HAN--87470

DECLASSIFIED

DE92 018862

**REACTOR BRANCH MONTHLY REPORT
JANUARY - DECEMBER 1964**

BY: RL PLUM

**ATOMIC ENERGY COMMISSION
HANFORD OPERATIONS OFFICE**

DISCLAIMER

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

DECLASSIFIED

MASTER

8371

AUG 05 1992

DISTRIBUTION RESTRICTED TO U.S. ONLY

UNITED STATES GOVERNMENT
Memorandum

DECLASSIFIED

TO : Files

DATE: February 11, 1964

FROM : R. L. Plum, Chief, Production Reactor Operations Branch

SUBJECT: MONTHLY REPORT - JANUARY, 1964

OR:GTO-JRK

HAN-87470
Report #1

This document consists of 13 pages

OPERATING EXPERIENCE

Production

Reactor input plutonium production for January was 478.1 KMW's; 250.0 at the six smaller reactors and 228.1 at the two K reactors. Production at KW reactor, 136 KMW, was an all-time monthly record for a Hanford reactor; its own previous record, established in June, 1963, was exceeded by 4.7 per cent. DK reactor established a new monthly production record for that reactor, exceeding its previous record (December, 1961) by 4.5 per cent.

Power Levels

Power levels at the smaller reactors (excluding C) were restricted by a recent Division of Production directive limiting levels to previously attained maximums. Power levels at C reactor and at the K reactors were restricted by the AEC administrative limits of 2310 MW and 4400 MW, respectively.

Efficiency

Overall time operated efficiency was 72.9 per cent (73.7 per cent forecast): 69.1 per cent at the smaller reactors and 84.1 per cent at the K reactors. Uninterrupted operation at KW reactor resulted in a 100% time operated efficiency for the month. Extended outages were experienced at the F, H and KE reactors.

By Authority of: *PR-34*
6/11/98
6/11/98
6/11/98

GROUP 1

DECLASSIFIED

DECLASSIFIEDRuptures

Seven failed I&E fuel elements were removed from the reactors: five of natural uranium and two of enriched uranium. One of the natural metal elements was of overbore size at C reactor. The four other natural metal failures were at B (1) and DR (3). The two enriched metal failures were at C and F reactors. Five of the ruptures were stuck in the process tubes.

MAINTENANCE AND EQUIPMENT EXPERIENCETube Replacement and Water Leaks

Two hundred sixty-six tubes were replaced during the month; 189 at F, 57 at H, 9 at C, 7 at D and 2 each at B and DR. One tube leak and two Van Stone leaks were corrected. The two Van Stone leaks were at B and the tube leak was at D.

H-Plant

During a 477.7-hour outage the following work was performed:

Block discharge, major maintenance to process tube hardware, the pressure monitor system, temperature monitor system and changeout of 57 process tubes.

All coolant water flow through the reactor was valved off to provide dry rear-face conditions for the major maintenance items. This is the first time that coolant has been completely shut off to a reactor. There were no detectable temperature increases. Work accomplished included replacement of temperature monitor wells, thermocouples, ducts, leads and stepping switches; modification of 1533 pressure monitor gauges with Delrin bushings and extension of mid-range to 300 psi, and repair of omega seals on the reactor skin. Under the program to increase coolant water flow through the reactors, the following major changes were made, based on satisfactory results of the test modification made to header #27 in December, 1963.

Replacement of all 0.310" venturis and fringe zone double orifices to 0.344" ID venturis. Existing venturis were rebored to the larger diameter.

H-Plant (cont'd)

Replacement of solid Li-Al target elements in the first lattice tubes with I&E geometry elements.

Completion of transition from bumpered to smooth surface fuel elements.

Reaming of rear crossheader Parker fittings (0.469") to the ID (0.543") of the rear connectors.

Replacement of existing rear nozzles with modified inlet nozzles excessed from the K reactor zirconium program.

Installation of nozzle adapters with larger ID and tapered bore to match the ID of the existing rear connectors.

During the subsequent period of operation, the coolant flow capacity was demonstrated at 93,200 gpm, an increase of 5,600 gpm.

Other major maintenance items accomplished during the extended outage included changeout of rod tips on horizontal control rods #4 and 10 with half rods, revision of the power calculator instrumentation, relocation of process water gauges, duct and drain line installation in the bauxite system, improvements to the alum and Separan systems, and inspection of four 190 annex pumps with replacement of one rotating assembly.

Reactor Last-Ditch Cooling

Production Test IP-651-AI, "Trip-Out Test, H Reactor," was conducted at H Area on January 17, 1964. The test involved the trip-out of the electrically-powered process pumps and the flow decay from fly wheel coast down to the point where high-tank stored, backup coolant is introduced into the reactor. The normal steam-powered secondary system pumps were inactivated for the test.

DECLASSIFIED

SECRET

DECLASSIFIED

Files

-4-

February 11, 1964

Reactor Last-Ditch Cooling (cont'd.)

The test provided reactor coolant flow calibration with high tanks, with high tanks and export system flow, and finally with a measure of the coolant flow provided by the export system alone. Minor screen plugging was experienced during the export flow test, amounting to about a 3% flow reduction. The test data are being analyzed.

REACTOR OUTAGES

<u>Date</u> <u>Down</u>	<u>Date</u> <u>Up</u>	<u>Outage</u> <u>Hours</u>	<u>Remarks</u>
<u>B Reactor</u>			
1/7	1/10	88.0	Scheduled charge-discharge.
1/21	1/23	39.9	Removal of an I&E natural metal rupture from tube 2181. Replacement of tubes 2054 and 1169 due to rear Van Stone leaks.
<u>C Reactor</u>			
1/10	1/10	0.2	Unexplained Panellit trip.
1/10	1/12	42.8	Manual trip for temperature control; charge-discharge and maintenance.
1/18	1/22	93.2	Manual trip to remove an oversize I&E natural metal rupture from tube 3366; charge-discharge; problem tube 2473 was split and removed.
1/23	1/23	0.2	Unexplained Panellit trip.
1/24	1/25	34.5	Removal of a I&E-E metal rupture from tube 1888.
1/26	1/26	0.2	Unexplained Panellit trip.

SECRET

February 11, 1964

D Reactor

1/12	1/16	80.0	Scheduled charge-discharge and maintenance.
1/25	1/28	69.4	Charge-discharge and leak testing. Replaced tube 1279 due to an internal leak.

DR Reactor

1/6	1/7	36.9	Removal of an I&E natural metal rupture from tube 1265.
1/10	1/12	37.0	Removal of an I&E natural metal rupture from tube 3663.
1/31	still down		Panellit trip due to a I&E natural metal rupture in tube 2263.

F Reactor

1/14	1/29	358.2	Removal of I&E E-metal rupture from tube 0678. Scheduled tube replacement, charge-discharge and maintenance.
------	------	-------	--

H Reactor

12/31	1/20	486.7	Scheduled maintenance, charge-discharge and tube replacement.
1/20	1/20	0.2	Tripped when one flux monitor stuck at a high trip and another flux monitor was adjusted to a low trip.
1/21	1/21	12.0	Manual trip for temperature control.
1/22	1/22	0.9	Repair of a faulty ball valve on tube 2788.

DECLASSIFIED

SECRET

SECRET

Files

-6-

February 11, 1964

KE Reactor

1/17	1/19	36.9	Questionable integrity of a front-face pigtail. Eight pigtails were replaced due to broken wire strands.
1/23	still down		Scheduled tube replacement.

KW Reactor

No outages

RESEARCH AND DEVELOPMENT - EXISTING REACTORS

Thorium Oxide Target Fabrication

The first charge of thorium oxide target elements, for irradiation under Production Test IP-645-AC, was charged into F reactor during the January 14 outage. This charge is made up of 620 pieces, approximately one ton, charged into 20 fringe process tubes. The material has a density of 6.6 g/cc.

A second 620-piece charge of 6.6 g/cc material is now being canned and will replace the first charge about April 1.

Fabrication of the first charge of high density thorium oxide target elements (nominally 8.5 g/cc) is just beginning. Trial canning to date indicates that with the "Sol-Gel" oxide on hand the maximum attainable density will be approximately 8.25 g/cc. This charge is scheduled for charging in a reactor central zone about March 1.

Thorium Oxide Irradiation

The final group of four thorium oxide target elements, irradiated under authority of PT IP-627-A, was discharged from D reactor on December 31, 1963. These elements, containing thorium oxide of about 85 per cent theoretical density, were irradiated in a poison column control facility tube for 15 days. A total of 16 thorium oxide elements were irradiated in this tube, with oxide density varying

SECRET

Thorium Oxide Irradiation (cont'd.)

from 65 to 85 per cent of theoretical density and irradiation time varying from 5-15 days. All of these target elements were charged and discharged during reactor operation.

Clean U-233

Calculations were made for the production parameters for the 20-tube thorium oxide (6.6 g/cc) fringe test load. The calculated flux is 1.36×10^{13} and the E/Q tube ratio 1.96. Irradiation time to one ppm U-233 is approximately 78 days. This time may be modified by data obtained during the test on power level of adjacent E-columns and fluxes obtained from spline traverses. For the purpose of the production test the E/Q tube ratio is assumed to be 2.0.

Examination of Moderator Stacks

A visual inspection was made of the liner blocks in two VSR channels at B reactor and one at D reactor. Only a portion of each channel was directly viewed, but each channel was entirely photographed. In all three channels roughly one-fourth of the liner blocks inspected were observed to be broken to some extent. The predominant location of the failure was at the keyway, although some liner blocks were broken in several pieces and had fallen to the bottom of the channel.

The D reactor channel was examined because of failure of the VSR to completely enter it. The channel was found to be blocked near the bottom by a protruding liner block. The two B reactor channels, while having somewhat longer VSR insertion times than the average, were generally picked at random.

DECLASSIFIED**SECRET**

DECLASSIFIEDNeptunium-237

The enriched uranium stream to all reactors continues to be 100 per cent recycle. Neptunium yields have been determined for part of the E-metal used in the third H reactor E-N core. The reported yield is 3.71 grams of neptunium per ton fuel at an exposure of 878 MWD/T. The theoretical yield for virgin E-metal at this exposure is 3.16 g/T.

New VSR Testing

Testing of sections and subassemblies of the new universal vertical safety rods continued during the month. The subassembly results continue to show about a seven to eight per cent increase in worth over the standard B, D, F-size rod. Sufficient data have now been obtained to enable a modification of the sampling procedure to just one sample per heat. Damaged sections are being requested from untested heats to further reduce disassembling rods for testing.

Splines

Problems with spline brittleness have been determined to be associated primarily with the point of flow introduction in K reactor nozzles. Redesign of the nozzles for K reactor aluminum tubes is under way.

Vertical Safety Rods - Graphite Distortion

- High strength polycrystalline graphite will be used for sleeving vertical rod channels at the C and K reactors. The requisition for three channels at C reactor has been issued.

Testing of a VSR channel enlargement tool on the second channel mock-up has achieved a removal rate of 6.8 cu.in/min. At this rate the C-41 channel (considered to be about the worst channel in C Reactor) could be enlarged in eight hours of cutting time.

SECRET

February 11, 1964

Zirconium Tube Installation - K Reactors - Design

Procurement difficulties on impact extruded nozzles for the spline tubes at the K reactors have been resolved. The nozzles will be anodized a blue color to assist in identification of the spline tubes.

Additional tests have been completed on the aluminum Van Stone gaskets used with the zirconium tubes. These tests show that there is no significant reduction in bolting torque resulting from cyclic application of loads on the nozzle.

Process Piping System Studies

Information regarding the inhibition of pipe corrosion has been received from Sheppard T. Powell and Associates. This report stated that use of 10 ppm or less of silicate could possibly accelerate corrosion because only a portion of the system might be protected and the remainder of the system take all the attack of the corrosive medium. It further stated that our systems would require a continuous silicate treatment to maintain a residual concentration of at least 80 ppm or more. The use of deaerated water for inhibition of the stagnant piping system was recommended. It was indicated that vacuum deaeration could reduce the dissolved oxygen level in the 180 gpm circulating flow in the K reactor crosstie line to about 0.12 ppm. To further reduce the oxygen content, and as a measure of added system protection, a small amount of sodium sulfite could be added to the deaerated water.

Coolant Backup - Six Small Reactors

A feasibility study regarding the use of flywheels on the export system electric pumps in order to eliminate the need for surge suppressors has been issued (HW-80072). The study concluded that this proposal is not feasible because the flywheels would not eliminate the problems of reliability that currently exist in the present coolant backup feature of the export system. Initial studies are under way to determine the changes in the scope of the proposed last-ditch coolant system modifications which will result from the announced shutdown of three of these reactors..

DECLASSIFIED
SECRET

DECLASSIFIEDPower Recovery Studies

Work on the first concept under study based on the conversion of one of the five smaller reactors to power production using technology developed for the NPR is near completion. All of the engineering concept drawings and process analysis defining the proposed revisions to the facility have been completed. Cost estimating has started. To date no information regarding the economic feasibility of this modification is available; however, it has become apparent that the basic economic assumptions used in calculating the value of power produced will have significant effect upon the economic feasibility of the program. Preliminary work is under way on the four remaining study concepts which are planned for completion this fiscal year.

Self Supported Fuel Element Charging

The responsibility for maintenance and operation of the prototype charging machines have been transferred to the Manufacturing Section. Very few breakdowns are being experienced.

The second order of prototype magazines lost two insert strips during the last three outages. This experience indicates that the current gluing technique is not adequate for the anticipated service. Delivery of the prototype magnesium magazines will start in February at a rate of 40 per week. A procedure for testing the magazines is being developed. Delivery of prototype all-plastic magazines has been delayed because of mold casting rejects of one vendor and delay of mold fabrication of another.

Intermediate Range Neutron Monitoring System

The specification for intermediate range neutron monitoring has been completed in draft form. Preparation of a companion specification to delineate component quality of workmanship has been initiated. Testing of the 105-F intermediate range monitor shield plug installation reveals less neutron leakage from the shield plug than from the surrounding reactor shielding. Testing of various gamma compensating ion chambers is continuing.

SECRET

February 11, 1964

Intermediate Range Neutron Monitoring System (cont'd.)

Data received from the prototype installation indicates that the instrumentation equipment is operating satisfactorily, and no unusual incidents have occurred.

Effluent Activity Data

The table below shows average concentrations of selected radionuclides from reactor effluent samples taken during December, 1963. All units are 10^{-12} curies/ml.

<u>Reactor</u>	<u>P-32</u>	<u>As-76</u>	<u>Zn-65</u>	<u>Np-239</u>	<u>Cr-51</u>
B	9.8	100	5.8	220	330
C	14.3	160	7.4	240	850
D	10.4	100	9.3	140	600
DR	11.8	130	9.0	160	1080
F	10.9	140	6.5	180	620
H	9.5	50	7.3	70	380
KE	5.5	40	4.1	50	200
KW	5.8	50	4.6	80	200

The three-month trend in effluent radionuclide concentrations continued adversely during December, 1963 at all reactors except H, KE and KW. There were no significant changes in the treatment of coolant during the month except at 100-D where the pH of the near side coolant was reduced from 6.6 to 6.3 on December 20, 1963 under Production Test IP-634.

E-N Load

Prediction values for plutonium production in E-N loadings is being increased to provide the four per cent increase over E metal irradiated in normal loadings. This increase coupled with the tritium production will give a substantial improvement in the total equivalent plutonium yield. The increase is reported for the first time this month.

DECLASSIFIED**SECRET**

(Year)
OUTAGES (1-64)

<u>Reason</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>DR</u>	<u>F</u>	<u>H</u>	<u>KE</u>	<u>KW</u>	<u>Total</u>
Charge-Discharge	47.8	73.3	72.4	8.5	34.7	97.1	23.6		357.4
Maintenance	9.5	20.6	36.5	37.6	128.6	285.5	14.1		532.4
Rupture Removal	9.0	8.5		35.2	6.4				59.1
Leak Testing	18.6		20.3						38.9
Tube Replacement	33.4	50.6	5.2	1.0	139.1	78.6	165.8		473.7
Project Work									
Production Tests	1.3	12.2	13.0		8.2	6.8	20.1		61.6
Standard Check	5.1	5.3	2.0	0.5	1.7	14.1			28.7
XXXXXXXXXXXXXXXXXXXX									
Rupture Suspects									
Miscellaneous	1.3	0.8			39.5	8.9	13.4		63.9
Total	126.0	171.3	149.4	82.8	358.2	491.0	237.0		1615.7
Scheduled Outages									
Unscheduled Outages									

SECRET

RUPTURED SLUG TABULATION FOR January 1964

Tube No.	Date Charged	Date Ruptured	Tube Power (KW)	Concentration MWD/Ton	Assigned Production Loss		Observations
					MWD	Days	
1265 DR	11-16-63	1-6-64	1278	405	1777	.95	I&E - N SIDE HOT SPOT
3663 DR	11-16-63	1-10-64	1242	394	1317	.70	I&E - N SIDE HOT SPOT
0678 F	10-8-63	1-14-64	1226	969	516	.27	I&E - E UNKNOWN NOT EXAMINED
3366 C	12-4-63	1-18-64	1475	315	201	.09	I&E - NO END DEFECT
2181 B	12-9-63	1-21-64	1302	362	817	.44	I&E - N SIDE HOT SPOT
1888 C	12-4-63	1-24-64	1394	538	865	.39	I&E - E SIDE HOT SPOT
2263 DR	11-16-63	1-31-64	1322	616	481	.26	I&E - N UNKNOWN NOT EXAMINED

UNITED STATES GOVERNMENT

Memorandum

DECLASSIFIED

TO : Files

DATE: March 10, 1964

FROM : R. L. Plum, Chief *RLP*
Production Reactor Operations Branch

This document consists of 12 pages

SUBJECT: MONTHLY REPORT - FEBRUARY, 1964

HAN-87470
Report #2

OR:GTO:RGR

OPERATING EXPERIENCE

Production

Reactor MWD input production for February was 2.8 per cent above forecast; 6.5 per cent above at the smaller reactors and 6.4 per cent below at the two K reactors.

Efficiency

Overall time operated efficiency was 75.0 per cent (75.4 per cent forecast); 85.9 per cent at the smaller reactors and 42.3 per cent at the K reactors. Low efficiency at the K reactors resulted from scheduled tube replacement outages at both reactors.

Power Levels

Power levels at the smaller reactors (other than C) were restricted during the first half of the month in compliance with an AEC directive limiting levels to previously attained maxima. On February 18 the reactor power level limits were relaxed at the five smaller reactors to the former administrative limit of 2090 megawatts. By month's end the B, D, DR and F reactors were restricted by the bulk outlet water temperature limit of 95°C and H by the administrative power limit. Power level records achieved during February were 2075 MW at B, 2040 at D, 2015 at DR, 2000 at F and 2090 at H.

DECLASSIFIED

GROUP 1

SECRET

Power Levels (cont'd.)

Power levels at the K reactors were restricted by the administrative limit of 4400 MW.

Ruptures

Six failed I&E fuel elements were removed from the reactors; five of enriched uranium and one of natural uranium. Two of the enriched failures were at H, two at F and one at C reactor. The natural metal failure was at D. All six of the failed elements were "side hot spot" failures and all six were stuck.

MAINTENANCE AND EQUIPMENT EXPERIENCETube Replacement

Six hundred thirty-eight tubes were installed during the month, 575 zirconium and 63 aluminum. The zirconium tubes were installed at KE reactor. Fifty-three of the aluminum tubes were installed in KE, 4 in F, 3 in C, and one each in B and D and DR reactors.

Water Leaks

Six water leaks were corrected; 4 at F, and one each at B, and DR reactors.

Zirconium Retubing Program

With the completion of the current outage at KW reactor, the zirconium retubing program is essentially complete. A total of 2351 zirconium tubes have been installed in KE and 2358 in KW.

DECLASSIFIED

DECLASSIFIED

Files.

-3-

March 10, 1964

REACTOR OUTAGES

<u>Date Down</u>	<u>Date Up</u>	<u>Outage Hours</u>	<u>Remarks</u>
<u>B Reactor</u>			
2/16	2/20	93.7	Scheduled charge-discharge.
2/22	2/24	35.2	Correction of a front-face cap leak (faulty O-ring). Replaced tube 3693 due to an internal leak.
<u>C Reactor</u>			
2/9	2/11	44.9	Removal of an I&E E-metal rupture from tube 3465.
2/25	2/29	98.0	Scheduled charge-discharge.
<u>D Reactor</u>			
2/20	2/24	88.4	Removal of an I&E natural metal rupture from tube 3473. Replacement of tube 3473. Charge-discharge.
<u>DR Reactor</u>			
1/31	2/3	62.0	Charge-discharge and rupture removal.
2/4	2/6	36.3	Leak testing. Tube 1857 was replaced due to a leaking Van Stone flange.
2/6	2/6	1.8	Correction of a front nozzle adapter leak on tube 3590.

DECLASSIFIED

March 10, 1964

F Reactor

2/7	2/8	36.5	Removal of an I&E E-metal rupture from tube 3781.
2/24	2/26	55.0	Removal of an I&E E-metal rupture from tube 2257. Leak testing; replaced 4 tubes due to rear Van Stone flange leaks.
2/26	2/26	0.2	Panellit trip due to a faulty relay on Row 27.

H Reactor

2/22	2/23	30.1	Removal of an I&E E-metal rupture from tube 1377.
2/23	2/24	12.7	Removal of an I&E E-metal rupture from tube 1987.

KE Reactor

1/23	2/15	559.8	Scheduled tube replacement; 575 zirconium and 53 aluminum tubes were installed.
2/16	2/16	0.5	Panellit trip caused by a broken spline in tube 2546.
2/24	2/26	35.4	Tripped when a power operator interrupted the electrical service to the KER loop pumps. Miscellaneous maintenance.

KW Reactor

2/12	Still down	Schedule tube replacement.
------	------------	----------------------------

DECLASSIFIED

SECRET

DECLASSIFIED

Files

-5-

March 10, 1964

RESEARCH AND DEVELOPMENT - EXISTING REACTORS

Thorium Oxide Target Fabrication

Fabrication of the second 20-tube charge of 6.6 g/cc thorium oxide target elements to be irradiated under PT IP-648-AC has been completed. These will be used to replace the first charge of 20 tubes, not being irradiated in F reactor, about April 1.

The first 19-tube charge of the higher density material is being fabricated. Earlier indications were that it would be possible to achieve densities of approximately 82 to 85 per cent of theoretical. It now appears that 78 to 82 per cent will be a more realistic range. This reduction is the result of greater than expected variations in the Sol-gel material. Attainable densities, using the as-received oxide, range from 75 to 85 per cent of theoretical.

Instability Limits for K Reactor Zircaloy Tubes

Data obtained in heat transfer experiments performed in an electrically-heated mock-up of the K reactor zircaloy process tube system confirm an earlier result, obtained with overbore equipment, that the present method of determining instability limits for ribbed process tube fuel charges is not adequate for self-supported fuel charges. The data show that at given initial operating conditions, flow instability occurs with less coolant flow reduction in smooth-bore process tubes with self-supported fuel than in ribbed process tubes with smooth fuel. Thus, the Panellit low trip pressures must be set higher to achieve the same level of protection normally provided a fuel charge in a ribbed process tube. Current limits for self-supported fuel charges in the K and C reactors are based on the C-overbore data and provide the desired degree of protection.

Thoria Irradiations in Graphite - DR Reactor

Gram samples of thoria were irradiated in DR reactor for 15 days. The samples were encased in graphite instead of aluminum to test the hypothesis that significant U-232 contamination in the earlier gram sample tests came from the absorption of high energy gamma rays from the aluminum. The preliminary results

March 10, 1964

Thoria Irradiation in Graphite -DR Reactor (cont'd.)

Bear out this hypothesis very well, compared to the results from the aluminum encapsulated thoria, these results indicate that gamma reaction accounted for about 48 per cent of the U-232.

Sample No.	ppm Th-230	Tube	Gram U-233 (1)	
			Ton Thorium	ppm U-232 (1)
3925	1.2	Fringe	422	0.30 ± 0.06
3927	0.2	Fringe	319	0.30 ± 0.05
3947	0.4	Fringe	371	0.26 ± 0.05
3945	0.4	Fringe	322	0.23 ± 0.04
3950	0.4	Center	983	0.77 ± 0.07
3935	80.0	Center	994	9.63 ± 0.28
3939	80.0	Center	1024	9.98 ± 0.24
3928	0.2	Center		

Sample crushed during transfer

(1) Extrapolated to 200 days decay

Neptunium-237

All reactors are still on 100 per cent recycle for their enrichment. Additional yield data from the third E-N core has been obtained. The new data (Part B) is reported along with that reported last month (Part A).

Neptunium Production in Third E-N Core

	Part A (45.1 tons)	Part B (68.1 tons)
g Np-237/ton U	3.71	3.86
Exposure, MWD/T	878	878

New Vertical Safety Rod Testing

Testing of samples from new safety rods in HTR continued during the month. Samples from 45 to 70 heats have now been tested (all were satisfactory), and 41 rods have been accepted for reactor use. The new rods continue to be approximately seven per cent stronger than the original size BDF rods due to the B₄C inserts.

UNCLASSIFIED

SECRET

DECLASSIFIEDExposures

A general reduction in goal exposure has taken place in line with earlier product quality observations; average spike enrichment requirements will be slightly higher.

Automatic Flux Distribution Control

A successful demonstration of automatic flux distribution control was completed at D reactor; two 3-hour runs and one 22-hour run indicated excellent over-all control consistency (with power level held in general to ± 0.25 per cent around the mean) with the input signals derived from representative tube outlet temperatures.

Should N reactor experience and incentives indicate the need for automatic distribution control, these test results would provide a basis for project action; the N-reactor rod system was earlier provided with leads and switching arrangements which would be compatible with such a system.

E-N Load

The most recent plutonium and tritium conversion information confirms the earlier best yield data.

Vertical Safety Rods - Graphite Distortion

An attempt was made to clear a second VSR channel (no. 41) at the 105 C reactor to permit subsequent installation of liner sleeves. Several difficulties and obstructions were encountered, with ultimate clearing down to Layer 9. Remaining outage time permitted only small drill penetration to the top of Layer 3.

Effort continues to be expended in testing the C reactor VSR channel reamers in the 195-D Test Tower mockup. Tests with simulated channel configurations (VSR channel No. 41) have been completed with an average graphite removal rate of 7 cu.in./min. Data obtained in the third mockup channel test indicate that enlargement can be accomplished with negligible damage to process tube channels. All data to date indicate that if VSR channel No. 41 can successfully be enlarged all other channels at C reactor can be drilled without damage to the process tube channels.

SECRET

Power Recovery Studies

All of the engineering studies on the concept of a high-pressure recirculating system based on NPR technology have been completed; fuel cycle and operating and maintenance cost evaluation completed; and the capital cost estimates are being prepared. These studies indicate the conversion of the older reactors is technically feasible; however, the economic attractiveness of the conversion proposal will be dependent largely upon the load factor developed for the power generating system and the availability of some economic return from the sale of the various by-products produced in the reactor.

For the cases considered in this portion of the study program, net electrical outputs ranging from 500 to 950 MWE were obtained.

Work is under way on all of the additional concepts included in this fiscal year's study program. These are:

1. Direct cycle steam generation
2. Organic coolant cycle
3. In-Reactor boiling
4. Nuclear or fossile superheat

Reactor Rear Crossheader Expansion Joints

Vibration and strain gauge readings have been taken from selected locations on the H reactor rear-face crossheaders to determine effectiveness of the recent expansion joint installation. The data obtained have been partially evaluated, and findings thus far indicate that definite reductions in vibration and stress values have resulted.

Self-Supported Fuel Element (SSFE) Charging

The two prototype charging machines designed and fabricated by the Union Machine Works, Inc. were utilized to charge approximately 1300 tubes at KE reactor on February 10 and 11. The machines functioned satisfactorily during the displacement discharging operation on goal exposed fuel. Abnormally high forces continue to be encountered on columns irradiated

DECLASSIFIED

Files

DECLASSIFIED

March 10, 1964

beyond goal. These higher-than-goal-exposure columns continue to cause difficulty and materially reduce charge-discharge rates. Minor modifications continue to be made to obtain incremental improvement in machine operation.

Ten all-magnesium fuel magazines were received from the Dow Metals Company and placed in service during the KE reactor charging operation. Each magazine was cycled through the fueling operation approximately twelve times and exhibited no damage to either the fuel or the magazine during or after the fueling operation. The balance of the order, approximately 390 magazines, was received from the vendor on February 13. These magazines will be used during the next fueling operation at KW reactor.

Effluent Activity Data

The table below shows average concentrations of selected radionuclides from reactor effluent samples taken during January, 1964. All units are 10^{-12} curies/ml.

<u>Reactor</u>	<u>P-32</u>	<u>AS-76</u>	<u>Zn-65</u>	<u>Np-239</u>	<u>Gr-51</u>
B	11.1	114	7.2	260	340
C	14.1	135	12.7	250	750
D	16.8	91	8.7	140	530
DR	10.8	122	15.2	170	1050
F	12.1	167		240	670
H	5.0	23	4.2	50	240
KE	6.0	49	5.0	80	220
KW	7.4	76	5.5	110	240

There were no significant changes in the treatment of coolant during the month of January, 1964.

NEW PRODUCTION REACTOR

KER Loop Operation

KER-1 Testing of four stainless steel clad crud detectors and four 17-inch NIE1 fuel elements as authorized by

SECRET

KER Loop Operation (cont'd.)

PT IP-601-D continued. The objective of this test is to further evaluate the effects of ammonium hydroxide for coolant pH control, particularly the crud forming and decomposition characteristics of ammonium hydroxide at conditions approximating those expected at N reactor.

KER-2 The loop was charged with four NIE1 elements, two 18-inch lithium aluminum target elements and one zircaloy-2 clad thorium-uranium crud monitor as authorized by PT IP-584-D, Supplement A; and IP-644-D. PT-IP-584-D, Supplement D, authorizes the irradiation of NIE1 fuel elements with modified end closures. The objective of the testing authorized by PT-IP-584-D, Supplement A, is to gain additional exposure information on the irradiation of the lithium-aluminum target alloys. PT-IP-644-D authorized the irradiation of the proposed N-reactor fuel surface crud monitor to demonstrate and evaluate its design. The loop pressure and temperature conditions more closely simulate those expected at N reactor as authorized by IP-638-D.

KER-3 The loop was charged with thirteen 26-inch co-producer elements as authorized by PT-IP-645-D. The objective of this test is to demonstrate and characterize multi-product production by the irradiation of simulated N reactor co-product fuel assemblies. The loop is being operated at temperature and pressure conditions authorized by PT-IP-638-D.

KER-4 The loop was placed on single-pass operation with the process tube empty February 14 because the pressurizer was damaged due to overheating during the reactor outage.

DECLASSIFIED

~~SECRET~~

(Year)
OUTAGES (1964) February

Reason	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	44.4	61.7	41.4	31.7	10.9		68.5		258.6
Maintenance	38.9	11.6	18.2	29.3	37.2		27.5	6.3	169.0
Rupture Removal		9.2	14.7	5.1	13.4	42.9			85.3
Leak Testing	20.1	15.3		18.9	28.0				82.3
Tube Replacement	22.8	10.5	7.3	6.3			256.8	384.6	688.3
Project Work	0	0	0	0	0	0	0	0	0
Production Tests		27.9	1.1		3.1		20.1	1.6	53.8
Instrument & Circuitry	2.6	0.4	5.7						8.7
Rupture Suspects									
Miscellaneous		6.3					22.8	15.0	44.1
Total	128.8	142.9	88.4	91.3	92.6	42.9	395.7	407.5	1390.1
Scheduled Outages									
Unscheduled Outages									

DECLASSIFIED

RUPTURED SLUG TABULATION FOR February 1964

Tube No.	Date Charged	Date Ruptured	Tube Power (KW)	Concentration MWD/Ton	Assigned Production Loss		Observations
					MWD	Days	
3781 -F	12-9-63	2-7-64	1283	535	820	.43	I&E E Side Hot Spot
3465 -C	12-4-63	2-9-64	1340	680	950	.38	I&E F Side Hot Spot
3473 -D	12-11-63	2-20-64	1234	694	1280	.64	I&E N Side Hot spot
1377 -H	12-31-63	2-22-64	1270	351	2695	1.37	I&E E Side Hot Spot
1987 -H	12-31-64	2-23-64	1320	343	1660	1.84	I&E E Side Hot Spot
2257 -F	12-4-63	2-24-64	1277	741	417	.21	I&E E Side Hot Spot

DECLASSIFIED

UNITED STATES GOVERNMENT

Memorandum

TO : Files

DATE: April 17, 1964

FROM : R. L. Plum, Chief
Production Reactor Operations Branch

This document consists of 14 pages

SUBJECT: MONTHLY REPORT - MARCH, 1964

HAN-87470
Report #3

OR:GTO-RGR

OPERATING EXPERIENCE

Production

Record reactor input plutonium production for March, 518.9 KMWD's (110.6 per cent forecast), exceeded the April, 1963 maximum by 16.4 KMWD's. The March record included 287.9 KMWD's (105.7 per cent forecast) at the six smaller reactors and 231.0 (117.4 per cent forecast) at the two K reactors. Production records were established at D, H and KE reactors.

Power Levels

The AEC administrative power level limits of 2090 MW at the five smaller reactors and 2310 MW at the C reactor were removed March 4, 1964. Power levels at these six reactors were limited during the remaining portion of the month by a bulk outlet water temperature limit of 95°C. The following record high power levels were achieved: 2090 MW at B, 2365 at C, 2055 at D, 2015 at F and 2110 at H.

Power levels at the K reactors were limited by an administrative limit of 4400 MW.

Efficiency

Over-all time operated efficiency was 78.2 per cent (77.1 per cent forecast): 75.9 per cent at the smaller reactors and 85.3 per cent at the K reactors. At month's end KE reactor had completed 35.0 days of continuous operation which resulted in its first 100 per cent time operated efficiency for a month.

GROUP 1

DECLASSIFIED

SECRET

or the disclosure of its contents in any manner to
an unauthorized person is prohibited.

April 17, 1964

Ruptures

Seven failed I&E fuel elements were removed from the reactors, five enriched uranium and two normal uranium. Two of the enriched failures were at H and one each at C, DR and F. The two natural failures were at B and DR. Five of the failed elements were "side hot spot" failures, one was "side unclassified" and one was not examined.

MAINTENANCE & EQUIPMENT EXPERIENCEWater Leaks

Five process tube leaks at the rear Van Stone flanges were corrected, two each at B and D reactors and one at C.

Tube Replacement

A total of 1431 process tubes was installed: 673 at KW (625 zirconium), 456 at B, 152 at F, 149 at D, and one at C.

REACTOR OUTAGES

<u>Date</u> <u>Down</u>	<u>Date</u> <u>Up</u>	<u>Outage</u> <u>Hours</u>	<u>Remarks</u>
<u>B Reactor</u>			
3/11	3/13	54.6	Removal of an I&E natural metal rupture from tube 2181. Tubes 0984 and 3251 were replaced due to internal leaks.
3/19	still down		Scheduled charge-discharge and tube replacement.
<u>C Reactor</u>			
3/2	3/2	0.2	Trip due to the malfunction of the temperature control system on No. 1 loop.

DECLASSIFIED

DECLASSIFIED

Files

-3-

April 17, 1964

C Reactor (cont'd)

3/5	3/5	0.2	Manual trip due to high pressure surge on HCR cooling water.
3/5	3/6	35.1	Removal of an I&E-E metal rupture from tube 2876.
3/7	3/7	0.3	Manual trip due to indicated high tube temperature. Instrumentation was found in error.
3/25	3/27	70.4	Scheduled charge-discharge.

D Reactor

3/7	3/9	57.3	Repair of a leak in the fire and sanitary water line; charge-discharge and leak testing. New flanges were formed on tubes 3164 and 3184.
3/31	still down		Panellit trip due to the failure of a rear Parker fitting on tube 3261. Will remain down for scheduled tube replacement.

DR Reactor

3/9	3/11	35.8	High pressure Panellit trip; removal of an I&E natural metal rupture from tube 3975.
3/11	3/20	210.3	Removal of an I&E-E metal (bumpered) rupture from tube 2464. Charge-discharge and replacement of 149 tubes.

[REDACTED]

Files

-4-

April 17, 1964

F Reactor

3/4	3/15	247.6	Removal of an I&E-E metal rupture from tube 2167. Charge-discharge and replacement of 152 process tubes.
3/31	still down		Scheduled charge-discharge.

H Reactor

3/1	3/2	24.8	Removal of an I&E-E metal rupture from tube 2888.
3/14	3/15	26.7	Removal of an I&E-E metal rupture from tube 3773.

KE Reactor

No outages

KW Reactor

2/13	3/10	520.0	Replacement of 672 tubes.
3/10	3/10	1.7	RTD repair.

RESEARCH & DEVELOPMENT - EXISTING REACTORS

K Reactor Coolant Backup System

A study has been initiated to evaluate the K area high pressure crosstie coolant backup system to determine the effect of corrosion on adequacy of coolant backup flow. The study includes a review of present capacities and requirements under present operating conditions, and limitations which might be placed on future operating conditions by the presently available flows.

DECLASSIFIED

SECRET

DECLASSIFIED

Files

-5-

April 17, 1964

K Reactor Coolant Backup System (cont'd)

Corrective measures under consideration to alleviate the expected inadequacy are: 1) cleaning and painting the extremities of the crosstie system wherein chemical corrosion inhibition has been impossible, and 2) increasing available coolant by increasing the speed of diesel-driven backup pumps.

Clean U-233 Irradiation Tests

Spline traverses in two fringe tubes in F reactor indicate that the average thermal flux in the thoria target is $1.5 \times 10^{13} \text{ n cm}^{-2} \text{ sec}^{-1}$ for an adjacent enriched E-column power of 600 KW. Calculations had previously predicted a flux 1.36×10^{13} . The difference will not affect the irradiation time to 1 ppm U-232, but it will increase the U-233 yield by about ten per cent.

The one-ton central zone thoria test was charged March 15, 1964 into F reactor and will be discharged about April 1, 1964. An enrichment-to-target ratio of 5.2 was used which is apparently close to the desired value in that no noticeable distortion in the reactor flux across the loading has been noted. Spline traverses are to be taken late in March to determine the absolute flux level and, consequently, the proper irradiation time.

Effluent Activity Data

The following table shows average concentrations of selected radionuclides from reactor effluent samples taken during February 1964. All units are 10^{-12} curies/ml.

<u>Reactor</u>	<u>P-32</u>	<u>As-76</u>	<u>Zn-65</u>	<u>Np-239</u>	<u>Cr-51</u>
B	12.1	150	10.2	290	330
C	17.6	130	15.8	250	830
D	18.1	80	13.7	130	500
DR	10.3	120	17.7	170	1020
F	13.5	170	15.1	230	610
H	9.1	40	9.5	70	330
KE	5.0	30	8.3	30	80
KW	9.7	90	10.5	14	280

There were no significant changes in the treatment of coolant during the month of February, 1964.

April 17, 1964

Vertical Safety Rods - Graphite Distortion

The previous attempt to clear VSR channel 41 at C reactor of accumulated debris in preparation for thermal shield drilling was not complete. Approximately two feet of 3X Balls were found in the bottom of the channel which precluded drilling the anticipated graphite obstructions. A second attempt during an outage late in the month permitted vacuum removal of the 3X Balls and debris down to the lower cast iron elevation.

The following course of action has been proposed for this program:

1. Renovation of the VSR channels and liner installation will proceed on an "as required" maintenance basis rather than a project basis.
2. Sufficient graphite sleeves should be ordered to permit the lining of ten channels at C reactor in the next fiscal year.
3. The C reactor prototype shield enlargement and channel reaming equipment will be utilized in the renovation program.
4. Work directed towards the installation of several VSR channel liners in K reactors on a test basis should proceed as rapidly as possible.
5. Additional investigation of the feasibility of installing metallic VSR channel sleeves in certain locations in the reactors will be undertaken.

Self-Supported Fuel Element (SSFE) Charging

The prototype SSFE charging machines continued to function satisfactorily during recent displacement discharging operations at the K reactors. Higher-than-goal exposed fuel was successfully displacement discharged routinely even though abnormally high forces were encountered. The third charging machine, being procured from Union Machine Works, has been completed and is undergoing tests at the

DECLASSIFIED**SECRET**

DECLASSIFIED

Files

-7-

April 17, 1964

Self-Supported Fuel Element (SSFE) Charging (cont'd)

vendor's plant. Tests, utilizing four fully loaded magazines, of the loaded section indicate a weakness of the magazine holding mechanism; redesign and repair are under way.

The all-magnesium fuel magazines were tested on-reactor at the last KW reactor outage and were judged to be satisfactory. Procurement of 1300 additional magazines has been initiated.

NEW PRODUCTION REACTOR

KER Loop Operation

KER-1 - Testing of four stainless steel clad crud probes, two of which are equipped with thermocouples, and four 17-inch N1E1 fuel elements as heaters authorized by PT IP-601-D continued. The objective of the test is to further evaluate the effects of ammonium hydroxide for coolant pH control, particularly the crud forming and decomposition characteristics of ammonium hydroxide at conditions approximating those expected at N reactor.

KER-2 - Testing of four N1E1 fuel elements, two 18-inch lithium-aluminum target elements and one Zircaloy-2 clad thorium-uranium crud monitor continued. The objective of the testing is to gain additional exposure information on the irradiation of lithium-aluminum target alloys. The irradiation of the proposed N reactor fuel surface crud monitor has been authorized to demonstrate and evaluate its design. The loop pressure and temperature conditions closely simulate those expected at N reactor.

KER-3 - Testing of thirteen 26-inch co-producer elements continued. The test objective is the demonstration and characterization of multi-product production by the irradiation of simulated N reactor co-product fuel assemblies. The loop is being operated at conditions expected in N reactor.

KER-4 - The loop remained out of service because of the damaged pressurizer vessel.

SECRET

RUPTURED SLUG TABULATION FOR March 1964

Tube No.	Date Charged	Date Ruptured	Tube Power (KW)	Concentration MWD/Ton	Assigned Production Loss		Observations
					MWD	Days	
2888 H	12-31-63	3-1-64	1290	425	1713	.84	INE E Side Hot Spot
267 F	12-9-63	3-4-64	1388	847	504	.26	I&E E Not examined
2876 C	1-29-64	3-5-64	1542	499	877	.39	I&E E Side Hot Spot
3975 DR	12-26-63	3-9-64	1232	646	915	.47	I&E N Side Hot Spot
2181 B	1-21-64	3-11-64	1377	445	1816	.89	I&E N Side Hot Spot
464 DR	12-13-63	3-11-64	1278	1044	521	.27	I&E EB Side unclassified
3773 H	12-31-63	3-14-64	1296	547	1705	.83	I&E E Side Hot Spot

DECLASSIFIED

Reason
Charge-Discharge
Maintenance
Rupture Removal
Leak Testing
Tube Replacement
Project Work
Production Tests
~~XXXXXXXXXXXXXX~~
Standard Check
Rupture Suspects
Miscellaneous
Total
Scheduled Outages
Unscheduled Outages

Reason	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	18.7	54.8	10.3	50.1	32.2			78.6	244.7
Maintenance	17.2	24.4	20.1	8.4	30.2	19.0		10.4	129.7
Rupture Removal	19.2	7.7		6.2	6.1	32.5			71.7
Leak Testing	19.9	7.8	19.3						47.0
Tube Replacement	265.7	5.5		134.6	111.8			124.7	642.3
Project Work	2.6	2.5	1.0	15.6	16.1			2.8	49.6
Production Tests		.5	.2					1.7	2.4
Rupture Suspects									
Miscellaneous	16.2	3.1	12.5	31.2	54.2				117.2
Total	359.5	106.3	63.4	246.1	250.6	51.5		218.2	1295.6
Scheduled Outages									
Unscheduled Outages									

(Year)
OUTAGES (3-64)

SECRET

REACTOR OUTAGES

(Monthly Report - March, 1964)

Date Date Outage
Down Up Hours

Remarks

B Reactor

110 3/11 3/13 54.6 Removal of an I&E natural metal^{rupture}/from tube
2181. Tubes 0984 and 3251 were
replaced due to internal leaks.

3/19 still down Scheduled charge-discharge and tube
replacement.

C Reactor

3/2 3/2 0.2 Trip due to the malfunction of the temperature
control system on No. 1 loop.

3/5 3/5 0.2 Manual trip due to high pressure surge
on HCR cooling water.

3/5 3/6 35.1 Removal of an I&E-E metal rupture from tube
2876

3/7 3/7 0.3 Manual trip due to indicated high tube
temperature. Instrumentation was found
in error.

3/25 3/27 70.4/ Scheduled charge-discharge.

DECLASSIFIED

DECLASSIFIED

- 2 -

D Reactor

3/7 3/9 57.3

Repair of a leak in the fire ^{sanitary} water line; *Charge - Discharge*
+ leak testing. New flanges were formed
on tubes 3164 and 3184.

3/31 still down

Panellit trip due to the failure of a rear
Parker fitting on tube 3261. Will remain
down for scheduled tube replacement.

DR Reactor

3/9 3/11 35.8

High pressure Panellit trip; removal of an
I&E natural metal rupture from tube 3975.

3/11 3/20 210.3

Removal of an I&E-E metal (bumpered) ~~rupture~~ rupture
from tube 2464. Charge-discharge and replacement
of 149 tubes.

F Reactor

3/4 3/15 247.6

Removal of an I&E-E metal rupture from tube 2167.
Charge-discharge and replacement of 152 process
tubes.

3/31 still down

Scheduled charge-discharge

H Reactor

3/1 3/2 24.8 Removal of an I&E-E metal rupture from tube
2888.

3/14 3/15 26.7 Removal of an I&E-E metal rupture from tube
3773.

~~H Reactor~~

~~3/15 3/16 26.7 Scheduled charge discharge~~

H Reactor - No outages

KW Reactor

2/13 3/10 520.6 Replacement of 672 tubes.

3/10 3/10 1.7 RTD repair.

DECLASSIFIED

Tube No.	Date Charged	Date Ruptured	Tube Power (KW)	Concentration MWD/Ton	Assigned Production Loss		Observations
					MWD	Days	
22284	12/31/63	3/11/64	1290	425	1713	.84	AGEE side hot spot
2167E	12/9/63	3/4/64	1388	847	504 877	.26	AGEE not examined
2876C	1/29/64	3/5/64	1542	499	877 975	.39	AGEE side hot spot
3975DR	12/26/63	3/9/64	1232	646	915	.47	AGEE side hot spot
2181B	1/21/64	3/11/64	1377	445	1816	.89	AGEE side hot spot
2464DR	12/13/63	3/11/64	1278	1044	521	.27	AGEEB side under test
27134	12/31/63	3/14/64	1296	547	1705	.83	AGEE side hot spot

SECRET - ROCKET

March (Year)
OUTAGES 4464

Reason	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	18.7	54.8	10.3	50.1	32.2			78.6	244.7
Maintenance	17.2	24.4	20.1	8.4	30.2	19.0		16.4	129.7
Rupture Removal	19.2	7.7		6.2	6.1	32.5			71.7
Leak Testing	19.9	7.8	19.3						47.0
Tube Replacement	265.7	5.5		134.6	111.8			124.7	642.3
Project Work									
Production Tests	2.6	2.5	1.0	15.6	16.1			2.8	40.6
Standard Check Instrument & Circuitry		5	.2					1.7	2.4
Rupture Suspects									
Miscellaneous	16.2	3.1	12.5	31.2	54.2				117.2
Total	359.5	106.3	63.4	246.1	250.6	51.5		218.2	1295.6
Scheduled Outages									
Unscheduled Outages									

DECLASSIFIED

UNITED STATES GOVERNMENT

Memorandum

DECLASSIFIED

TO : Files

DATE: 5-12-64

FROM : R. L. Plum, Chief *CPD*
Production Reactor Operations Branch

This document consists of 12 page

SUBJECT: MONTHLY REPORT - APRIL 1964

HAN-87470
Report #4

OR:GTO-RGR

OPERATING EXPERIENCE

Production

Reactor input plutonium production for April was 93.2% of forecast: 88.2% at the six smaller reactors and 99.4% at the two K reactors.

Power Levels

Power levels at the six smaller reactors were restricted by a bulk outlet water temperature limit of 95°C. Power levels at the K reactors were restricted by the administrative limits of 4400 MW.

Efficiency

Over-all time operated efficiency was 67.5% (74.9% forecast): 63.8% at the smaller reactors and 78.7% at the K reactors. Low efficiency at the smaller reactors and the under-run of the production forecast resulted from fuel element failures and an over-run of forecast time for the charge-discharge of fuel elements and for tube replacement.

Ruptures

Nineteen failed I&E fuel elements were removed from the reactors: fifteen of enriched uranium and four of natural uranium. Six of the enriched failures were at H, four at DR, three at C and one each at

DECLASSIFIED

GROUP 1

Ruptures cond't

D and F. The four natural metal ruptures were at B, D, F and H reactors. Fourteen of the enriched elements were "side hot spot" failures; one has not yet been examined. Two of the natural elements were "side hot spot" failures; two were not examined. Fourteen of these fuel element failures (11 enriched and 3 natural) were stuck in process tubes.

Effluent Activity Data

The table below shows the average concentrations of selected radionuclides from reactor effluent samples taken during March, 1964, all units are 10^{-12} curies/ml.

<u>Reactor</u>	<u>As-76</u>	<u>P-32</u>	<u>Np-239</u>	<u>Zn-65</u>	<u>Cr-51</u>
B	150	12.9	300	10.8	330
C	120	17.2	260	18.3	750
D	80	14.5	130	14.7	520
DR	130	11.9	210	20.1	880
F	170	14.8	240	7.3	550
H	50	12.8	120	12.6	340
KE	50	9.0	70	7.9	150
KW	60	9.2	70	4.9	120

There were no significant changes in the treatment of coolant during the month of March, 1964.

H Reactor Incident

Upon startup of H Reactor on April 17, 1964, a rising period was achieved prematurely with six VSR's still in the reactor; the estimated difference between the indicated and calculated reactivities was approximately eight mk. From initial calibration measurements it was judged that temporary poison geometry effects had resulted in excessive shadowing; additional supplemental poison was loaded and reactor operation began. Following observation of reactivity and flux distortions during four days' operation [REDACTED] it was concluded that a

DECLASSIFIED

SECRET

DECLASSIFIED

Files

-3-

H Reactor Incident cont'd

a significant number of E-N columns in the upper half of the reactor were charged with excessive target element displacement downstream. The reactor was shut down on April 23, 1964 and the offending 171 columns were replaced with the originally intended configuration.

Efficiency and Safety Improvements

The KW and DR reactors have initiated a programmed inward movement of the enrichment ring (and thus a decrease in flat zone size) in independent efforts to optimize operating efficiency and total control status.

MAINTENANCE AND EQUIPMENT EXPERIENCE

Water Leaks

Four process tube leaks, at the rear Van Stone flanges, were corrected: three at F and one at DR. A total of 481 process tubes were installed: 265 at D, 146 at H, 65 at DR, 4 at F and one at C.

Self-Supported Fuel Element (SSFE) Charging

The third SSFE charging machine built by the Union Machine Works, Inc. has been received at Hanford and is undergoing final check-out prior to on-reactor-use.

Deactivation of Auxiliary Facilities

Information has been developed for a project proposal associated with deactivation of DR, F and H reactors. The Hanford Laboratories Animal Farm facility at 100-F Area, and the administrative and shop facilities at 100-H Area would be retained in service after the reactors are deactivated. This would require the provision of heat by package boiler units. Sanitary water would be supplied by converting the export lines from D Area to a sanitary water line.

SECRET

Files

-4-

REACTOR OUTAGES

B. REACTOR

<u>Date Down</u>	<u>Date Up</u>	<u>Outage Hours</u>	<u>Remarks</u>
3/19	4/4	395.3	Replacement of 454 tubes. Charge-discharge and miscellaneous maintenance.
4/8	4/9	36.6	Tripped when a front face cap O-ring failed on tube 3189.
4/23	4/25	37.6	Removal of an I&E natural metal rupture from tube 2772. Miscellaneous maintenance.

C REACTOR

4/13	4/15	51.1	Removal of an I&E enriched metal rupture from tube 1681. Charge-discharge.
4/15	4/15	8.7	Removal of an I&E enriched metal rupture in tube 3960.
4/28	still down		Removal of an I&E enriched metal rupture in tube 3181. Charge-discharge and maintenance.

D REACTOR

3/31	4/16	379.5	Panellit trip due to the failure of a rear Parker fitting on tube 3261. Replacement of 263 tubes, charge-discharge and maintenance.
4/16	4/17	22.5	Removal of an I&E enriched metal rupture in tube 1958.
4/22	4/24	42.8	I&E natural metal rupture was removed by pushing tube (2361) and metal. Miscellaneous maintenance.

DECLASSIFIED

CONFIDENTIAL

Files

-5-

DR REACTOR

4/15	4/22	154.5	Removal of an I&E enriched metal rupture from tube 3257. Charge-discharge and replacement of 61 process tubes.
4/22	4/22	1.6	Removal of an I&E enriched metal rupture from tube 2058.
4/23	4/25	34.8	Removal of an I&E enriched metal rupture from tube 3357.
4/25	4/25	2.1	Manually tripped due to 3 front pigtail leaks.
4/29	still down		Removal of an I&E enriched metal rupture from tube 3788.

F REACTOR

3/31	4/2	46.4	Scheduled charge-discharge. Replaced 3 tubes due to rear Van Stone leaks.
4/6	4/7	38.3	Removal of an I&E enriched metal rupture from tube 0678.
4/15	4/19	86.5	Removal of an I&E natural metal rupture from tube 1189. Charge-discharge.
4/19	4/19	0.2	Low pressure Panellit trip on tube 4388.
4/19	4/19	0.2	Thermocouple repair.
4/23	4/24	34.7	High pressure Panellit trip on tube 3464 when a spline was being withdrawn.

H REACTOR

4/3	4/4	29.0	Removal of an I&E enriched metal rupture from tube 3486.
-----	-----	------	--

CONFIDENTIAL

Files

-6-

H REACTOR cont'd

4/4	4/5	9.6	Removal of an I&E enriched metal rupture from tubes 3059, 2962 and 2057.
4/5	4/18	343.0	Removal of I&E enriched metal ruptures from tubes 2056 and 1785, and I&E natural (mixer) from tube 2058. Charge-discharge of E-N block and replacement of 146 tubes.
4/19	4/19	7.8	Poison discharge.
4/23	4/24	41.6	Investigation of abnormal flux distribution. 172 tubes in the E-N load were recharged.

KE REACTOR

4/1	4/5	45.5	Scheduled charge-discharge.
4/5	4/5	2.2	RTD repair.
4/6	4/6	0.3	Tripped when a broken spline in tube 0967 washed down stream.
4/7	4/8	26.7	Tripped when a broken spline in tube 4458 washed down stream.
4/26	4/30	81.4	Tripped by KER 3 due to faulty instrumentation on the heat exchanger exit temperature. Charge-discharge.
4/30	4/30	0.4	Panellit trip caused by a faulty gauge.
4/30	4/30	0.6	Unexplained Panellit trip on 4861.

KW REACTOR

4/13	4/16	78.6	Scheduled charge-discharge.
------	------	------	-----------------------------

DECLASSIFIED

DECLASSIFIEDRESEARCH AND DEVELOPMENT - EXISTING REACTORSReactor Fuels

On April 1, 1964, 19 central zone columns of high density (80% of theoretical density) thorium oxide target elements were discharged from F Reactor with an equivalent exposure of 16.4 reactor operating days. During the same reactor outage, a second group of 19 high density thoria columns was charged. These elements were discharged on April 16, 1964 during an unscheduled reactor outage with an exposure equivalent of about 10.5 reactor operating days. Eighteen of 20 low density (65% of theoretical density) thoria columns were discharged from the fringe zone tubes of F Reactor after 65 reactor operating days. These tubes were recharged with low density thoria elements for a planned irradiation period of about 120 days. The two tubes not discharged will give data on extended fringe zone irradiations.

Depleted Uranium

A production test is being prepared for the irradiation of depleted uranium in both a smaller reactor and a K reactor. To date 4,957 smaller reactor-size cores and 112 K-reactor fuel cores have been received, and it is anticipated that the depleted loading will be charged by June 1964 and irradiated until near midyear 1965.

1.25 Enriched Fuel

The use of fuel elements enriched to 1.25 w/o U-235 has been proposed to support target loadings and an order was placed for the enriched metal. For adequate heat transfer, the fuel design proposal for the K reactors would require process tube coolant flow rates somewhat greater than those currently being obtained. The preliminary results of an experimental program to investigate the hydraulic characteristics of the K process tube and fitting geometry at the higher flow rates indicated that the current hardware is compatible with the flow increase.

Earthquake Studies

Seismic vibration measurements are being planned which would be initiated by a series of blasts in the reservation. Vibration measurements in reactor structures will be made to determine response to

SECRET

Earthquake Studies cont'd

disturbances of a seismic nature.

The Alaskan earthquake of March 22, 1964, was felt at Hanford with an intensity exceeding MM-2 but not reaching MM-4. No reactors were scrambled, but high sensitivity alarms were received on seismoscopes in five of the eight reactors.

KER LOOP OPERATION

KER-1 - Testing of four stainless-steel-clad crud probes and four 17-inch NIE1 fuel elements as authorized by PT-IP-601-D was completed with the discharge of the loop April 1. The loop was recharged with eight 12-inch K5E fuel elements and a thermocouple train assembly as authorized by PT-IP-544-A. The objective of this test is to evaluate the swelling behavior of Zr-2 clad thick-walled enriched uranium tubular elements at high uranium temperatures. The loop pressure was lowered to 460 psig and tube outlet temperature to 150°C, April 10 because of a piping leak between the pressurizer and the vent control valve. The charge described above was replaced with an identical charge on April 27, 1964.

KER-2 - Testing of four NIE1 fuel elements, two 18-inch lithium-aluminum target elements and one Zr-2 clad thorium-uranium crud monitor as authorized PT-536A, Supplement D, IP-584-D, Supplement A, was completed with the discharge of the loop April 1. The loop was recharged with eight 12-inch K5E fuel elements as authorized by PT-IP-544-A.

KER-3 - Testing of thirteen 26-inch co-producer elements as authorized by PT-IP-654-D continued. The objective of this test is to demonstrate and characterize multi-product production by the irradiation of simulated N Reactor co-product fuel assemblies.

DECLASSIFIED

KER-4 - Testing of a Zr-2 clad thorium-uranium crud monitor and ten 23-inch NAEI fuel elements as authorized by PT-IP-644-D and IP-477-A was started. The loop was charged April 1 and is being operated on single-pass until the pressurizer is replaced. The object of this test is to demonstrate and evaluate the design of the proposed N Reactor fuel surface crud monitor.

Shield Attenuation Studies

ICARIUS, a program to calculate theoretical shield leakage data, has been modified so as to permit variance of deterioration coefficient of the basic equations and thus to match the observed data. The program has also been set up to machine-plot the results directly onto graph paper.

Vertical Safety Rods - Graphite Distortion

Two different configurations of sleeves have been designed for the VSR channels at K Reactors. The sleeves will be of high strength graphite identical to that used for the sleeves at C Reactor. Procurement of two sets of prototype sleeves has begun.

Boroscopy of VSR channel No. 41 at C Reactor revealed that material obstructing the bottom of the channel was composed of Ball 3X balls imbedded in metallic matrix. A sample of the metal matrix was obtained and analysis showed the major constituent to be lead with a 0.01 to 1 per cent bismuth, iron, molybdenum and nickel. The source of this material is believed to be a lead brick used for temporary shielding accidentally dropped into the channel during some previous work possibly performed several years ago. Studies were initiated on the possibility of modifying tools and equipment at C Reactor and fabrication of new equipment where necessary, in preparation for sleeving at the K reactors.

100-K Reactor Coolant Backup System

Investigations to determine the effect of corrosion on the adequacy of coolant backups flow continued. As a means of overcoming the friction due to corrosion, tests were run

DECLASSIFIED

DECLASSIFIED100-K Reactor Coolant Backup System cont'd

to determine feasibility of increasing coolant flows by an increase in diesel pump speed. Results indicate that flow increases up to four per cent may be expected without detriment to pump or driver. Further evaluation is in progress.

Small Reactors - Emergency Coolant Backup System

The proposed deactivation of three smaller reactors has necessitated a modified approach to the problems of providing adequate emergency coolant backup to the operating reactors. The current study proposes a system which will include diesel engine-driven backup pumps at 182-B to provide emergency coolant backup to the B and C reactors and piping modifications as required to make the 100-B and C backup system independent of the export water system. Additional steam turbine-driven pumping units will be installed at 182-B and 182-D to ensure dependable water supply to the 200 areas and, in the case of the additional pumping capacity at 182-D, to provide a secondary water supply to the 182-B reservoir.

Reactivity and Safety Control Studies

During the H Reactor run of April 19-22, special analog cases were run for calculating the H Reactor total control status. Longitudinal flux traverse data were used to establish empirical bucklings in the overly-reactive region in the top-front of the reactor. These studies indicated that total control conditions were satisfied with the 45-rod H Reactor VSR pattern in the distorted loading configuration which existed at that time.

(Year)
OUTAGES (64)

Reason	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	58.9	32.4	39.4	63.3	48.7	163.6	151.1	56.4	613.8
Maintenance	66.2	33.2	147.7	25.8	88.9	56.8	22.7	11.2	452.5
Rupture Removal	2.7	26.6	35.2	42.8	15.8	47.5			170.6
Leak Testing					14.5				14.5
Tube Replacement	15.8	8.5	178.2	69.6	4.5	129.8			406.4
Project Work	13.9								13.9
Production Tests		16.8	11.7		26.9		41.5	6.3	103.2
Standard Check Production Tests	2.8	.2	9.7		3.0	1.5		2.3	19.5
Rupture Suspects									
Miscellaneous	4.2		20.5	25.6	2.4	8.0	11.9	2.5	75.1
Total	164.5	117.7	442.4	227.1	204.7	407.2	227.2	78.7	1869.5
Scheduled Outages									
Unscheduled Outages									

RUPTURED SLUG TABULATION FOR April 1964

Tube No.	Date Charged	Date Ruptured	Tube Power (KW)	Concentration MWD/Ton	Assigned Production Loss		Observations	
					MWD	Days		
3486 H	12-31-63	4-3-64	1326	785	705	.41	I&EE	Side Hot Spot
3059 H	12-31-63	4-4-64	1255	759	969	.57	I&EE	"
2962 H	12-31-63	4-4-64	1267	776			I&EE	"
57 H	12-31-64	4-4-64	1273	790			I&EE	"
2058 H	12-31-63	4-5-64	1309	809			I&E NWM	"
2056 H	12-31-63	4-5-64	1322	788	2178	1.27	I&EE	Side Hot Spot
1785 H	12-31-63	4-6-64	1320	785			I&EE	"
0678 F	1-14-64	4-6-64	1249	621	722	.41	I&EE	"
1681 C	3-25-64	4-13-64	1357	244	608	.28	I&EE	"
3960 C	3-25-64	4-15-64	1270	239	1121	.51	I&EE	"
3257 DR	3-11-64	4-15-64	1223	349	611	.32	I&EE	Side Hot Spot
89 F	1-14-64	4-15-64	1261	555	712	.41	I&EN	Unknown - Not Examined
1958 D	2-22-64	4-16-64	1362	485	1363	.75	I&EE	Side Hot Spot
2058 DR	3-11-64	4-22-64	1223	357	593	.31	I&EE	"
2361 D	3-31-64	4-22-64	1257	50	1741	.95	I&EN	Side - Not examined *
2772 B	2-16-64	4-23-64	1278	419	260	.14	I&EN	Side Hot Spot
3357 DR	3-11-64	4-23-64	1202	376	1863	.99	I&EE	Side Hot Spot
181 C	3-25-64	4-28-64	1373	419	1288	.59	I&EE	Unknown (not examined)
3788 DR	3-11-64	4-29-64	1265	439	1246	.66	I&EE	Side Hot Spot

SECRET - DECLASSIFIED

UNITED STATES GOVERNMENT

Memorandum

TO : Files

DATE: 6-17-64

FROM : R. L. Plum, Chief
Production Reactor Operations Branch

SUBJECT: MONTHLY REPORT - MAY, 1964

HAN-87470
Report #5

OR:RGR-GTO

This document consists of
1 page, No. 1 of 1
1 copy, Serial 1 of 1
1 file, 1 of 1

OPERATING EXPERIENCE

Production

Reactor input plutonium production for May, 542.1 KMWD's (108.2% of forecast), represents a new record exceeding the previous maximum (established in March, 1964) by 4.5%. Production at the six smaller reactors was 300.1 KMWD's (103.3% of forecast) and at the two K Reactors 242.0 KMWD's (115% of forecast). The K Reactor production also represents a new record which is 2.6% above their March, 1963 record.

Power Levels

Power levels at the smaller reactors, other than H, were restricted by a bulk outlet water temperature limit of 95.0 C. The H Reactor power level was arbitrarily held below the bulk outlet water temperature limit for fuel element failure considerations. Power levels at the K Reactors were limited by the AEC administrative limit of 4400 MW.

Efficiency

Overall time operated efficiency was 85.9% (84.1% forecast), the highest since November, 1959. May efficiency at the smaller reactors was 84.6% and at the K's 89.8%. High efficiency

Efficiency cont'd

and the associated production record resulted from no extended outages, no outages for the correction of process tube water leaks and fewer unscheduled outages from miscellaneous causes.

Ruptures

Twelve failed I&E fuel elements were removed from the reactors: eight of enriched uranium and four of natural uranium. Two of the enriched failures were at B, two at C, two at F and one each at DR and H. Two natural metal failures were at DR, one at D and one (watermixer) at C. Seven of the enriched failures were "side hot-spot" failures; one has not yet been examined. Two of the natural metal failures were "side hot-spot" and two were "side-unknown". The enriched failures ranged from 64% to 94%. Six of the eight enriched failures were stuck in process tubes; none of the natural failures were stuck.

MAINTENANCE AND EQUIPMENT EXPERIENCESWater Leaks

One process tube leak, at the rear Van Stone flange, was corrected at F Reactor. Six process tubes were installed: two each at B and DR and one each at C and F.

REACTOR OUTAGES

B REACTOR

<u>Date Down</u>	<u>Date Up</u>	<u>Outages Hours</u>	<u>Remarks</u>
5/4	5/6	38.1	Power failure trip caused by a faulty voltage regulator at 190-B Annex, and other miscellaneous maintenance.
5/13	5/16	50.9	Scheduled charge-discharge.
5/19	5/20	34.5	Removal of an I&E enriched metal rupture from tube 3688.
5/27	5/29	56.4	Removal of an I&E enriched metal rupture from tube 4071.

C REACTOR

4/28	5/2	98.2	Removal of an I&E enriched metal rupture from tube 3181.
5/4	5/5	33.7	Removal of an I&E enriched metal rupture from tube 3173. Miscellaneous maintenance.
5/10	5/12	35.7	Removal of an I&E enriched metal rupture from tube 3960.
5/13	5/13	0.3	Scrammed when instrument air to C-1 loop was inadvertently shut off.
5/20	5/21	35.1	Removal of an I&E natural metal rupture from tube 3361.

D REACTOR

5/2	5/4	35.8	Removal of an I&E natural metal rupture from tube 1281.
-----	-----	------	---

Files

-4-

5/17 5/18 46.3 Scheduled charge-discharge.

DR REACTOR

4/29 5/1 39.3 Removal of an I&E enriched metal
rupture from tube 3788.

5/2 5/3 33.0 Removal of an I&E enriched metal
rupture from tube 2958.

5/5 5/7 28.3 Removal of an I&E natural metal
rupture from tube 1179.

5/15 5/17 35.6 Removal of an I&E natural metal rupture
from tube 1184.

F REACTOR

5/2 5/4 51.4 Removal of an I&E enriched metal
rupture from tube 1290.

5/5 5/6 28.3 Removal of an I&E enriched metal
rupture from tube 0662.

5/23 5/26 63.2 Scheduled charge-discharge.

H REACTOR

5/28 5/29 26.2 Removal of an I&E enriched metal
rupture from tube 2676.

KE REACTOR

5/1 5/1 0.2 Panellit trip caused by a broken
spline in tube 5182.

5/17 5/19 38.9 Panellit trip and miscellaneous
maintenance.

KW REACTOR

5/11 5/15 113.4 Scheduled charge-discharge and
maintenance.

RESEARCH AND DEVELOPMENT - EXISTING REACTORSThorium Oxide

The second group of thorium oxide target elements, irradiated in fringe zone tubes in F Reactor, currently has an exposure equivalent to 26 full-reactor-power operating days. The elements are scheduled for discharge during the same outage that the supporting enriched uranium fuel reaches 1000 MWD/T. At that time, it is estimated that the thoria columns will have an exposure equivalent to 120 full-reactor-power operating days. The irradiation has proceeded without difficulty; tube outlet temperatures about 5 C above inlet temperatures are being observed on the thoria columns.

Depleted Uranium

Canning of depleted uranium elements for the smaller reactors has been completed, yielding approximately 3700 elements acceptable for reactor charging. A production test to authorize depleted irradiation is currently being prepared and charging of the test material at a smaller reactor is expected in early June 1964. Depleted uranium for the K Reactors is now arriving on-plant. Irradiation of these elements should begin early in July 1964.

1.25% Enriched Fuel

Integration of physics and engineering aspects is proceeding to establish fuel element dimensions for the 1.25% of U-235 enriched uranium for both the smaller and K Reactors. Preliminary studies indicate a balanced design for the smaller reactors; however, additional work is required for the case of the K Reactors.

Longer Fuel Cores

Twenty fuel columns containing ten-inch enriched uranium, 0.947 w/o U-235, fuel elements were charged into D

Longer Fuel Cores cont'd

Reactor during the April 22, 1964, outage. This test is the first step in evaluating the irradiation behavior of longer fuel cores. Five columns of the test are scheduled for discharge at 600 MWD/T, the remaining columns to be discharged at either 800 MWD/T or 1000 MWD/T.

Thulium-170 (Boeing Request)

Arrangements are being made to measure the rise factor and axial flux distributions for the Tm-169 target in the PCTR to determine whether a Hanford irradiation is feasible. Graphite spacers will be used instead of beryllium, calculations indicate little difference in the average target flux with either moderator. Boeing scientists have indicated that they can have the test target prepared in two to three weeks. The PCTR irradiation is planned for the third week in June. The results of this test will better enable an estimate of the flux level in the Tm target and, therefore provide a basis for the irradiation time.

Effluent Activity Data

The table below shows the average concentrations of selected radionuclides from reactor effluent samples taken during April 1964. All units are 10^{-12} curies/ml.

<u>Reactor</u>	<u>As-76</u>	<u>P-32</u>	<u>Np-239</u>	<u>Zn-65</u>	<u>Cr-51</u>
B	120	6.0	230	12	220
C	150	19.5	310	27	850
D	80	7.1	120	20	320
DR	130	8.6	280	33	740
F	140	14.7	270	20	420
H	33	11.7	170	16	290
KE	48	10.1	65	12	120
KW	64	10.4	75	11	130

During April 1964, the sodium dichromate addition rate was reduced at all reactors to provide a coolant concentration of 1.0 ppm. On May 19, 1964 the Ph of the F & H process water was raised to 7.0 to determine the effect on effluent radioactivity.

KER-1 -

The eight 12-inch KSE5 fuel elements and thermocouple train assembly charged April 2 were discharged on April 27 because of several days operation at reduced temperature required by a piping leak. The loop was recharged with eight 12-inch KE5 fuel elements and a thermocouple train assembly. The object of this test is to evaluate the swelling behavior of Zr-2 clad, thick-walled, enriched uranium tubular elements at high uranium temperatures.

KER-2

Testing of eight 12-inch KE5 fuel elements continued. The objective of this test is to evaluate the swelling behavior of Zr-2 clad thick-walled, enriched uranium tubular elements at high uranium temperatures.

KER-3

Testing of thirteen 26-inch co-producer elements as authorized by PT-IP-645-D continued. The objective of this test is to demonstrate and characterize multi-product production by the irradiation of simulated N Reactor co-product fuel assemblies. The loop is being operated at temperatures and pressure conditions authorized by PT-IP-638-D.

KER-4

Testing of Zr-2 clad thorium-uranium crud monitor and ten 23-inch NAE1 fuel elements as authorized by PT-IP-644-D and PT-IP-477-A continued. The object of this test is to demonstrate and evaluate the design of the proposed N Reactor fuel surface crud monitor. The loop is being operated on single pass.

Vertical Safety Rods-Graphite Distortion

The obstruction was removed from VSR channel #41 at 105 C Reactor, and enlargement completed through the top cast iron thermal shield and ball guide plate.

Vertical Safety Rods-Graphite Distortion cont/d

The matrix of 3X balls and lead at the bottom of the channel was penetrated by drilling. Completion of channel enlargement and installation of sleeving in this channel is currently scheduled for the June outage at 105-C reactor.

VSR channel #28 at 105 C Reactor, was examined to determine the condition of the graphite test sleeves. These sleeves, fabricated from excess NPR graphite and installed August 15, 1963 appear in good condition. Displacement measurements and full channel photographs were obtained during the examination. These data are currently being processed and will be available for detailed analysis in the near future.

Preliminary studies were initiated relating to the use of water cooled metal liners for permanent installation in the VSR channels as an alternative to the current graphite sleeving concept. Metal liners would resist graphite shifting, insure channel integrity for VSR entry and 3X ball retention. Initial efforts are concerned with a review of the problems associated with metal liners and feasibility of alternate materials and configurations. Because of the reactivity and control strength losses associated with water cooled metal liners, partial as well as full length liners are being considered.

Reactor Shutdown

On May 1, 1964, DR, H and F were selected for shutdown on December 31, 1964, April 30, 1965 and June 30, 1965 respectively. The press release making this announcement was issued on May 5, 1964. Along with the selection of reactors, DR was selected to be placed in a standby status at time of shutdown.

Two project proposals were received from the General Electric Company in mid May relative to reactor shutdown work. One proposal, CGI-141, covered the general construction work concerned with reactor shutdown. The other proposal, CGI-142, covered the modification work to the export water line and the back-up coolant system made necessary by the reactor shutdown.

Scoping work is underway by General Electric engineers on the preparation of a shutdown and layaway manual for DR.

(Year)
OUTAGES (May)

Reason	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	52.8	36.5	38.6	24.7	43.8		19.5	94.0	309.9
Maintenance	47.6	60.3	23.9	42.0	56.8		9.9	5.5	246.0
Rupture Removal	59.8	26.3	2.9	28.0	16.3	26.2			159.5
Leak Testing		5.8			13.6				19.4
Tube Replacement	2.8		5.1	9.5	8.4				25.8
Project Work	11.0								11.0
Production Tests	3.9	6.5	7.6	1.8	4.0			5.7	26.9
Instrument & Circuitry	3.7	7.4	4.1	3.5				8.2	26.9
Rupture Suspects									
Miscellaneous				0.6			9.3		9.9
Total	181.6	142.8	82.2	110.1	142.9	26.2	38.7	113.4	837.9
Scheduled Outages									
Unscheduled Outages									

RUPTURED SLUG TABULATION FOR May 1964

Tube No.	Date Charged	Date Ruptured	Tube Power (KM)	Concentration MWD/Ton	Assigned Production Loss		Observations
					MWD	Days	
1281 D	2-20-64	5-2-64	1362	501	271	.14	I&E-N, Side Hot Spot
58 DR	3-11-64	5-2-64	1170	402	1235	.67	I&E-E, Side Hot Spot
1290 F	3-4-64	5-2-64	811	379	656	.36	I&E-E, Side Hot Spot
3173 C	3-25-64	5-4-64	1403	405	537	.25	I&E-E, Side Hot Spot
0662 F	3-4-64	5-5-64	1141	501	780	.42	I&E-E, Side Hot Spot
1179 DR	3-11-64	5-5-64	1274	348	639	.35	I&E-N Side Unknown
3960 C	4-15-64	5-10-64	1384	282	1735	.82	I&E-E, Side Hot Spot
1184 DR	3-11-64	5-15-64	1262	436	422	.23	I&E-N, Side Unknown
3688 B	3-19-64	5-19-64	1327	493	1266	.70	I&E-E, Side Hot Spot

May 1964 cont-d

-11-

UNITED STATES GOVERNMENT

Memorandum

DECLASSIFIED

TO : Files

DATE:

FROM : R. L. Plum, Chief
Production Reactor Operations Branch

JUL 17 1964

SUBJECT: MONTHLY REPORT - JUNE 1964

HAN-87470
Report #6

OR:GTO:RGR

OPERATING EXPERIENCE

This document consists of 11 pages

Production

Reactor input plutonium production for June was 500.8 KMWD's (107.9% forecast) 296.6 KMWD's (113.0% forecast) at the six smaller reactors and 204.2 (101.2% forecast) at the two K reactors. Input production for the second quarter represents a new record, exceeding the previous quarterly maximum (first quarter of CY-1964) by 4.5%.

Power Levels

Power levels at the B, D, DR and F Reactors were restricted by a bulk outlet water temperature limit of 95 C. The C Reactor power level was limited by the 95 C bulk outlet temperature during mid-month but was held below this limit both early and late in the month when the possibility of a broken spline washing downstream existed. The power level at H Reactor was held below the bulk outlet water temperature limit because of fuel element failure considerations. Power levels at the K Reactors were limited by the administrative limit of 4400 MW.

CRCLP 1

DECLASSIFIED

Efficiency

Over-all time operated efficiency was 85.6% (81.7% forecast): 87.9% at the smaller reactors and 78.8% at the K reactors. Efficiency at the smaller reactors was 6.3% higher than forecast because of exceedingly good water leak and fuel element failure experience, and a deferment of the C Reactor tube replacement and bellows foaming outage.

Ruptures

Two failed I&E natural metal fuel elements were removed from the reactors; one from DR Reactor at 57% of goal exposure and one (overbore) from C at 21% of goal exposure. The cause of the DR fuel element failure is unknown (not examined), the C failure was at the end cap.

MAINTENANCE AND EQUIPMENT EXPERIENCEWater Leaks

Two process tube leaks, at the rear Van Stone flanges, were corrected at C Reactor. Nine process tubes were installed, six at D and 3 at C Reactor.

REACTOR OUTAGESB REACTOR

<u>Date Down</u>	<u>Date Up</u>	<u>Outage Hours</u>	<u>Remarks</u>
6/16	6/19	58.3	Scheduled charge-discharge.

C-REACTOR

6/3	6/6	75.9	Scheduled charge-discharge and miscellaneous maintenance.
6/6	6/6	0.3	Unexplained Panellit trip.

DECLASSIFIED

DECLASSIFIEDC REACTOR cont'd

6/6	6/7	19.8	Shut down for the correction of a water leak. Replaced tube 2469 due to a rear Van Stone flange leak.
6/13	6/13	0.1	Unexplained Panellit trip.
6/13	6/15	23.2	Manual trip to control high tube temperature.
6/15	6/15	5.9	Removal of an overbore I&E natural metal rupture from tube 3363.
6/15	6/15	0.2	Beckman trip due to a faulty range change switch.
6/15	6/15	0.2	Manual trip due to a false indication of a fast rate of rise.

D REACTOR

6/22	6/27	115.3	Scheduled charge-discharge.
6/27	6/27	2.9	Scrammed by an unexplained Panellit trip on tube 0282.

DR REACTOR

6/1	6/2	41.6	Scheduled charge-discharge.
6/3	6/5	54.1	Removal of an I&E natural metal rupture from tube 3679.
6/30	still down		Scheduled charge-discharge.

F REACTOR

6/4	6/6	36.7	Shut down for the correction of a front face cap leak. The cap was not fully engaged. Miscellaneous maintenance.
-----	-----	------	--

Files

-4-

F REACTOR cont'd

6/6	6/6	0.3	Manually tripped due to insufficient control when spline insertion equipment failed.
-----	-----	-----	--

6/28	still down		Scheduled charge-discharge.
------	------------	--	-----------------------------

H REACTOR

6/8	6/9	27.7	Shut down for the correction of leaking front pigtail on tube 2353.
-----	-----	------	---

KE REACTOR

6/7	6/11	110.3	Tripped when a broken spline washed downstream in tube 1967. Scheduled charge-discharge.
-----	------	-------	--

6/14	6/15	33.2	Shut down for the correction of a front pigtail leak on tube 0392.
------	------	------	--

6/17	6/18	35.0	Tripped by a broken spline in tube 3370.
------	------	------	--

KW REACTOR

6/14	6/18	79.2	Tripped by a broken Panellit sensing line fitting on tube 3351. Scheduled charge-discharge.
------	------	------	---

6/19	6/19	1.5	Panellit trip caused by a broken spline in tube 5149.
------	------	-----	---

6/19	6/20	49.6	Shut down to investigate the broken spline problem.
------	------	------	---

DECLASSIFIED

DECLASSIFIEDRESEARCH AND DEVELOPMENT - EXISTING REACTORSVertical Safety Rods - Graphite Distortion

Design of a biological and thermal shield drilling machine for the 105-K reactors was initiated by the equipment vender early in June. Initial emphasis is being placed upon the biological shield enlargement equipment with contract completion scheduled for mid-December.

Procurement of the high strength graphite sleeves for the first test installation of this material at 105-C Reactor has been delayed an estimated three months by the vendor's inability to supply the specified material. The vendor has proposed substitution of a material with comparable density and strength characteristics for fabrication of the test sleeves. The vendor has been instructed to proceed with sleeve fabrication and expedite delivery of sufficient sleeves for installation in one VSR channel. Contact with the vendor has resulted in reasonable assurance that there will be no problem in fabrication and procurement of the molded graphite sleeves in place of the specified extruded graphite.

This delay in procurement of graphite sleeves precluded the enlargement and sleeving of VSR channel #41 at C Reactor scheduled for June. The enlargement effort will be re-scheduled when sleeves become available.

Replacement of Horizontal Control Rods

The problem of procuring boron carbide poison elements for 105-K reactor prototypic flexible HCR's remains unsolved. Following denial of the vendor's request for relaxation of dimensional requirements, their Technical Director visited Hanford to discuss their fabrication problems. Several minor changes in dimensions were made. Subsequently, a trial batch of poison elements was fabricated and is awaiting inspection. Scheduling of production of the required number of

SECRET

Files

Replacement of Horizontal Control Rods cont'd

poison elements will be delayed pending a determination of the acceptability of the trial batch.

The rod fabricator has voluntarily made an aluminum bar to simulate a length of poison elements in order to proceed with testing the technique for drawing the inconel sheath onto the inner assembly. Final results indicate good contact between the sheath and the "poison" over the entire area.

The General Electric Company Nuclear Materials and Propulsion Operation, Cincinnati, Ohio is making some encouraging progress in their research and development work on an uncooled HCK. Preliminary tests indicate at least four candidate materials 19-9 DL, Inconel-X, nickel, and 80-20 nickel-chromium warrant additional more extensive environmental tests.

K Reactor RTD Corrosion

Two ceramic coated RTD's installed in 105-KW in early March were removed for inspection. The ceramic coating has decomposed to a powdery, loosely adhering layer; similar effects were observed after several hundred hours in the 189-D test loop. Silicone varnish coatings tested in this loop revealed unsatisfactory resistance to the environment. Incaloy, Inconel, and Monel RTD's continue to perform satisfactorily.

K Enrichment Ring

The enrichment ring has been moved inward by two lattice units at KW Reactor, and relocation is approximately half complete at KE Reactor; loss in flattening efficiency has been less than originally calculated.

Reactor Fuels - Thoria Irradiation

The second fringe group of thoria elements have reached an equivalent exposure of 51 reactor operating days, 43% of goal in F Reactor. Discharge is scheduled for September 20, 1964.

~~SECRET~~

DECLASSIFIED

DECLASSIFIEDReactor Fuels - Thoria Irradiation cont'd

The two tons fabricated for charging into KE Reactor will probably be charged during the month of July.

Depleted Uranium Irradiations

About 12 tons of depleted uranium is expected to be charged in early July in B Reactor. The delay from the original schedule is due to changes in available reactivity control.

The irradiation of the second batch of depleted elements now being canned will be scheduled to utilize the enriched metal charged for the thoria irradiation. Irradiation of the depleted elements should begin in K in August.

Longer Fuel Cores

The 20 fuel columns of ten-inch enriched uranium elements charged into D Reactor during the April 22, 1964, outage are now estimated to have an average exposure of 660 MWD/T. Six of these columns will be discharged during the next outage and the remaining columns will be held to goal exposures of 800 or 1000 MWD/T.

Downcomer Studies

Water - level indicating instrumentation was installed on the top two trays of the B Reactor downcomer. The upper instrument was calibrated at increasing cold reactor flow rates and then used to measure the flow during equilibrium operating conditions. No excessive water level elevation in the downcomer was found.

Effluent Activity Data

The table below shows the average concentrations of selected radio-nuclides from reactor effluent water samples taken during May 1964. All units are 10^{-12} curies/ml.

<u>Reactor</u>	<u>As-76</u>	<u>P-32</u>	<u>Zn-65</u>	<u>Cr-51</u>	<u>Np-239</u>
B	140	4.7	11	260	240
C	190	11.8	22	850	340
D	130	9.7	19	360	220
DR	130	11.5	19	750	390
F	140	15.9	20	450	330
H	75	16.0	16	410	220
KE	35	9.2	10	120	50
KW	40	9.5	11	150	70

The only significant changes in the treatment of reactor coolant were changes in pH at DR and H, increasing from pH 6.6 to 7.0 on May 19, 1964.

- KER-1 - Testing of eight 12-inch KSE5 fuel elements and a thermocouple train assembly continued. Two eight-inch coupon holders were added to the existing charge on June 8. The objective of the test is to evaluation of the swelling behaviour of Zr-clad, thick-walled enriched uranium tubular elements at elevated uranium temperature. The loop was on low temperature and pressure operation from May 30 until June 7 because of a leak in the primary heat exchanger.
- KER-2 - Testing of eight 12-inch KSE5 fuel elements was completed with a June 8 discharge. The loop was charged with five NIE1 fuel tubes and three target elements containing isotopes as authorized by PT-IP-584, Sup.B. The test objective is information on irradiations of natural lithium-bearing materials and samples for production and extraction information.
- KER-3 - Testing of thirteen 26-inch co-producer elements as authorized by PT-IP-645 was completed and the elements discharged on June 8. The loop was left empty.

DECLASSIFIED

DECLASSIFIED

Files

-9-

KER-4 - Testing of Zr-2 clad thorium-uranium crud monitor and ten 23-inch NAE1 fuel elements as authorized by PT-IP-644 and PT-IP-477 continued with the loop on single-pass operation. The objective of this test is to demonstrate and evaluate the design of the proposed N Reactor fuel surface crud monitor.

REACTOR DEACTIVATION

The General Electric Company deactivation group, 8 people, continued the scope planning for the shutdown of three reactors. The planning has been adjusted in the direction of a minimum cost program which will incorporate local use of installed equipment from DR, H and F to the greatest extent possible and sale on an "as is-where is" basis for practically all of the remaining equipment not utilized at Hanford. Equipment preservation work is consequently very nearly eliminated including much of the work previously contemplated for the standby reactor. This approach will reduce shutdown costs but will considerably increase startup costs if the standby reactor is reactivated. Along with the revised planning for equipment disposal, plans have been revised to incorporate only a minimum amount of decontamination and cleanup work. This approach will reduce shutdown costs but might require future decontamination and cleanup work should circumstances require access into certain areas.

(Year)
OUTAGES (1964)

<u>Reason</u>	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	43.1	50.6	65.2	47.3	44.3	0	101.4	104.6	456.5
Maintenance	9.7	10.4	34.2	23.0	28.6	20.0	16.7	17.2	159.8
Rupture Removal	0.5			14.7					15.2
Leak Testing		16.4							16.4
Tube Replacement		9.4		0.5	10.3				20.2
Project Work							17.3		17.3
Production Tests	5.0	11.1	14.4		4.0		10.4	4.7	49.6
Instrument & Circuitry		38.9	1.5		7.4	7.8	1.6	1.6	58.8
Rupture Suspects									
Miscellaneous		0.9	2.9		2.1		26.2	3.2	35.3
Total	58.3	137.7	118.2	85.5	96.7	27.8	173.6	131.3	829.1
Scheduled Outages									
Unscheduled Outages									

DECLASSIFIED
SECRET

JUNE 1964

14-00000

UNITED STATES GOVERNMENT

Memorandum

TO : Files

DATE: August 14, 1964

FROM : R. L. Plum, Chief
Production Reactor Operations Branch

THIS DOCUMENT CONSISTS OF 10 PAGES

SUBJECT: MONTHLY REPORT - JULY, 1964

OR:GTO-RGR-JPT

HAN-87470
Report #7

OPERATING EXPERIENCE

Production

Reactor input plutonium production for July was 480.7 KMWD's (107.3% forecast): 253.4 KMWD's (104.3% forecast) at the six smaller reactors and 227.3 (110.8% forecast) at the two K reactors.

Power Levels

Power levels at all reactors were restricted by a bulk outlet water temperature limit of 95°C during the major portion of the month.

Efficiency

Overall time operated efficiency was 78.0% (78.6% forecast): 75.4% at the smaller reactors and 86.0% at the K reactors.

Ruptures

Five failed I&E fuel elements were removed from the reactors: three of enriched uranium and two of natural uranium. The two natural uranium failures at DR and C (overbore at C) were at 62% and 80% of goal exposure, respectively. The three enriched failures at F, KW and DR failed at 68%, 79% and 120% of goal exposure. All of the failures, except the overbore at C, were stuck in the process tubes. The removal of the enriched failure at DR required pushing forces up to 20,000 pounds after backseating and removing the tube ribs.

DECLASSIFIED

August 14, 1964

MAINTENANCE AND EQUIPMENT EXPERIENCESWater Leaks

One process tube leak at the rear Van Stone flange was corrected at D Reactor.

Tube Replacement

Forty-eight process tubes were installed: 43 at C, three at B, one at D and one at DR. One of the tubes replaced at C was an oversized zirconium tube.

REACTOR OUTAGES

<u>Date</u> <u>Down</u>	<u>Date</u> <u>Up</u>	<u>Outage</u> <u>Hours</u>	<u>Remarks</u>
<u>B Reactor</u>			
7/18	7/29	257.6	Scheduled outage for charge-discharge. Miscellaneous maintenance.
7/29	7/29	0.7	Panellit trip due to a leaking toggle valve.
<u>C Reactor</u>			
7/9	7/28	442.4	Scheduled charge-discharge, tube replacement and foaming of rear-face bellows.
7/31	Still down		Removal of an overbore rupture from tube 1459.
<u>D Reactor</u>			
7/5	7/6	25.7	Unexplained Panellit trip on gauge 0969. Replaced tube 1257 due to a rear Van Stone leak.
<u>DR Reactor</u>			
6/30	7/2	69.5	Scheduled charge-discharge.
7/2	7/2	1.2	Corrected a faulty thermocouple on tube 2472.
7/13	7/15	36.4	Stuck I&E natural metal rupture in tube 3160.

DECLASSIFIED

DECLASSIFIED

Files

- 3 -

August 14, 1964

DR Reactor (cont'd.)

7/31 Still down Removal of a stuck I&E enriched rupture
from tube 1858.

F Reactor

6/28	7/1	69.5	Scheduled charge-discharge.
7/1	7/1	2.5	Correction of a rear cap leak on tube 2164.
7/4	7/5	34.1	Unexplained Panellit trip on gauge 4073.
7/18	7/19	37.3	Removal of a stuck I&E enriched metal rupture from tube 4174.

H Reactor

7/5	7/12	171.6	Scheduled (block) charge-discharge.
7/13	7/13	9.9	Poison discharge.

KE Reactor

7/12	7/15	76.1	Scheduled charge-discharge.
------	------	------	-----------------------------

KW Reactor

7/2	7/4	41.5	Removal of an I&E enriched metal rupture from tube 4755.
-----	-----	------	---

RESEARCH AND DEVELOPMENT - EXISTING REACTORS

Thoria Irradiation

During the July 12 outage of KE Reactor thorium oxide was charged into 29 central-zone process tubes. The E-Q tube ratio was 5.8. The two tons of thoria involved are scheduled for 35 full-reactor-power operating days irradiation with an expected yield of about 940 gm U-233 per ton of thorium with 5 ppm U-232. A preliminary analysis of operating conditions indicates that the enriched uranium columns supporting the irradiation are operating around 1725 KW, or about 8% higher than the adjacent natural uranium. A coolant temperature rise of approximately 11°C is being observed on the process tubes containing the thoria elements.

August 14, 1964

Thoria Irradiation (cont'd.)

This thoria irradiation plan has been combined with a depleted uranium irradiation to form a "back-to-back" exposure scheme. Therefore, the enriched uranium for this plan will also be used in the forthcoming depleted uranium irradiation, thus negating the necessity of dividing the thoria irradiation into two parts.

Depleted Uranium Irradiations

K Reactor - The "back-to-back" irradiation scheme adopted for the thoria and depleted test at the K reactors will delay about five weeks the loading of the depleted uranium elements. As the K-reactor irradiation program actually requires less in-reactor time than the smaller reactor plan, essentially no time will be lost. About 85 depleted uranium columns will be loaded into central zone process tubes of KE reactor during the mid-August outage.

B Reactor - The depleted uranium fuel columns for irradiation in central zone process tubes of B reactor were charged during the July 18 outage. Of the 104 depleted columns of the test, 28 columns will be charged during the next reactor outage to minimize sub-goal natural uranium discharge. Goal exposure for the depleted elements, to meet the 18% Pu-240 specifications, is 1400 MWD/T. The elements are expected to achieve the exposure by June, 1965.

Longer Fuel Cores

Fifteen fuel columns containing 10-inch enriched uranium elements were discharged from D reactor on June 22 at an average exposure of 730 MWD/T. No difficulties were encountered during discharge. The five remaining fuel columns of the test will be irradiated to an exposure of 1000 MWD/T.

Reactor Engineering

During the recent C outage 16 VSR channels were visually examined and measured. Data from these measurements will be available for analysis in several weeks. In addition to the VSR channel inspection, a horizontal rod channel and a test hole were also examined. Measurement of the filler block length and the test hole confirmed that the contraction along the axis of the filler block is progressing at approximately double the rate of the contraction perpendicular

~~RECLASSIFIED~~

DECLASSIFIED

Files

- 5 -

August 14, 1964

Reactor Engineering (cont'd)

to the axis of the blocks. Inspection of the VSR channels at C reactor revealed the same basic distortion pattern as the K reactors. The most severely distorted channels are on the near and far sides of the reactor.

Li-Al Splines

Contractual arrangements are being completed with Nuclear Metals Division of Textron to develop fabrication techniques for making aluminum clad lithium-aluminum splines. The contract will cover the development of a coextrusion process for the cladding of the lithium aluminum, and investigation of the effect of the lithium content on the capability to fabricate, and will provide about 24 splines for evaluation and reactor testing at Hanford. This work is scheduled for completion by the end of CY-1964 and will be designated as D-DR 186.

Process Water Tanks - 190 C

A final report was received from Dr. E. R. Parksen, of the University of California, on the results of his inspection of reactor process water piping and storage tanks. This report indicated that the 190-C process water tanks were particularly susceptible to brittle fracture failure. The conditions required for brittle fracture failure, including stress levels, temperature, material specifications and improper welding, were found to exist in the 190-C tanks. A hazards analysis reviewing the reactor safety implications of a sudden tank failure has been completed. The major reactor safety implication of this review is the need for early corrective action to minimize the tank failure probability.

Process Piping System Studies

Approximately fifty metallurgical specimens, representative of materials used in process piping in 105-B and C, and in 190-B and C, have been subjected to a Charpy impact test. Evaluation of test results has revealed further evidence that material in certain of the process and high-tank lines possesses a relatively low resistance to brittle fracture. Radiographic examination of some of the process pump discharge line welds is in progress. Evidence of cavitation in the bypass lines has been slight and is not considered serious.

August 14, 1964

Effluent Activity Data

The table below shows the average concentrations of selected radionuclides from reactor effluent water samples taken during June, 1964. All units are 10^{-12} curies/ml.

<u>Reactor</u>	<u>As-76</u>	<u>P-32</u>	<u>Zn-65</u>	<u>Cr-51</u>	<u>Np-239</u>
B	125	2.4	5	230	220
C	195	8.6	15	860	280
D	125	10.1	15	430	200
DR	89	8.1	43	930	290
F	110	7.3	17	350	250
H	107	10.0	11	420	210
KE	29	6.2	5	120	45
KW	41	7.4	6	140	60

The only significant change made in treatment of reactor coolant during June, 1964 was at 100-D. Under provisions of PT-IP-634-A, the near side coolant continued at pH 6.3 until June 24, when the test was terminated. At month's end coolant at DR and H was at pH 7.0, and at all other reactors was at pH 6.6.

Dose Alarm Device

A personnel warning dosimeter was received from the AECL Chalk River, Canada, installation. It is a well-designed unit and appears to be applicable to IPD monitoring needs. The device, when in a radiation field, signals with a chirping sound that increases in frequency as the radiation intensity increases. This sound is of low intensity and not objectionable to the wearer. It alarms at a pre-determined dose with loud, high pitched sound that cannot be ignored. The entire system is a solid state electronic design.

Preliminary tests conducted with a known value source indicate good reproducibility for the dose required to trip the alarm.

DECLASSIFIED

DECLASSIFIED

August 14, 1964

Confinement Filter Efficiency Testing

A condensation nuclei counter was purchased to measure the efficiency of the confinement filter. The counter, when received, was set up to sample normal exhaust air before and after filtration at D reactor. It counted about 20,000 particles per cc in unfiltered exhaust air and 15-35 particles per cc after filtration. This 10^3 reduction measurement is indicative of filter efficiency. The counter was turned over to Industrial Hygiene to be calibrated. When returned, in-line tests within the reactor exhaust system will be conducted while particles of known size are generated.

Neptunium Production

The test to determine experimentally the conversion of uranium-236 to neptunium-237 continued with the loading of 12 columns of fuel into the H reactor. Spectrographic analyses of the uranium-236 in the pre-irradiated uranium were made by both Hanford Laboratories and Chemical Processing Department with good agreement.

E-Q Hazards Summary Report

A Hazards Summary Report Supplement is being prepared for the full-reactor E-Q load and is scheduled for issuance in September. The analysis has shown that the safety of the operation will be basically unchanged from that with current loads. Some minor modification in procedures and limits will be required because of changes in lattice parameters. The principal procedural change will be directed toward reducing the probability of nuclear accidents associated with a loading error to a vanishingly small point. Such increased emphasis is required because of the accident potential from an unpoisoned block of enriched fuel.

KER-Loop Operation

KER-1 - Testing of eight 12-inch KSE5 fuel elements and a thermocouple train assembly, and two eight-inch coupon holders continued. The objective of this test is to evaluate the swelling behavior of Zr-2 clad thick-walled enriched uranium tubular elements at elevated uranium temperatures.

August 14, 1964

KER-Loop Operation (cont'd.)

KER-2 - The testing of five NIEL fuel tubes and three target elements containing natural lithium bearing materials was completed with the discharge of elements on July 12. The loop was left empty and layaway procedure has been initiated.

KER-3 - Loop empty and in layaway status.

KER-4 - The testing of Zr-2 clad thorium-uranium crud monitor and ten 23-inch NAE1 fuel elements was completed with the discharge of the elements on July 12. The loop was left empty.

Vertical Safety Rods - Graphite Distortion

The design of the 105-K biological shield boring machine has been completed by the vendor. Design and fabrication of the various pieces of equipment required for enlargement of VSR channels at the K reactors are continuing. The redesign of the C reactor thermal shield boring machine for use at the K reactors is 60% complete and shop fabrication has been initiated.

REACTOR DEACTIVATION

The General Electric Company deactivation group, eight people, continued with scoping revisions to minimize shutdown work and cost. The estimate has been reduced, with further reductions under consideration. Agreement was reached that power would be supplied to F and H by means of the 13.8 KV line after shutdown. Consequently, F and H can be removed from the 230 KV line and the F and H 230 KV substation equipment will not have to be kept in operation. To accomplish this the 13.8 KV line will have to be extended to F area from White Bluffs at a cost of about \$20,000. The coolant backup modification project proposal was transmitted to Headquarters on July 6. Authorization of funds had not been received at month's end.

DECLASSIFIED

RUPTURED SLUG TABULATION FOR July, 1964

Tube No.	Date Charged	Date Ruptured	Tube Power (KW)	Concentration MWD/Ton	Assigned Production Loss		Observations
					MWD	Days	
1755 KW	5-11-64	7-2-64	1855	630	2166	.51	I&E-E Side Hot Spot
3160 DR	6-1-64	7-13-64	1146	356	1194	.68	I&E-E Side Hot Spot
4174 F	6-4-64	7-18-64	1139	445	773	.44	I&E-E Side Hot Spot
1459 C	4-28-64	7-31-64	1011	477	436	.21	I&E NO End Unclassified
1858 DR	5-2-64	7-31-64	1162	965	6454	3.66	I&E-E Side Unclassified

DECLASSIFIED

(Year)
OUTAGES (7/64)

Reason	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	40.8	90.0	1.1	31.6	15.7	130.8	40.8	82.2	433.0
Maintenance	32.1	203.3	15.3	26.1	50.8	18.6	5.5	8.0	359.9
Rupture Removal		4.0		23.0	8.4			10.7	46.1
Leak Testing			11.6					3.0	14.6
Tube Replacement	11.4	106.7		3.0		19.3			140.4
Project Work	81.1		6.3						87.4
Production Tests	63.3		0.6		6.4	12.8	29.1	28.9	141.1
Standard Check INTERFEROMETER	5.6	17.1	3.4	1.2			0.7		28.0
Rupture Suspects									
Miscellaneous	24.0	32.2	0.7		2.0				58.9
Total	258.3	453.3	39.0	84.9	83.3	181.5	76.1	132.8	1309.2
Scheduled Outages									
Unscheduled Outages									

Standard Check
~~INTERFEROMETER~~

DECLASSIFIED

UNITED STATES GOVERNMENT

Memorandum

DECLASSIFIED

TO : Files

DATE: September 18, 1964

FROM : R. L. Plum, Chief
Production Reactor Operations Branch

This document consists of 10 pages

SUBJECT: MONTHLY REPORT - AUGUST 1964

HAN-87470
Report #8

OR:GTO:RGR

OPERATING EXPERIENCE

Production

Reactor input plutonium production for August was 474.9 KMWD's (106.0% forecast: 291.8 KMWD's (108.4% forecast) at the six smaller reactors and 183.1 KMWD's (102.3% forecast) at the two K reactors.

Efficiency

Over-all time operated efficiency was 83.9% (83.6% forecast): 88.3% at the six smaller reactors and 70.8% at the two K reactors. The H Reactor achieved a 100% time operated efficiency during August.

Power Levels

Power levels at all reactors except B were restricted by a bulk outlet water temperature limit of 95°C during the month. The B Reactor power level was restricted by trip-after-instability limits resulting from a flux distortion associated with the recent loading of depleted metal.

Ruptures

Four failed I&E fuel elements were removed from the reactors: three of natural uranium and one of enriched uranium. Two of the natural metal failures, at B Reactor, were side-hot-spot failures at 80% and 84% of goal exposure. The other natural metal failure was at DR and failed at 10% of goal exposure because of mechanical damage. The enriched failure, bumpered at F, was a hole defect failure at 51% of goal exposure.

GROUP 1

DECLASSIFIED

RESTRICTED DATA

Disclosure of its contents in any manner to an unauthorized person is prohibited.

September 18, 1964

MAINTENANCE AND EQUIPMENT EXPERIENCE

Water Leaks

There were no Van Stone flange or internal tube water leaks during August, the first leak-free month since June 1954.

Tube Replacement

Three process tubes were installed: two at B and one at D.

RESEARCH AND DEVELOPMENT - EXISTING REACTORS

Thoria Irradiations

The irradiation of two tons of thoria target elements at the KE Reactor has been completed, with the elements being discharged during the August 19, 1964, reactor outage after an irradiation equivalent to 33 operating days at full reactor power. One thoria target column of the test will remain in the reactor for an irradiation of approximately six months, to evaluate target element performance.

Discharge near the end of August 1964 of the two tons of thoria elements from fringe zone tubes in F Reactor will complete the irradiation of the six-ton demonstration test. Two tons of thoria elements were previously irradiated and discharged from central zone process tubes of the F Reactor.

The analytical results of one of the elements from the F Reactor thoria test have been rechecked, and the yield for the fourteenth element of tube 1576 (16.5 day irradiation) is between 540 and 590 g/ton thoria and the U-232 ppm is between .83 and .95. The reported concentration is about 30% low compared to the expected 1.3 ppm. At present, no reason is known for this difference. The 1.3 ppm was based on data obtained from an earlier smaller-scale test irradiation at F Reactor. The lower concentration does agree better with a pure theoretical value, which makes earlier calculations look better.

Depleted Uranium

B Reactor - During the July 18, 1964, outage at B Reactor, 76 columns of depleted uranium elements were charged into central zone process tubes. About 225 enriched uranium fuel elements were charged to support the irradiation. A total of 104 depleted

DECLASSIFIED

~~SECRET~~

-3-

Septemb. 18, 1964

uranium fuel columns will be irradiated under the program. The 28 additional columns of depleted elements are to be charged during a near-future outage as the staggered charging schedule minimizes discharge of subgoal natural uranium fuel elements.

The depleted fuel columns are now operating at about 460 KW or at about 38% of the adjacent enriched uranium fuel column powers. The depleted columns are to be irradiated to exposures of 1400 MWD/T in order to meet the 18 per cent Pu-240 requirement. Exposures have reached about 85 MWD/T, to date.

K Reactors - Ninety columns of depleted uranium elements were charged into the KE Reactor during the August 19, 1964 outage. This loading is the second part of a "back-to-back" irradiation plan which permits use of enriched uranium fuel columns first for support of a two-ton thorium loading and then for support of the depleted uranium irradiation. Goal exposures for the depleted uranium elements is 1600 MWD/T, to provide the 18 W/O Pu-240 concentration. The elements are expected to achieve this exposure during May 1965.

Longer Fuel Cores

The five remaining columns of a test involving ten-inch enriched uranium elements were discharged from the D Reactor during the August 9, 1964, outage. At the time of discharge, these five fuel columns had exposures of about 1200 MWD/T. No difficulties were encountered in discharging the fuel columns. Fifteen additional fuel columns of the test were previously discharged at exposures averaging 730 MWD/T. All fuel columns of the test are now being examined in the 105 C Fuel Examination Facility.

Moderator Stacks

An analysis of C stack distortion data from VSR Channels, process tube channels, and test holes is in progress to define present and projected stack distortion, and to characterize the distortion and distortion mechanisms which will influence future rod and Ball-3X problems. The sixteen VSR channels which have been measured and photographed to date indicate essentially the same basic distortion pattern observed at the K Reactors. The greatest distortion (and consequently the most severe rod entry problems) occurs at the extreme near and far sides of the stack. These channels are displaced inward from their original position approximately two inches. This inward movement, coupled with no movement of the top portion of the channels, results in the formation of several slippage planes in each channel which partially close off the channel opening at the slippage plane.

~~SECRET~~

September 18, 1964

Observations have been made in the front and rear bank of VSR channels at C Reactor which show sizeable front to rear separations in the filler layers in these banks capable of trapping 3X Balls in the event of a ball drop. Separations of approximately one inch have been seen over a length of about one-third of the channels examined in these banks. The total quantity of balls which would become lost in the stack has not been estimated.

Vertical Safety Rods - Graphite Distortion

Design and fabrication of the various pieces of equipment required for enlargement of VSR channels at the K Reactor are continuing.

A graphite mockup to represent the upper 17 layers of graphite in a K Reactor VSR Channel has been designed and the structural steel portion fabricated. It will be used in conjunction with the biological shield mockup for boring and reaming preliminary testing of shield cutting equipment.

Test quantities of high strength graphite VSR channel sleeves for 100 K have been ordered from Great Lakes Carbon Corporation. Delivery is indicated for mid-November 1964. These sleeves will be evaluated by off-reactor tests and also on a one channel in-reactor test basis.

Difficulties in the procurement of graphite sleeves for 105-C VSR channels have been resolved. Sleeves for channel #41 have been promised for final inspection early in September.

Oxygen Limits at Startup

A test to examine the effects of allowing higher concentration of air in the reactor gas at startup was conducted during a recent startup at F Reactor. The present limit of one percent oxygen in the reactor gas was relaxed to five per cent. During the start-up the actual oxygen concentration was measured at 2.65 per cent. The helium loss at startup, which normally ranges from 10,000 to 15,000 cubic feet, was reduced to about 7,500 cubic feet. The rate of graphite temperature increase during the startup indicates that the increased limit may be acceptable however, removal and examination of the oxidation monitoring samples will be necessary before this can be confirmed. During the startup, front face air contamination was quite high as a result of the test, and front elevator crews were on fresh air during splining. This by itself may fix the limit of permissible air concentration in the gas during startup.

DECLASSIFIED

DECLASSIFIED 5-

September 18, 1964

Replacement of Horizontal Control Rods

The supplier of boron carbide poison elements for prototype flexible HCR's is still having difficulty in producing satisfactory elements. Modified casting techniques are being employed in an effort to eliminate the difficulties. Attempts to place a second order for the boron carbide elements with a different company have continued without success.

Process Piping System Studies

Sampling to determine resistance of piping materials to brittle fracture has continued in 105 and 190 B and 105 and 190 C. In addition, three samples were removed from the 190 C tanks to determine the brittle fracture condition of these tanks.

Operational Physics

Assigned Pile Physicists are now providing on-site startup coverage for the first two shifts of reactor operations following a startup. Non-cold startup procedures have been discontinued at all reactors; instead, the more conservative procedures required for cold startups are now used on all startups. These steps are part of a Manufacturing - R&E agreement to increase plant assistance coverage during the reactor cutbacks and contractor transition period.

KER LOOP OPERATION

KER-1 - Testing of eight 12-inch KSE5 fuel elements, a thermocouple train assembly, and two 8-inch coupon holders was completed with the discharge of the loading on August 20. The loop will be charged with three NIE1 fuel elements, two lithium-aluminum target elements, and front and rear crud probes. The objectives of this test are to evaluate the crud forming characteristics of loop coolant containing ammonium hydroxide for pH control and to provide lithium-aluminum samples which can be used to determine production and extraction information.

KER-3 - Tube was charged August 20 with carbon steel spacers and flux dosimeters to determine the thermal and fast neutron flux levels in KER-3. Flux level measurements are required in order to accurately predict the heat generation of the rod cluster experiment requested by the Atomics International Division of North American Aviation, Inc.

DECLASSIFIED

September 18, 1964

Effluent Activity Data

The table below shows the average concentrations of five radionuclides from reactor effluent samples taken in July 1964. All units are 10⁻¹² curies/ml.

REACTOR	As-76	P-32	Zn-65	Cr-51	Np-239
B	84	2.2	7	220	160
C	132	7.2	12	610	160
D	83	7.6	7	300	130
DR	79	4.2	8	400	150
F	67	3.1	11	250	130
H	70	7.2	6	240	110
KE	25	4.0	6	110	40
KW	32	5.8	4	120	50

There were no significant changes made in reactor coolant treatment during July 1964.

REACTOR DEACTIVATION

Project Proposal AEC-186 was issued on August 6, for equipment for reactor deactivation. A directive was issued on August 13, authorizing \$58,000 for Title I and II design. A work authority was issued to Vitro Engineering on August 20 authorizing them to proceed with design work. Preparation of specifications for the package boilers was started.

Project Proposal AEC-187 was issued on August 17, for plant modification work necessary for reactor shutdown. The proposal was approved on August 27, and the directive authorizing design was in process of approval at month's end.

• Authorization of funds for design and modification work for reactor coolant backup has not yet been received from Headquarters.

The General Electric Company deactivation group continued with their study work looking toward a reduction of shutdown costs. The extent of decontamination work is being reviewed as well as possible means of reducing the boiler and water plant operation after shutdown.

REACTOR OUTAGES

DATE DOWN	DATE UP	OUTAGES HOURS	REMARKS
B REACTOR			
8/16	8/18	37.2	Removal of an I&E natural metal rupture from tube 0863.
8/23	8/25	53.5	Removal of an I&E natural metal rupture from tube 3976. charge-discharge and tube replacement.

DECLASSIFIED

~~SECRET~~
DECLASSIFIED

September 18, 1964

8/26	8/28	35.2	Down for temperature control on two process tubes. Charge-discharge and miscellaneous maintenance.
C REACTOR			
7/31	8/2	36.4	Removal of an overbore rupture from tube 1459.
8/4	8/5	33.7	Unexplained Panellit trip on tube 1271.
8/5	8/5	2.7	Faulty thermocouple on tube 3162.
8/7	8/9	42.3	Panellit trip on overbore tube 4472. Charge-discharge and miscellaneous maintenance.
D REACTOR			
8/9	8/12	67.3	Charge-discharge and installation of 0.244 venturis.
DR REACTOR			
7/31	8/6	136.0	Removal of an I&E enriched metal rupture from tube 1858. Charge-discharge and miscellaneous maintenance.
8/11	8/13	35.6	Removal of an I&E natural metal rupture from tube 1583.
F REACTOR			
8/5	8/7	58.0	Charge-discharge.
8/31	Still down		Removal of an I&E enriched metal rupture from tube 0788.
H REACTOR			
No outages			
KE REACTOR			
8/19	Still down		Charge-discharge and maintenance. Gamma Monitoring Systems Improvement CGI-998, and Front and rear face hardware standardization.

~~SECRET~~
Files

-8-

September 18 1964

KW REACTOR

8/14	8/15	37.8	Unexplained Panellit trip on tube 0750.
8/26	8/28	64.7	Charge-discharge.
8/30	8/31	32.4	Broken spline in tube 5358.

DECLASSIFIED

~~SECRET~~

(Year)
OUTAGES (8-64)

DECLASSIFIED

<u>Reason</u>	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	13.2	13.6	21.5	31.7	37.2		62.3	66.4	245.9
Maintenance	15.4	82.7	23.4	44.4	14.9			57.6	238.4
Rupture Removal	46.1	0.7		86.7	5.0				138.5
Leak Testing									
Tube Replacement							42.8	0.9	43.7
Project Work	14.4						152.2		166.6
Production Tests	34.6		2.3		4.9		17.1	6.4	65.3
XXXXXXXXXXXXXXXXXXXX Instrument & Circuitry Standard Check	1.5	3.3	20.1		1.0				25.9
Rupture Suspects									
Miscellaneous	0.7	3.9					25.6	3.6	33.8
Total	125.9	104.2	67.3	162.8	63.0	0	300.0	134.9	958.1
Scheduled Outages									
Unscheduled Outages									

DECLASSIFICATION

01

UNITED STATES GOVERNMENT

Memorandum

TO : Files

DATE: October 16, 1964

FROM : R. L. Plum, Chief
Production Reactor Operations Branch

SUBJECT: MONTHLY REPORT - SEPTEMBER 1964

HAN-87470
Report #9

OR:RGR:GTO:JPT

This document consists of 10 pages.

OPERATING EXPERIENCE

Production

Reactor input plutonium production for September was 457.9 KMWD's (109.0% forecast): 258.9 KMWD's (105.3% forecast) at the six smaller reactors and 198.9 (114.3% forecast) at the two K Reactors.

Efficiency

Over-all time operated efficiency was 81.4% (79.4% forecast): 82.3% at the six smaller reactors and 78.9% at the K Reactors. A high time operated efficiency at KW Reactor, 95.3%, was offset by 8.5 days of outage time at KE for scheduled work. The H Reactor concluded 68.7 days of continuous operation on September 20. This established a new record for a Hanford reactor, exceeding the previous record of 60.6 days also held by H Reactor.

Power Levels

Power levels at all reactors except B were restricted by a bulk outlet water temperature limit of 95°C. The B Reactor power level was restricted largely by trip-after-instability limits on enriched tubes supporting the depleted uranium load and periodically by the graphite temperature limit.

Ruptures

Six failed I&E fuel elements were removed from the reactors: three of natural uranium and three (bumpered) of enriched uranium. The three natural metal failures, two at B and one at DR were side hot spot failures at 70, 97 and 102% of goal exposure. Two of the enriched failures, at H Reactor, were hole defect failures at 83 and 92% of goal exposure. The third enriched failure, at DR Reactor, was at 119% of goal exposure. The failed element was not found and the type failure was classified as "unknown".

DECLASSIFIED

GROUP 1

EXCLUDED FROM AUTOMATIC DOWNGRADING

SECRET

MAINTENANCE AND EQUIPMENT EXPERIENCESTube Leaks

One process tube leak, at the rear Van Stone flange, was corrected at DR.

Tube Replacement

Four new process tubes were installed: two at DR and one each at B and D.

REACTOR OUTAGES

<u>DATE</u> <u>DOWN</u>	<u>DATE</u> <u>UP</u>	<u>OUTAGES</u> <u>HOURS</u>	<u>REMARKS</u>
<u>B REACTOR</u>			
9/2	9/5	76.8	Removal of an I&E natural metal rupture from tube 3880. Charge-discharge
9/18	9/21	72.1	Removal of an I&E natural metal rupture from tube 3566. Charge-discharge and miscellaneous maintenance.
<u>C REACTOR</u>			
9/1	9/5	96.2	Down for charge-discharge and maintenance.
9/5	9/5	2.2	Down due to faulty thermocouple on tube 0175.
9/21	9/23	48.1	Scrammed due to an unexplained Panellit trip on tube 3265. Miscellaneous maintenance.
<u>D REACTOR</u>			
9/7	9/10	91.7	Down for scheduled charge-discharge.
9/10	9/10	1.1	Down to correct a rear face cap leak.
<u>DR REACTOR</u>			
9/10	9/13	71.3	Removal of an I&E natural metal rupture from tube 2362. Charge-discharge. Replaced tube 4374 due to a sheared rear Van Stone flange.

DECLASSIFIED

DECLASSIFIED

Files

-3-

October 16, 1964

DR REACTOR Cont'd

9/13	9/13	0.4	Down due to a Panellit trip caused by faulty row relay.
9/26	9/27	36.2	Removal of an I&E enriched metal rupture from tube 0868.

F REACTOR

8/31	9/2	35.5	Removal of an I&E enriched metal rupture from tube 0788.
9/2	9/2	3.5	Down due to an unexplained Panellit trip.
9/9	9/11	46.3	Down for scheduled charge-discharge.
9/11	9/12	3.2	Scrammed for temperature control.
9/12	9/12	13.1	Down to correct a front face cap leak on tube 3170.

H REACTOR

9/20	9/21	26.1	Reactor scrambled by a high pressure Panellit trip caused by an I&E enriched metal rupture in tube 3261.
9/21	9/21	1.4	Scram due to a Panellit trip.
9/21	9/21	2.2	Scram due to insufficient control for turnaround.
9/22	9/27	164.7	Discharge of E-N load. Removal of an I&E enriched metal rupture in tube 2378. Charge-discharge.
9/28	9/28	1.3	Down due to no flow from No. 37 cross-header to near sample room.
9/30	still down		Down due to insufficient reactivity.

KE REACTOR

8/19	9/9	505.8	Charge and maintenance, and hardware standardization work.
9/9	9/9	0.4	Down due to an unexplained Panellit trip on tube 4568.

Files

-4-

October 16, 1964

KE REACTOR Cont'd

9/11	9/12	29.3	Scram due to the rupture of the cooper sensing line to the flow orifice on a 1706 KE single pass tube.
9/15	9/17	35.2	Scram due to a ruptured Panellit sensing line on 1706 KE single pass tube no. 3050.

KW REACTOR

9/29	still down	Down due to a Panellit trip caused by a broken spline in tube 3561. Charge-discharge and maintenance.
------	------------	---

RESEARCH AND DEVELOPMENT - EXISTING REACTORS

R&EO

Clean U-233

U-233 yields and U-232 contaminant build-up have been computed as functions of exposure for the various reactors. Typical examples are shown in the following table and have an estimate accuracy of -5 per cent and +15 per cent.

K CORE

(Supporting E-Metal - Tube Power Assumed to be 1900 KW)

Irradiation Time Days	Exposure MWD/T	gm U-233/ ton ThO ₂	ppm U-233	%Pa - 233
10	136	278	1.2	88.5
40	543	1098	5.0	63.8
70	950	1881	9.4	48.5

K FRINGE (845 KW)

90	573	608	1.4	40.0
130	827	864	2.3	30.0
170	1081	1121	3.5	24.0

B FRINGE (650 KW)

90	509	608	1.0	40.0
140	791	929	1.8	28.0
180	1017	1184	2.5	22.0

DECLASSIFIED

DECLASSIFIED

files

-5-

October 16, 1964

Irradiation Time	Exposure gm U-233/ MWD/T	Ton ThO ₂ ppm U-233 C RRINGE (750 KW)	%Pa-233
Days			

90	593	701	1.2	40.0
120	791	928	1.8	32.0
150	990	1148	2.5	26.0

PROCESS TECHNOLOGY

Thoria Irradiations

A schedule for irradiation of thoria for the production of 110 kg. of U-233 has been prepared. The schedule calls for irradiation of thoria in the fringe zones of KW, D, B, C, and KE Reactors, with the KW irradiations to begin in early October 1964. In addition, use of the central zone of KW Reactor is scheduled with this portion of the irradiation beginning in December 1964, subject to safety approvals.

Depleted Uranium

B Reactor - A total of 104 columns of depleted (0.22 w/o U-235) uranium fuel elements are now under irradiation in central zone process tubes of B Reactor. These columns are a portion of the over-all irradiation plan to produce 25 kg. of plutonium with an 18 per cent Pu-240 content. The depleted elements have accumulated an exposure of approximately 160 MWD/T, with their goal exposure being 1400 MWD/T. Discharge of the fuel elements at goal exposure is expected during May 1965.

KE Reactor - Ninety columns of depleted uranium (0.22 w/o U-235) elements are currently under irradiation in central zone process tubes of KE Reactor. The depleted fuel columns have accumulated an exposure of approximately 60 MWD/T, with goal exposure for these columns being 1600 MWD/T. Discharge of this test at goal exposure is expected by June 1965. This irradiation combined with the irradiation in B Reactor involves a total of 22 tons of depleted uranium elements.

Reactor Hydraulics

The hydraulic characteristics of thoria target columns were determined in the flow laboratory in support of the current ThO₂ irradiation program. The results confirmed preliminary estimates of thoria column coolant flow rates and Panellit pressures. K Reactor operating conditions with both fringe and core E-Q loadings have been calculated in support of the current ThO₂ irradiation program. The results indicate that use of the new arch-type supports give the K5E fuel elements better flow balance to the reactor core than the present self-support design.

Process Water Tanks - 190C

Samples taken from the 190-C process water tanks indicate that the as-built plate material is thicker than specified, thus indicating a lower stress in the tank material than previously believed. Preliminary tensile tests indicate that the tank material is not the specified ASTM A-283, Grade D, and is probably Grade B. Carbon tests, tensile tests, and Charpy V-notch tests are being performed on samples from C tanks and test results will be available by the first week in October.

Reactor Physics, E-D Loadings

The test in B Reactor is running with a ratio of three E-columns per D-column. The predicted ratio for existing conditions is 2.7 to 1. The test in K Reactor is now running according to calculations. The recommended initial E-D ratio was 3.86 to 1. A ratio of 4.2 to 1 was used in order to be sure there was no reactivity shortage. Following startup, it appears that the correct ratio should have been in the range of 3.7 to 1.

Effluent Activity Data

The table below shows the average concentrations of five radionuclides from reactor effluent samples taken in August 1964. All units are 10^{-12} curies/ml.

<u>REACTOR</u>	<u>As-76</u>	<u>P-32</u>	<u>Zn-65</u>	<u>Cr-51</u>	<u>Np-239</u>
B	86	1.2	3	240	120
C	110	4.6	7	600	150
D	72	4.2	3	370	110
DR	51	3.0	7	400	110
F	43	2.8	7	240	80
H	90	7.9	23	360	120
KE	29	3.7	3	120	50
KW	29	2.6	4	140	50

There were no significant changes in the treatment of reactor coolant during the month of August 1964.

KER LOOP Operation

KER-1 - The loop was charged August 20 with three NIE1 fuel elements, two lithium-aluminum target elements and front and rear crud probe train assemblies containing four ceramic fueled crud probes as authorized by PT-IP-601. The objectives of these tests are to evaluate the crud

DECLASSIFIED

forming characteristics of loop coolant containing ammonium hydroxide for pH control by operating at conditions expected to induce high crud concentration and to provide lithium-aluminum samples which can be used to determine tritium production and extraction information.

KER-3 - Flux dosimeters positioned by means of a carbon steel spacer were charged August 20 as authorized by PT-IP-699 to determine the thermal and fast neutron flux levels. This information is needed to predict accurately the heat generation of the fuel rod cluster experiment requested by North American Aviation.

Identifying Seals for IAEA

Development and preliminary testing of two possible sealants for tamper proof seals have been completed. Efforts are continuing to refine the application procedures and the techniques of identification.

The development contemplates a "safing" wire which will penetrate the reactor and be sealed at an accessible location on the exterior of the reactor. The sealant material will be treated with random inclusions for inspections and identifications. Polaroid transparencies of X-ray negatives will allow rapid in-the-field verification of seal integrity.

Vertical Safety Rods - Graphite Distortion

The development of tooling and equipment for VSR enlargement and graphite sleeve installation in the 105-K Reactor is continuing. Multiple pass graphite enlargement tooling is undergoing preliminary testing in the 189 D test facility mockup. Maximum cutting rates of 16 inches per minute on unirradiated nuclear graphite have been reached. Initial testing of the biological shield boring machine has been completed, and equipment and technique alterations undertaken to correct observed cutting problems.

Final machining of the high strength graphite sleeve planned for installation in a second VSR channel (#41) at 105-C Reactor has been started by the vendor. Shipment of these sleeves is expected before mid-October.

An independent evaluation of the two theories which have been proposed regarding the distortion mechanism which is occurring in the 105-K and C Reactor graphite stacks is being performed by the Advanced Technology Laboratories. This evaluation has been undertaken to provide a reconciliation regarding the magnitude of the stack force which will act on the VSR channel lines installed in problem channels. In support of this evaluation, laboratory experiments to verify postulated graphite key failure mechanisms have been undertaken. The

DECLASSIFIED

DECLASSIFIED

Files

-8-

October 16, 1964

final results of this work are expected to be available by the first of the year. The initial test sleeve installed in a VSR channel in 105-C Reactor continues to function satisfactorily after approximately one year's service.

As an alternate to the graphite sheet sleeving of VSR channels, studies have been initiated regarding the possibility of installing cooled metal liners in the VSR channels. Initial attention is being directed toward the use of zirconium alloys for this application, fabrication of the required configuration will require some developmental work.

Replacement of Horizontal Control Rods

Receipt of the boron-carbide poison elements for the prototype 105-K Reactor flexible HCR's has been further delayed. The vendor's plant was visited in an effort to expedite his work. A second order will be placed with another vendor.

The design of an improved aluminum HCR for the smaller reactors has been completed and a purchase requisition has been written for two prototype test rods.

Deactivation Program

Five design criteria have been approved.

The design criteria for modification of the 100-F and H electrical distribution systems are in preparation.

The A-E has initiated design of the steam boiler facilities at F and H.

Reactor Plant Deactivation

Studies were completed and summarized to show the over-all schedule, manpower requirements, and costs of the deactivation program.

A listing was prepared of the detailed procedures and instructions planned for DR deactivation. An estimate indicates 50% completion.

105 DR Storage Basin Cooling Capacity

Vitro Engineering Company completed a study of the cooling water capacity, drainage, and utilities required to utilize the 105-DR storage basin for irradiated metal storage after deactivation. On the basis of the recommended modifications, this work has been included in the deactivation project.

~~SECRET~~

(Year)
OUTAGES (9-64)

<u>Reason</u>	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	53.7	60.7	52.8	50.0	40.9	92.3	29.3	32.0	411.7
Maintenance	13.3	61.0	22.3	25.8	35.7	10.5	29.4		198.0
Rupture Removal	69.0			13.8	2.2	41.2			126.2
Leak Testing	.6			10.2					10.8
Tube Replacement	6.1	12.3	12.8	6.0	3.4	18.4	116.6		175.6
Project Work	.5	6.3	3.7	2.4	9.1		53.8		75.8
Production Tests	4.2						38.7		42.9
Instrument & Circuitry		2.5	1.2	1.0			2.1		6.8
Rupture Suspects									
Miscellaneous	1.5	1.5			6.3	9.9	.4	2.0	21.6
Total	148.9	144.3	92.8	109.2	97.6	172.3	270.3	34.0	1069.4
Scheduled Outages									
Unscheduled Outages									

Oct r 16, 1964

Files

RUPTURED TUBE TABULATION FOR September 1964

Tube No.	Date Charged	Date Ruptured	Tube Power (KW)	Concentration MWD/Ton	Assigned Production Loss		Observations
					MWD	Days	
							Files
3880 B	6-16-64	9-2-64	1148	570	1635	1.00	I&E N SIDE HOT SPOT
2362 DR	6-30-64	9-10-64	1166	563	112	.07	I&E N SIDE HOT SPOT
3566 B	7-18-64	9-18-64	1164	392	3744	2.29	I&E N SIDE HOT SPOT
3261 H	6-10-64	9-20-64	1164	739	2407	1.37	I&E E B HOLE DEFECT
2378 H	6-10-64	9-22-64	1147	664	1250	.71	I&E E B HOLE DEFECT
0868 DR	5-20-64	9-26-64	1227	917	800	.47	I&E E B UNKNOWN

-10-

~~SECRET~~

October 16, 1964

DECLASSIFIED

UNITED STATES GOVERNMENT

Memorandum

DECLASSIFIED

TO : Files

DATE: NOV 23 1964

FROM : R. L. Plum, Chief
Production Reactor Operations Branch

SUBJECT: MONTHLY REPORT - OCTOBER 1964

HAN-87470
Report #10

OR:GTO:RGR

OPERATING EXPERIENCE

This document consists of [REDACTED]

Production

Reactor input plutonium production for October was 388.3 KMWD's (93.0% of forecast): 235.1 KMWD's (92.0% of forecast) at the six smaller reactors and 153.2 (94.6% of forecast) at the two K reactors. Tritium input production for October was 2373 equivalent MWD's and thoria input production was 725 equivalent MWD's.

Efficiency

Overall time operated efficiency was 68.6% (74.9% forecast); 71.8% at the six smaller reactors and 59.1% at the K reactors. Efficiency was below forecast at the smaller reactors due largely to fuel element failures and other unscheduled outages at the B, C, D, and DR reactors. Forecast efficiency was not made at the K reactors because of a small overrun of forecast time for scheduled maintenance work, a water leak outage and two reactor scrams at KW Reactor.

Power Levels

Power levels at the C, D, F, KE and KW reactors were restricted by a bulk outlet water temperature limit of 95°C except for the last third of the month when the KE Reactor power level was restricted by the administrative limit of 4400 megawatts. The B Reactor power level was restricted by trip-after-instability limits, DR by the 95°C bulk outlet temperature limit until mid-month when the level was restricted to control fuel element failures, and H Reactor by graphite temperature limits until reactivity gains resulted in a bulk outlet temperature limit of 95°C during the last third of the month.

GROUP 1

DECLASSIFIED

Under the Atomic Energy Act of 1954, its transmittal or the disclosure of its contents in any manner to unauthorized person is prohibited.

Ruptures

Eleven failed I&E fuel elements were removed from the reactors: six of enriched uranium and five of natural uranium. Two of the enriched failures were at C Reactor (55% and 62% of goal exposure), two at DR (70% and 88%), one at D (105%) and one at H (104%). Two of the natural failures were at B (70% and 131%), two at DR (96% and 107%) and one at D (39%). Five of these failed elements were side-hot-spot failures, three were from side corrosion, one from hole corrosion, one was side unclassified and one was not examined. Eight of these failures were stuck in the process tubes and one caused a process tube water leak.

MAINTENANCE AND EQUIPMENT EXPERIENCESWater Leaks

Three internal process tube leaks, two at DR and one at KW, and one rear Van Stone leak, at B, were corrected.

Tube Replacement

Twenty new process tubes were installed: 9 at D, 4 at B, 3 at H, 2 at DR and one each at C and KW.

REACTOR OUTAGES

<u>Date Down</u>	<u>Date Up</u>	<u>Outages Hours</u>	<u>Remarks</u>
<u>B REACTOR</u>			
10/11	10/16	118.0	Removal of an I&E natural metal rupture from tube 1374. Charge-discharge and miscellaneous maintenance.
10/16	10/16	7.9	Manual scram due to flow restriction to No. 8 HCR caused by corrosion material.
10/24	10/25	38.8	Removal of an I&E natural metal rupture from tube 0964.

DECLASSIFIED

DECLASSIFIED

Files

-3-

NOV 2 3 1964

B REACTOR Cont'd

10/26	10/28	37.6	Scrammed by a Panellit trip when a spline was being pulled from tube 3281. Miscellaneous maintenance was performed.
10/30	still down		Manually scrambled because of HCR water loss annunciations caused by a circuit short. Miscellaneous maintenance.

C REACTOR

10/10	10/14	99.7	Down for scheduled charge-discharge.
10/21	10/22	36.3	Removal of an I&E enriched metal rupture from tube 2763.
10/24	10/26	40.2	Removal of a stuck I&E enriched rupture from tube 2774. The front venturi assembly on tube 2764 parted from the header adapter when water pressure was raised to 400 lbs. A complete new assembly was installed.
10/26	10/28	57.3	Down to check the integrity of the front CG-558 hardware.

D REACTOR

10/8	10/9	42.2	Scrammed due to an I&E natural metal rupture in tube 3259. Completed a small charge-discharge.
10/13	10/15	33.3	Scrammed due to a stuck I&E enriched metal rupture in tube 0886.
10/16	10/17	26.2	Down to manually close a ball valve on tube 1182. Startup failed when No. 25 VSR cable tangled.
10/17	10/17	0.5	Down due to a trip caused by a faulty Beckman.
10/19	still down		Down for scheduled charge-discharge.

DECLASSIFIED

Files

-4-

NOV 2 3 1964

DR REACTOR

10/2	10/4	40.0	Manually scrambled due to an I&E natural metal rupture in tube 2561. Replaced tube 2561.
10/7	10/8	34.8	Scrammed due to an I&E enriched metal rupture in tube 1360.
10/10	10/12	34.7	Manually scrambled due to rupture indications. Removal of an I&E enriched metal rupture from tube 1161. Charge-discharge.
10/19	10/22	54.5	Manually scrambled due to a stuck I&E natural metal rupture in tube 1364. Charge-discharge.
10/26	10/28	45.0	Scrammed by a low pressure Panellit trip when a rear pigtail adapter failed on tube 3979. Miscellaneous maintenance.

F REACTOR

10/2	10/4	40.9	Scrammed by an unexplained Panellit trip on tube 0980. Charge-discharge.
10/16	10/18	55.1	Down for scheduled charge-discharge.
10/18	10/18	1.2	Correct two rear cap leaks.

H REACTOR

9/30	10/2	32.4	Down due to insufficient reactivity. Charge-discharge and installation of three process tubes.
10/3	10/4	27.6	Scrammed when the wrong ball valve was bypassed.
10/14	10/15	33.2	Removal of an I&E enriched metal rupture from tube 0576.
10/15	10/15	1.0	Discharge of a stuck poison charge from ball valve tube 0874.

DECLASSIFIED

DECLASSIFIED

NOV 2 1984

KE REACTOR

10/7	10/10	69.2	Scheduled charge-discharge.
10/10	10/10	0.4	Down due to an unexplained Panellit trip.
10/10	10/10	3.0	Down due to an unexplained Panellit trip.
10/17	10/19	37.1	Scrammed by an unexplained Panellit trip on tube 4365. Charge-discharge and miscellaneous maintenance.

KW REACTOR

9/29	10/20	492.1	Down due to a Panellit trip caused by a broken spline in tube 3561. Maintenance.
10/24	10/25	37.4	Down due to a water leak. Tube 3155 was confirmed as a leaker and was replaced.
10/25	10/25	1.6	Manually scrambled due to high pressure on tube 3069.
10/31	still down		Down due to a Panellit trip caused by partial plugging of the Panellit opening at the orifice cage.

PLANT ASSISTANCE - EXISTING REACTORSVertical Safety Rods - Graphite Distortion

Fabrication and testing of VSR channel boring and drilling tools continued. Mockup tests of biological shield enlargement tools have revealed binding problems with the diamond drills; revised cutting techniques are being formulated. Modification to the thermal shield boring machine used at C Reactor are 95 percent complete. Rework of the single path channel reamer for enlargement of the graphite portion of the K VSR channel is also nearing completion. Laboratory tests of the multiple path cutting concept are proceeding satisfactorily.

SECRET

[REDACTED]

3
4
5
6

—

—

1

11

THE

DECLASSIFIED

THE

THE

This schedule is based upon an 83% TOE.

DECLASSIFIED

Files

-7-

NOV 2 3 1964

The experience obtained with the KW fringe material during the operation since the startup of October 20 has shown the flux in the fringe to be about 7% lower than expected. The splining which will be necessary in the center to compensate the long term reactivity gains will probably reduce this figure some because the redistribution of flux at the same equilibrium level will increase the fringe flux level.

All thoria is now scheduled for discharge between May 15, 1965 and July 20, 1965, however, discharge plans will probably change between now and discharge due to variations in individual reactor TOE.

Depleted Uranium Irradiations

The depleted uranium (0.22 w/o U-235) fuel columns, 104 columns total, now under irradiation in central zone process tubes of B Reactor have accumulated an exposure of approximately 280 MWD/T of a 1400 MWD/T goal. The depleted uranium columns have average tube powers of 480 kw, about 44 per cent of supporting enriched uranium tube powers. The outlet coolant temperature of the depleted fuel columns is now averaging about 64C.

The ninety columns of depleted uranium (0.22 w/o U-235) elements currently under irradiation in central zone process tubes of KE Reactor now have an average exposure of 235 MWD/T. Goal exposure for these columns is 1600 MWD/T. The outlet coolant temperature of the depleted columns is now averaging about 60 C with the tube powers averaging 790 kw. The depleted columns are operating at about 45 per cent of the supporting enriched uranium tube powers.

E-D Loadings

The test load in B Reactor is still running with a higher-than-predicted E-D ratio. The ratio is now 2.96; the ratio predicted for this time is 2.5. The test load in KE Reactor is running very close to the predicted E-D ratio.

Effluent Activity Data

The table below shows the average concentrations of five radionuclides from reactor effluent samples taken in September 1964. All units are 10^{-12} curies/ml.

<u>REACTOR</u>	<u>As-76</u>	<u>P-32</u>	<u>Zn-65</u>	<u>Cr-51</u>	<u>Np-239</u>
B	110	1.7	5	330	140
C	250	7.5	10	930	230
D	68	3.9	10	330	80
DR	54	4.0	18	440	110
F	51	3.9	6	270	70
H	96	10.0	7	450	120
KE	34	5.8	9	110	50
KW	32	3.4	7	130	50

The coolant pH was increased from 6.6 to 7.0 at KE and KW reactors starting on September 25, 1964. The test at 100-H where liquid alum was used to treat far-side coolant was terminated on September 16, 1964, and the bauxite treatment for both sides was resumed.

Ph Changes - Process Water

The pH of the process water was changed to 6.6 at DR and F reactors on October 19 and October 29, respectively, after operating at a pH of 7.0 since May 19, 1964. The reason for this change was a large increase in the corrosion rates of the fuel cladding and process tubes observed at these reactors.

DR Reactor had sustained a rash of ruptures, and examination of fuel elements from both DR and F reactors revealed a high incidence of severe ledge and groove corrosion, a phenomenon not observed at the other reactors.

At F Reactor, recent probolog tests show a substantial increase in the number of process tubes that will reach a critical stage (potential leakers) by the time of reactor shut down next June. By changing pH it is believed possible to retard this corrosion rate and reduce by a factor of about eight the number potential problem tubes.

The additional acid requirements will cost about \$3,000 per month per reactor.

DECLASSIFIED

DECLASSIFIED

NOV 2 3 1964

KER-1 Loop Operation

Testing was continued with three NIE1 fuel elements, two lithium-aluminum target elements, and front and rear crud probe train assemblies containing four ceramic fueled crud probes. The objectives of these tests are to evaluate the crud forming characteristics of loop coolant containing ammonium hydroxide for pH control by operating at conditions generally believed to induce high crud concentrations and to provide lithium-aluminum samples which can be used to determine production and extraction information.

KER-3 Loop Operation

Flux dosimeters authorized by PT-IP-699 for determination of the thermal and fast neutron flux levels were discharged.

Irradiated Fuel Age Monitor

Preliminary engineering and testing have been completed on the instrumentation for an irradiated fuel age monitor. The device will supplement operating procedures and ensure that a sufficient decay time is allowed prior to shipping to separations. Fabrication of a prototype for in-service testing has begun.

Front Venturi Assembly Failure - C Reactor

The front venturi assembly on tube 2764 parted from the header adapter when water pressure was raised to operating conditions on October 25, 1964. A complete new assembly was installed and the reactor started up at 5:42 a.m. on October 26. Subsequent inspection of the failed assembly revealed that the threads in the venturi housing had been reamed out. The reactor was shut down at 9:20 a.m. on October 26 to check the integrity of the front CG-558 hardware. The failed assembly was one of 424 similar fittings that had been recently modified and installed on the reactor. A total of 50 venturi assemblies and 67 header adapters were rejected. Eleven of the venturi housings had a thread ID of greater than .889 inches. Twenty one of the header adapters had a thread OD of less than .927 inches. It was thus possible, with the right combination of housing and adapter, to become disengaged. No problems were found upon inspection of 173 venturi fittings and 50 double orifice bodies that had recently been removed at D Reactor. It is believed that the problem was confined to the modified C Reactor fittings.

It was recommended by the General Electric investigating committee that a better means of quality control be established for critical reactor fittings. A third party inspection system will be initiated which will certify and tag all inspected components.

SECRET

DECLASSIFIED

(Year)
OUTAGES (64) OCT

Reason	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	50.9	93.9	24.2	45.7	37.6	37.3	61.6	94.7	445.9
Maintenance	61.3	70.9	251.4	56.6	35.8	11.6	12.3	16.4	516.3
Rupture Removal	33.6	28.8	13.3	96.4		5.6			177.7
Leak Testing	17.7	3.2			14.3			24.0	59.2
Tube Replacement	5.3	12.0	38.1	4.0	6.3			183.5	249.2
Project Work	2.9		25.8					153.8	182.5
Production Tests	1.0		0.8				6.0	6.9	14.7
Instrument & Circuitry	34.2	6.1	3.0	6.3			10.6	0.4	60.6
Rupture Suspects									
Miscellaneous	22.0	18.6	48.4		3.2	33.4	19.3	19.9	164.8
Total	228.9	233.5	405.0	209.0	97.2	87.9	109.8	499.6	1870.9
Scheduled Outages									
Unscheduled Outages									

NOV 2 1964

NOV 2 1964

RUPTURED SLUG TABULATION FOR OCTOBER 1964

Tube No.	Date Charged	Date Ruptured	Tube Power (KW)	Concentration MWD/Ton	Assigned Production Loss		Observations
					MWD	Days	
2561 DR	7-31-64	10-2-64	1159	493	3287	2.02	INE NW SIDE GROOVE CORROSION
1360 DR	7-24-64	10-7-64	1252	694	1512	.93	I&E EB SIDE GROOVE CORROSION
3259 D	9-7-64	10-8-64	1095	235	219	.13	I&E N SIDE HOT SPOT
1161 DR	7-31-64	10-10-64	1214	689	2069	1.27	I&E EB HOLE GROOVE CORROSION
1374 B	7-18-64	10-11-64	1214	628	1731	1.02	I&E N SIDE HOT SPOT
86 D	8-9-64	10-13-64	1256	754	947	.57	I&E EB SIDE UNCLASSIFIED
0576 H	7-5-64	10-14-64	1175	776	550	.30	I&E EB SIDE GROOVE CORROSION
1364 DR	7-31-64	10-19-64	1156	586	981	.60	I&E N UNKNOWN NOT EXAMINED
2763 C	9-1-64	10-21-64	1354	527	778	.39	I&E E SIDE HOT SPOT
696 B	9-2-64	10-24-64	1274	389	862	.51	I&E N SIDE HOT SPOT
2774 C	9-21-64	10-24-64	1376	368	2061	1.04	I&E E SIDE HOT SPOT

UNITED STATES GOVERNMENT

Memorandum **DECLASSIFIED**

TO : Files

DATE: December 14, 1964

FROM : *for [signature]* E. L. Plum, Chief
Production Reactor Operations Branch

SUBJECT: MONTHLY REPORT - NOVEMBER 1964

HAN-87470
Report #11

OR:RGR:GTO

OPERATING EXPERIENCE

This document consists of 11 pages

No. [REDACTED]

Production

Reactor input plutonium production for November was 487.6 KMWD's: 267.3 KMWD's (94.6% of forecast) at the six smaller reactors and 220.3 KMWD's (103.4% of forecast) at the two K reactors.

Efficiency

Over-all time operated efficiency was 82.4% (85.2% forecast): 81.7% at the six smaller reactors and 84.7% at the K reactors. Forecast efficiency was not made at the smaller reactors due to fuel element failures and miscellaneous outages largely associated with reactor hardware.

Power Levels

Power levels at the C, D, DR, F and H reactors were restricted by a bulk outlet water temperature limit of 95°C except for the last half of the month when the H Reactor level was limited by tube power to control fuel element failures. The B Reactor power level was restricted by trip-after-instability limits associated with the flux distortion around the E-D demonstration load and power levels at the two K reactors were restricted by the administrative limit of 4400 megawatts.

Ruptures

Nine failed I&E fuel elements were removed from the reactors: eight of natural uranium and one of enriched uranium. In addition, the can wall was stripped from one side of a stuck natural uranium element when the piece was removed from the tube. No fuel element failure indications were apparent prior

GROUP 1

DECLASSIFIED

This document contains restricted data as defined in the Atomic Energy Act of 1954. Its transmission or disclosure in any manner is prohibited.

December 14, 1964

to movement of the stuck pieces. Four of the natural failures were at D Reactor (78, 79, 84 and 88% of goal exposure), two were at B (78 and 100%), one (overbore) was at C (96%) and one was at H (89%). The enriched failure, at F Reactor, failed at 102% of goal exposure. The stuck natural uranium element was at H Reactor and was at 58% of goal exposure when discharged. Five of these failed elements were side hot-spot failures and four were unknown-not examined at month's end. Six of the failed elements were stuck in process tubes and one caused a process tube water leak.

MAINTENANCE AND EQUIPMENT EXPERIENCES

Water Leaks

One internal process tube leak was corrected at D Reactor.

Tube Replacement

Eight new process tubes were installed; three at D, two at B and F and one at H Reactor.

REACTOR OUTAGES

<u>DATE</u> <u>DOWN</u>	<u>DATE</u> <u>UP</u>	<u>OUTAGES</u> <u>HOURS</u>	<u>REMARKS</u>
<u>B REACTOR</u>			
11/30	11/1	35.8	Manually scrammed because of HCR water loss caused by a circuit short. Rod water flow was normal. Miscellaneous maintenance.
11/4	11/6	47.0	Removal of a rupture from tube 1560.
11/14	11/19	124.6	Removal of an I&E natural metal rupture from tube 0986. Charge-discharge.
<u>C REACTOR</u>			
11/9	11/11	36.9	Removal of an overbore rupture from tube 2868. Twelve overbore tubes were charge-discharged.

DECLASSIFIED**SECRET**

DECLASSIFIED

Files

-3-

December 14, 1964

C REACTOR cont'd

11/12	11/14	45.4	Scrammed by an unexplained Panellit trip. Charge-discharge of special material and miscellaneous maintenance work followed.
11/24	11/26	50.9	Down for scheduled charge-discharge.
11/26	11/26	6.4	Down to correct six front face cap leaks.

D REACTOR

10/19	11/3	369.3	Down for charge-discharge, thermocouple work and replacement of the top seal on the rear face.
11/3	11/3	4.6	Scrammed by a high pressure Panellit trip caused by two pieces of gasket material on the Venturi cross wire.
11/3	11/3	0.6	Down to correct a partially engaged front face cap on tube 3396.
11/13	11/14	33.5	Scrammed due to an I&E natural metal rupture in tube 0969.
11/14	11/15	13.3	Down for removal of an I&E natural metal rupture from tube 3161.
11/18	11/20	34.5	Down due to a broken pigtail adapter on the rear of tube 3776. Charge-discharge and miscellaneous maintenance.
11/23	11/25	33.4	Down for removal of a I&E natural metal rupture from tube 3485.
11/29	11/30	38.1	Down for removal of an I&E natural rupture from tube 3674.

DR REACTOR

11/20	11/21	35.8	Down for scheduled charge-discharge
11/21	11/21	0.8	Scrammed from an unexplained low Panellit trip.

SECRET

Files

-4-

December 14, 1964

F REACTOR

11/6	11/8	42.2	Down for removal of I&E enriched metal rupture from tube 2078. Charge-discharge.
11/19	11/21	56.2	Down due to effluent water leak in the downcomer. Charge-discharge.
11/22	11/23	31.2	Scrammed from a Panellit trip while attempting to insert a plastic stub in spline cap 3662.

H REACTOR

11/4	11/6	62.4	Scrammed by a high pressure Panellit trip on tube 2585.
11/25	11/26	37.5	Down for removal of an I&E natural metal rupture from tube 1085.

KE REACTOR

11/14	11/15	107.8	Down for scheduled charge-discharge and maintenance.
-------	-------	-------	--

KW REACTOR

10/31	11/3	67.1	Scrammed due to a Panellit trip caused by partial plugging of the Panellit opening at the orifice cage.
11/3	11/4	0.7	Scrammed by an unexplained Panellit trip on tube 5762.
11/4	11/4	13.1	Scrammed by an unexplained Panellit trip on tube 5762.
11/29	Still down		Down for charge-discharge.

EX-100-1

DECLASSIFIED

DECLASSIFIED

Files

-5-

December 14, 1964

RESEARCH AND DEVELOPMENT

Plutonium - 238

A cursory look at a self-contained plutonium fuel cycle (using a plutonium-depleted uranium load) in a small reactor indicates that about 40 kg. of Pu-241 could be made per year. The plutonium would contain about seven percent 241. Further Pu-241 step-up in thermal converters does not look practical due to Pu-241 burnout. Maximization of Pu-241 by irradiation of plutonium in a resonance flux would deserve a closer look and is planned. By this scheme and subsequently irradiating the Am-241 that is milked from plutonium, about 150-200 kg. of Pu-238 could be formed by 1980. Milking of power reactor plutonium (8-12 percent Pu-241) should be substantially cheaper and considerably more productive of Pu-238 by 1980. Further study, including the economics, is planned for the near future.

PROCESS TECHNOLOGY

The program to assess the integrity of critical process piping has continued. An additional sample of tank material has been removed from a second 183-C storage tank and sent to off-plant laboratory for testing. The sampling of process piping and material testing has been completed except for a few samples yet to be tested from 105-B and 105-C. An extended reactor outage is required for the remaining sample removals.

Reactor Effluent Studies

The design of a test facility for a sodium silicate system in 190-D is progressing in support of the planned half-plant test. In this test program sodium silicate will be injected into the reactor coolant supply downstream of the 183-D filter plant to observe the effect of such chemical addition on effluent activity.

Further activity in connection with reactor effluent studies has included feasibility investigation of alternate methods of reactor effluent disposal. Work on this program has been concentrated on the problems of disposing of reactor effluent, particularly from the 100-K Areas, by means other than discharge directly to the Columbia River. This work consists of investigation of potential inland canal and lake sites, percolation and infiltration effects, radioisotope cleanup potential of the soil column, and thermal decay effects of an open canal and lake system. Work has been initiated on preliminary cost estimates of an alternate effluent canal routing to the inland lake.

SECRET

Effluent Activity Data

The table below shows the average concentration of five radionuclides in reactor effluent samples taken in October 1964. All units are 10-12 curies/ml.

<u>REACTOR</u>	<u>As-76</u>	<u>P-32</u>	<u>Zn-65</u>	<u>Cr-51</u>	<u>Np-239</u>
B	140	3.6	5	380	170
C	130	8.0	9	640	140
D	91	6.3	3	430	90
DR	63	4.6	18	480	110
F	62	4.3	10	270	80
H	86	7.5	5	380	110
KE	64	6.3	5	120	60
KW	47	4.0	6	86	30

The coolant pH was reduced from 7.0 to 6.6 at DR and F reactors on October 23, 1964, and October 29, 1964, respectively. There were no other significant changes made in the treatment of reactor coolant during October 1964.

Thoria Irradiations

Radiological information has been developed to assist the processing personnel to prepare guides on handling thoria target elements. Most of the potential problems would stem from the failure of the cladding of a thoria element irradiated or unirradiated and the subsequent release of fine powder.

The normal dose rate for handling thoria elements is about five times higher than that for uranium fuel elements (15 MR/hr. versus 3 MR/hr.).

An analysis of KW Reactor operating condition shows the use of arch-type supports on KVE fuel elements will be required to achieve current reactor coolant flow rates with core E-Q loadings. Central zone columns with this type of fuel element will cause the reactor flow rate to decrease 0.7 percent, the bulk outlet coolant temperature will increase 0.6C, and the outlet coolant temperature of central-zone process tubes will increase 3C compared to current natural uranium loadings at the same power level. These conditions can be supported without adversely affecting reactor operating efficiency. Although they do require operation closer to existing limits.

~~SECRET~~ **DECLASSIFIED**

DECLASSIFIED

Files

-7-

December 14, 1964

The outermost lattice unit tubes in the KW Reactor were charged with thoria during the September 30, 1964, outage. Similar charging of the D Reactor fringe took place during the October 19, 1964, outage and of the B Reactor fringe during the November 14, 1964, outage. A total of approximately 27 tons of thorium oxide target elements are now under irradiation. Loading dates for the fringes of C and KE reactors are tentatively scheduled for December 22, and 28, respectively, depending upon thoria delivery.

Depleted Uranium Irradiations - B Reactor

The 104 columns of depleted uranium (0.22 w/o U-235) fuel elements now under irradiation in the central zone of B Reactor have accumulated an average exposure of approximately 400 MWD/T of a 1400 MWD/T goal which is anticipated by June 1965.

KE Reactor - An average exposure of 350 MWD/T of a 1600 MWD/T goal is now estimated to have been obtained by 90 columns of depleted uranium fuel elements in KE Reactor.

Self-Support Development

Nineteen columns of self-support fuel elements fabricated as a portion of a production test to evaluate "arch-rail" self-supports are now under irradiation in the KW Reactor. Ten of these fuel columns are equipped with downstream thermocouple probes to measure the coolant temperature unbalance in the process tubes. The initial measurements obtained from this test indicate no operationally significant differences between fuel columns containing arch-rail elements and those columns with the standard production bridge rails. A comprehensive evaluation will not be available until the test elements have been discharged and examined. The fuel columns are currently estimated to have an average exposure of 190 MWD/T, with a goal exposure of 1000 MWD/T.

ACRS Presentation

The K Reactor E-Q hazards report was completed and issued in October. Review of the K core loading was given to the ACRS Hanford Sub-committee on November 6, 1964, and to the full ACRS committee on November 13, 1964. Dr. Thompson of MIT expressed interest in a spatial-dependent kinetics calculation, and a copy of the CLUMSEY document will be sent to him.

Speed-of-Control Studies

The speed-of-control calculations for normal fuel loads in all production reactors have been completed. Calculations for the E-Q loads are nearly finished, and revised bases will be issued in the near future. In general, revised limits will not affect

current reactor operations, and the speed-of-control requirements for E-Q loadings will be less restrictive than for normal loadings.

Chemical Decontamination Development

Development of a prototype spot contamination-locating instrument is progressing to the final stages. The current prototype instrument resembles a five-cell flashlight with a long, slender probe attached to one end. The reduced weight and revised location of controls materially improved the utility of the instrument. Progress is being made in the program of reducing chemical concentration of decontamination solutions while maintaining effectiveness. On reactor tests have demonstrated the efficiency of a solution utilizing a 25 percent reduction in concentration. Preliminary tests at 50 percent reduced concentration appear promising; additional tests are planned.

Identifying Seals for IAEA Inspection

The support effort to develop and test prototypic seals and procedures has been completed.

C Reactor Ball Loss

As part of a program to determine the distortion of the C Reactor moderator stack, extensive measurements and observations were made of C Reactor VSR channels during July of this year. An important observation made during these examinations was the separations found in the front and rear banks of the VSR channels. Separations between the graphite blocks composing these channels of approximately one-inch were noted over 1/3 to 1/2 the length of the channels. It is estimated that a total of approximately 300 pounds of balls could be trapped in these separations in the event of a ball drop. Only the front and rear VSR channels are susceptible to separation because of slight differences in the key and block arrangement, therefore, ball loss in the remaining channels is considered unlikely.

Improved Gas Drying Facilities

Discussions with industrial representatives indicate that substitution of silica gel with molecular sieve material in the drying towers will substantially reduce the gas inlet dewpoint. Replacement with molecular sieve material, with no changes in present equipment at the K Reactors, is estimated to provide gas with a dewpoint of about -50 C. The addition of a small heater in the regeneration line to more thoroughly remove water from the sieve during regeneration would reduce the inlet dewpoint to about -90 F. Molecular sieve is slightly more expensive than silica gel and is being investigated further.

~~SECRET~~

DECLASSIFIED

DECLASSIFIED

Files

-9-

December 14, 1964

KER-1 Loop Operation

Testing with three NIE1 fuel elements, two lithium aluminum target elements, and front and rear crud probe train assemblies containing four ceramic fueled crud probes authorized by PT-IP-601 was terminated and the loop discharged during the November outage. The objectives of these tests were to evaluate the crud forming characteristics of loop coolant containing ammonium hydroxide for pH control by operating at conditions generally regarded to induce high crud concentrations and to provide lithium-aluminum samples which can be used to determine production and extraction information. The loop was left empty and on layaway status.

SECRET

RUPTURED SLUG TABULATION FOR November 1964

Tube No.	Date Charged	Date Ruptured	Tube Power (KW)	Concentration MWD/Ton	Assigned Production Loss		Observations
					MWD	Days	
1560 B	9/2/64	11/4/64	1309	427	1769	1.06	I&E N Unknown - not examined
2078 F	8/31/64	11/6	1153	708	204	.11	I&E EB Unknown - not found
2868 C	7/9/64	11/9	1467	767	235	.11	I&E NO Unknown - not examined
0969 D	9/7/64	11/13	1286	415	556	.32	I&E Side Hot Spot
0986 B	9/2/64	11/14	1305	521	1372	.82	I&E Unknown - not examined
3161 D	9/7/64	11/14	1277	420	1630	.95	I&E - Side Hot Spot
3485 D	9/7/64	11/23	1242	473	2836	1.66	I&E " " "
1085 H	9/22/64	11/25	1236	507	1459	.81	I&E " " "
3674 D	9/7/64	11/29	1226	493	2630	1.54	I&E " " "

DECLASSIFIED

(Year)
OUTAGES (NOV) 1964

Reason	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	91.7	74.5	19.7	28.7	48.4	36.6	67.1	13.2	379.9
Maintenance	21.1	16.1	110.7	5.3	58.7	6.8	28.5	57.3	304.5
Rupture Removal	34.8	2.3	82.9		2.4	13.3			135.7
Leak Testing								32.5	32.5
Tube Replacement	2.3	5.3			18.1				25.7
Project Work								5.7	5.7
Production Tests	14.0	17.2			1.0		12.2	2.8	47.2
Standard Check	2.1	0.7	1.2	1.0					5.0
Standard Check									
Rupture Suspects									
Miscellaneous	6.7	23.5		0.8	1.0	43.2		0.7	75.9
Total	172.7	139.6	214.5	35.8	129.6	99.9	107.8	112.2	1012.1
Scheduled Outages									
Unscheduled Outages									

DECLASSIFIED

UNITED STATES GOVERNMENT

Memorandum

DECLASSIFIED

TO : Files

DATE: January 18, 1965

FROM : R. L. Plum, Chief
PRODUCTION REACTOR OPERATIONS BRANCH

SUBJECT: MONTHLY REPORT - DECEMBER 1964

HAN-87470
Report #12

OR:GTO:JPT:RGR

OPERATING EXPERIENCE

THIS DOCUMENT CONSISTS OF 12 PAGES

Production

Reactor input plutonium production for December was 519.5 KMWD'S (102.3% forecast: 295.8 KMWD'S (102.8% forecast) at the six smaller reactors and 223.7 (101.6% forecast) at the two K reactors.

Reactor MWD input production for calendar year 1964 was 8.2% above the previous record production year of 1963. New yearly production records were established at the two K reactors and at five of the six smaller reactors.

Efficiency

Over-all time operated efficiency for December was 83.9%: 83.5% at the six smaller reactors and 84.9% at the K reactors.

Power Levels

Power levels at the C, D, DR, F and H reactors were restricted by a bulk outlet water temperature limit of 95°C except for short periods at D, DR and H when levels were limited to minimize rupture potential. The B Reactor power level was restricted by trip-after-instability limits associated with increased power generation in selected tubes caused by the E-D and E-Q programs. Power levels at the two K reactors were restricted by the administrative limit of 4400 megawatts. A record power level of 2125 megawatts was achieved at H Reactor exceeding their previous maximum by 15 megawatts.

GROUP 1

DECLASSIFIED

Ruptures

Eight failed I&E fuel elements were removed from the reactors; six of natural uranium and two of enriched uranium. The six natural uranium failures, three at B, two at DR and one at F, occurred at 22% to 128% of goal exposure. Two were side hot spot failures and four were not examined at month's end. The two enriched failures at C and KE, failed at 39% and 120% of goal exposure, respectively. The KE failure (ledge corrosion) was the first failure of self-support fuel at the K reactors. Five of the eight failed elements were stuck in process tubes.

Reactor Shutdown

The DR Reactor plant was shutdown on December 30, 1964, at 11:50 p.m.. Deactivation work was initiated on December 31, 1964, for placing the plant in a standby status.

MAINTENANCE AND EQUIPMENT EXPERIENCESWater Leaks

Three process tube Van Stone flange leaks were corrected at F Reactor. Nine new process tubes were installed.

REACTOR OUTAGES

DATE DOWN	DATE UP	OUTAGES HOURS	REMARKS
<u>B REACTOR</u>			
12-13	12-16	73.6	High pressure Panellit trip caused by an I&E natural metal rupture in Tube 3581, and charge-discharge.
12-16	12-16	8.0	Replacement of a ruptured rear expansion joint and discharge of an I&E normal uranium rupture from Tube 3686.
12-25	12-27	43.9	Removal of a stuck I&E normal uranium rupture from Tube 1961.

DECLASSIFIED

DEC 1965

Files

-3-

January 18, 1965

REACTOR OUTAGES - Cont.

C REACTOR

12-18	12-25	174.8	Scheduled charge-discharge and miscellaneous maintenance.
12-25	12-26	.5	Low Panellit trip on Tube 3387.
12-26	12-27	19.4	Correction of a faulty thermocouple connection on Tube 3676.
12-31	Still down		Removal of an I&E 94 metal rupture from Tube 3369.

D REACTOR

12-9	12-14	102.8	Scheduled charge-discharge.
12-14	12-14	5.3	High pressure Panellit trip on Tube 4080.

DR REACTOR

12-21	12-23	53.6	High pressure trip on Tube 2561. Removal of an I&E normal uranium rupture from Tube 2561.
12-23	12-24	6.5	Removal of an I&E normal uranium rupture from Tube 1961.
12-30	Will remain down.		Manually scrambled as first step in deactivation. Deactivation schedule being followed.

F REACTOR

12-8	12-10	48.1	Removal of an I&E normal uranium rupture from Tube 2676. Replacement of Tubes 0781 and 0561 due to rear Van Stone leaks.
12-10	12-10	.8	Restoration of flow on Gamma monitor sample line from header No. 42.
12-27	12-30	83.5	Scheduled charge-discharge. Replacement of Tube 4468 due to cracked rear Van Stone.

REACTOR OUTAGES - Cont.

H REACTOR

12-6	12-10	79.9	Scheduled block discharge.
12-12	12-13	28.8	Flexowriter failed during a period of flux change.

KE REACTOR

12-4	12-5	34.0	Removal of I&E 94-metal rupture in Tube 4189 and scheduled charge-discharge.
12-5	12-5	.5	Panellit trip apparently caused by an unseated charge in Tube 5151.
12-16	12-18	61.2	Excessive icing on incoming 230 KVA line. Charge-discharge.
12-31	Still down.		Low crossheader pressure trip on 1706 single pass Tubes 4355 and 4456.

KW REACTOR

11-29	12-5	150.2	Scheduled charge-discharge.
12-5	12-5	.7	Panellit trip caused by an oscillating gage on Tube 4271.
12-6	12-6	1.6	Panellit trips on gages 5280 and 3283, caused by oscillating gages on thorium tubes.

RESEARCH AND DEVELOPMENTReactor Fuels - Irradiation Studies

The irradiation test of hot-die-sized fuel elements, comparing the effect of uranium heat treatment parameters on irradiation behavior, was discharged from C Reactor during the December 18 outage. Exposure at the time of discharge of the 18 columns averaged 850 MWD/T. Post-irradiation examination of the fuel elements is in progress.

DECLASSIFIED

DECLASSIFIED

January 18, 1965

RESEARCH AND DEVELOPMENT - ContPlutonium 238

Several schemes for enhancing the production of Pu-238 are being investigated. The study cases include neptunium irradiations in Hanford reactors, complete recycle, higher blend enrichments, overbored reactors, in-reactor loops for neptunium irradiation, and milking Am-241 from the power reactor plutonium.

Also, equations are being developed for a generalized neptunium production code. Considerable time was spent in obtaining a useable and meaningful self-shielding correction for the U-236 resonance integral as U-236 builds up in the fuel as a result of continued recycling. This program will be used to augment additional reactor cost studies.

PROCESS TECHNOLOGYDepleted Uranium Irradiation

The 104 columns of depleted uranium (0.22 w/o U-235) fuel elements now under irradiation in central zone process tubes of B Reactor have accumulated an average exposure of approximately 550 MWD/T. Goal exposure for these columns, based on over-all program plans for production of 25 kg. of plutonium with 18% Pu-240 is scheduled for 1400 MWD/T.

The 90 columns of depleted uranium fuel elements in the KE Reactor are now estimated to have an average exposure of 520 MWD/T, compared to a goal exposure of 1600 MWD/T, scheduled for these columns.

Self Support Development

The test of fuel elements in KW Reactor containing "arch-rail" self supports is continuing satisfactorily. Eight of the arch-rail columns were discharged at average exposures of 400 MWD/T. The remaining fuel columns are scheduled for discharge at average exposures of 1000 MWD/T.

Thoria Irradiations

Charging of one-half of the KW central zone with an E-Q loading was accomplished on schedule, during the November 29 outage. One hundred and twenty-six thoria columns and 723 supporting enriched uranium columns were loaded as authorized. The oxide used in these target elements generally did not meet current specifications for particle size or density. A range in composition densities from 6.5 g/cc to 7.3 g/cc necessitated a preferred target element placement within each column of elements charged. A charge makeup

January 18, 1965

Thoria Irradiations - cont.

scheme was developed to provide an flux-squared weighted density for each column. This required somewhat more stringent charge makeup techniques than normal. The charging and startup operations were continually monitored by R&E and no significant deviations from preplanned procedures were observed. Difficulties with fluctuation of the Panellit gauges on the process tubes containing the thoria resulted in a few low power level reactor scrams. The cause of the fluctuation of the gauges is being investigated and several means of reducing or minimizing the effects of gauge oscillation are being considered. The fringe zone thoria loadings continue to operate without difficulty. These loadings are scheduled to continue irradiation until mid-summer 1965.

E-Q Program - Six Ton Demonstration Test

U-233 and Pa-233 yields and U-232 ppm have been calculated for the six ton ThO₂ test loads. These irradiations were made in the F Core, the F Fringe, and a K Core. The calculated results indicate a yield of 3.4 Kg U-233 at 2.7 ppm U-232 and 95 gms of Pa-233 as of December 5, 1964.

KW-Half-Core Load

Startup of the half-core E-Q loading in KW Reactor proceeded without incident. The in-core neutron monitor, used during the loading to monitor shutdown flux level, performed satisfactorily and provided the desired increased sensitivity. The cold, clean reactivity of the reactor was predicted to within 50 cmk. The graphite temperature coefficient is smaller than expected, and the reactor is behaving very similarly to an E-N block. The minimum excess reactivity in the reactor has been about 10 mk, providing a comfortable control margin.

Speed of Control Limit - E-Q Loads

The power level limit curves for the E-Q load in the K and BDF-type reactors are being computed. The E-Q void coefficient as a fraction of graphite temperature has been calculated for the K reactors, and work is continuing for the BDF reactors. The speed of control power level limits will be higher with E-Q loads due to the smaller prompt void coefficient.

DECLASSIFIED

Reactor Engineering - Process Water Tanks - 190-C

A 10-inch diameter sample has been removed from another 190-C tank (No. 3) and laboratory testing and evaluation have been completed. The Charpy V notch energy values were an average of 17 ft-lb at + 33°F and the yield strength and elongation were approximately the same as that indicated in the first sample. The taking of carbon test specimens has been discontinued due to recent periods of severe cold weather. In light of new information recently developed, these tests will not be resumed. Columbia Geneva Steel Co., the original supplier, has determined that the actual chemistry tests and physical properties tests performed on each plate are available and will supply this information within the coming month. Hanford personnel recently visited Dr. Earl R. Parker in Berkeley, California, to discuss the results of the sample analysis. In light of the information obtained from tests to date, Dr. Parker's general conclusion was that his concern for the potential for brittle fracture failures of the 190-C tanks was no longer valid. However, Dr. Parker recommended determining the carbon analysis of the remaining 190-C tank plates.

VSR Channel Separation Plugging

A 46 layer mockup simulating observed VSR channel separation has been built to test the effectiveness of various separation caulking or plugging techniques. A method has been developed for tamping graphite chips into the separations which appears promising. Separation plugging by this method could be effective in minimizing ball loss. One difficulty with this method, however, is that the chips can be easily dislodged. A procedure is now being developed to coat each graphite chip with sugar. It is expected that once installed in the reactor, the sugar coating would melt and fuse the graphite particles together. Further development and testing work are required before an in-reactor test can be attempted.

VSR Graphite Distortion

The second prototype set of VSR liner sleeves has been successfully installed in Channel #41 at 105-C Reactor. Only minor amounts of difficulty were encountered with either the channel boring or sleeve installation operation. The graphite cutting rates were significantly improved over initial attempts, with instantaneous rates of 1.2 to 1.5 inches per minute achieved. The high strength polycrystalline graphite liner installed in this channel will provide a basis of comparison with the regular grade polycrystalline graphite liner previously installed in Channel #28 at C Reactor. These sleeves were also recently inspected. This inspection showed that the sleeves were in good condition with no apparent damage after approximately 18 months in reactor service, other

January 18, 1965

VSR Graphite Distortion - cont.

than minor amounts of wear from VSR insertion. The external loading which is being applied to these sleeves by the reactor stack is still undetermined. The design and fabrication of the 105-K Reactor biological shield boring machine has been completed and preliminary testing is underway in the vendor's plant. On site fabrication of the K Reactor thermal shield boring machine is currently 70% complete with final completion scheduled for late January.

Reactivity and Control Studies

An examination of ball drop implications at C Reactor was completed during the month. A ball drop at this time is estimated to require \$400,000 actual costs for added enrichment during the boron burnout and about \$100,000 in equivalent production losses. These estimates are comparable to the losses experienced in the 1961 ball drop at DR Reactor. Total control at the C Reactor would appear to be possible with Ball 3X hoppers locked out and only vertical rods used in the channels most vulnerable to residual ball effects.

Higher Graphite Temperature Test

A production test PT-IP-725 has been prepared to authorize an increase of 50°C in graphite temperature at F Reactor. The test will be started shortly after the first of the year. The objective of this test is to evaluate the graphite - CO₂ reaction at higher graphite temperature.

Replacement of Horizontal Control Rods - C and K Reactors

Fabrication of boron carbide and aluminum elements by General Astrometals Corp. for use in assembling two more flexible HCR prototypes was completed late in November. Assembly of the first K Reactors more flexible rod was accomplished by the vendor. The assembly of this rod was accomplished without any significant problems being encountered. Testing at 189 D of this prototype has been initiated prior to installation in a K Reactor.

Effluent Activity Data

The table below shows the average concentrations of five radio-nuclides in reactor effluent samples taken during November 1964. All units are 10^{-12} curies/ml.

<u>Reactor</u>	<u>As⁷⁶</u>	<u>p³²</u>	<u>Zn⁶⁵</u>	<u>Cr⁵¹</u>	<u>Np²³⁹</u>
B	126	5.3	5	390	170
C	127	9.4	10	930	180
D	77	8.2	14	420	88
DR	70	7.9	13	520	110
F	56	6.8	11	330	95
H	84	12.3	5	420	115
KE	64	7.6	8	140	81
KW	54	6.5	5	120	72

C Reactor Incident

An unintended power rise occurred at C Reactor on November 26 when half-rods were incorrectly inserted to accomplish reactor shutdown during a start-up operation. Peak power exceeded pre-insertion level by about 20 percent, and the reactor was shutdown by a flux monitor high trip. Measures under consideration to prevent recurrence include a previously authorized design change which will cause activation of the deadman switch during half-rod insertion, and the use of the audible alarm during insertion of half-rods past their point of maximum effectiveness.

DECLASSIFIED

UNCLASSIFIED
Files

-10-

January 18, 1965

100-K Reactor Coolant Backup System

Engineering investigations in support of the program to improve flow conditions in the 100 K emergency coolant backup systems have continued. These studies have been extended to include possible solutions as cement mortar lining of the pipe (partial), a deaerating system which would reduce corrosive attack by removal of oxygen from the water and flow-restrictive devices intended to divert optimum flow to the reactor in need of emergency coolant. This change in emphasis has been undertaken as a result of the conclusion reported previously that there is not an economical method currently available for painting the inside of the cross-tie piping system to protect against further particle buildup in the system.

Prototype High Speed Scanner

The prototype system has continued to operate since November and without failure. Total accumulated operational hours are 30,119.

January 18, 1965

-11-

Files

OUTAGES () December 1964

Reason	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	63.3	110.9	60.6		53.4	52.4	70.3	70.0	480.9
Maintenance	9.1	50.9	24.6	9.4	32.0	41.1	5.1	11.8	184.0
Rupture Removal	36.4	1.8		50.7	2.3		8.6		99.8
Leak Testing					25.2			25.5	50.7
Tube Replacement		8.7	13.6		3.0	12.4			37.7
Project Work	7.1								7.1
Production Tests	3.5	21.0	5.7		1.5		15.1	4.5	51.3
Standard Check	3.5	2.8	1.3			2.8		4.8	15.2
Instrumentation									
Equipment									
Miscellaneous	2.6	.5	2.3		15.0		7.0	2.3	29.7
Total	125.5	196.6	108.1	60.1	132.4	108.7	106.1	118.9	956.4
Scheduled Outages									
Unscheduled Outages									

RECEIVED

RUPTURED SLUG TABULATION FOR December 1964

Tube No.	Date Charged	Date Ruptured	Tube Power (KW)	Concentration MWD/Ton	Assigned Production Loss		Observation
					MWD	Days	
4189 KE	8-19-64	12-4-64	1981	962			I&EES Side Ledge Corrosion
2676 F	10-16-64	12-8-64	1290	463			I&EN Side Hot Spot
3581 B	9-2-64	12-13-64	1291	748			I&EN Unknown - Not Examined
3686 B	11-14-64	12-16-64	1235	260			I&EN Unknown - Not Examined
2561 DR	11-20-64	12-21-64	1310	130			I&EN Unknown - Not Examined
1961 DR	11-20-64	12-23-64	1300	133			I&EN Side Hot Spot
1961 B	11-14-64	12-25-64	1251	357			I&EN Unknown - Not Examined
3369 C	11-23-64	12-31-64	1436	361			I&EE Side Hot Spot

END

**DATE
FILMED**

9 / 16 / 92