air samples taken by the process ponds from April to September 1968 varied widely in SO_2 content. During April, May, and June, when the highest values were encountered, maximum ambient air concentrations of SO_2 ranged up to 0.25 ppm.

Last month, HEHF began collecting flue gas and additional ambient air samples for SO_2 analysis during the period of relatively high fuel consumption. Results will be evaluated with a view toward taking corrective action if required. Tentatively, a particle separator and flue gas scrubber for the steam plant have been budgeted for FY 1971. Projected higher steam loads and fuel consumption in future years indicate that these additions will be needed to assure that standards will be consistently met.

Smoke Emission from 300 Area Burning Ground

As has been noted, combustible trash is burned in an open pit at the burning ground. However, such burning will continue only on a short-term basis. AEC-RL has requested an exemption from the 25 pounds burning limit established in "Performance Standards and Techniques of Measurement", 42 CFR 76. Planning includes a trash compactor for use with sanitary land fill.

Gaseous Emission from Fabrication Processes (DUN)

Most of the DUN stacks emitting effluents from acid processes were sampled by HEHF for oxides of nitrogen during 1968. The data obtained provide a basis for engineering evaluation of scrubber and exhaust system effectiveness.

In periods of atmospheric downwash, employees complained about a stinging sensation on their skin when in the proximity of Buildings 306 and 313. An intense review of all acid scrubber systems, stack samples, and process conditions conducive to the emission of nitric acid mists was made this past winter. Out of this review came proposed methods for removing the mists in the exhaust and scrubber systems prior to stack entry. Action on this problem will continue until the condition is fully corrected.

HEHF sampling of stack emissions from DUN processes utilizing acids is continuing, and additional ambient air sampling was started in February.

Control of Exhausts from Toxic Radioactive Processes (DUN)

Several facilities, principally the 3708 Transuranium Pilot Plant, the 3720 Analytical Laboratory, the 3732 and 3722 thoria processing buildings, the uranium oxide burner, and the beryllium exhaust system, handle toxic, radioactive materials. These facilities all use absolute filter systems, and are controlled by sample analysis and by compliance to both Radiation Work Procedures and standard operating practices. The 3708 Transuranium Pilot Plant has a complete backup exhaust filter system, and is connected to emergency power.

Air samples are taken at the oxide burner and the beryllium exhaust system and analyzed to assure continued compliance with limits.

PROGRAM SURVEILLANCE & IMPROVEMENT

All facets of the 300 Area Environmental Control Program will continue to be monitored closely.

As noted, improvements are needed with respect to process nitric acid mists and the smoke from open burning of trash. These needs are recognized and steps to meet them are underway.

Potential other problem areas are the SO_2 from boiler stacks (currently under study) and the limited-capacity sewage disposal system.

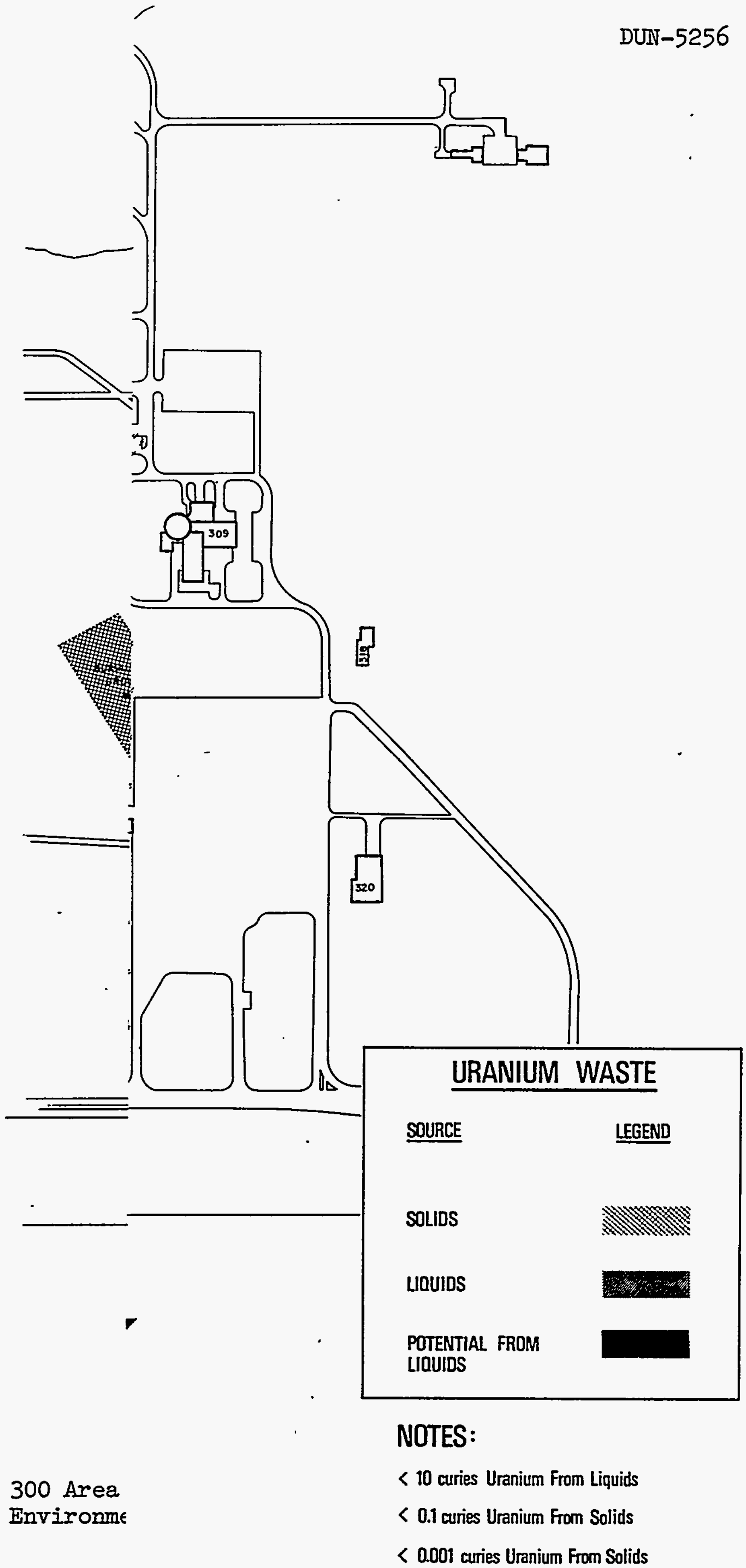

Figure 1. 300 Area
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