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TITLE

MONTHLY RECORD REPORT - JULY 1965
RESEARCH AND ENGINEERING OPERATION
IRRADIATION PROCESSING DEPARTMENT

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AUTHOR

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RL-REA-2248-D

August 4, 1965

MONTHLY RECORD REPORT

RESEARCH AND ENGINEERING OPERATION
IRRADIATION PROCESSING DEPARTMENT

BY

T. W. Ambrose

JULY 1965

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VISITORS

Name	Firm & Location	Date	Purpose
RC Courtright ED Falk JE Kinzer DB West	Atomics International Canoga Park California	6/28 - 7/2/65	Witness charging and startup NAA-115-2

VISITS

Name	Firm & Location	Date	Purpose
RW Pitman	American Water Works National Conference Portland, Oregon	6/28 - 7/2/65	To attend conference
RD Jensen	Union Carbide Oak Ridge, Tenn.	7/22-24/65	To discuss Pu computer model
AD Vaughn	ANL (Chicago AEC office)	7/22/65	Familiarization with ANL reactors
	Fuels Standards Meeting (Nuclear Materials Management organization) Chicago, Illinois	7/23/65	Working subcommittee meeting
R Nilson	AEC-Division of Operational Safety Washingtion, D. C.	7/27/65	Attend Reactor Safety Conference at Jackson Lake Lodge, Wyoming
	American Nuclear Society Jackson, Wyoming	7/28-29/65	Attend ANS meeting on Reactor Operating Experience
RG Geier	Oak Ridge Nat'l Lab. Oak Ridge, Tenn.	7/29-30/65	Discuss the application of ultracentrifuges to the Columbia River contamination problem

ORGANIZATION AND PERSONNEL

	Exempt		Nonexempt		Rotational	
	June	July	June	July	June	July
Management & Administration	3	3	3	3	0	0
Process & Reactor Development	21	21	3	3	0	0
Process Technology	22	21	7	7	1	1
Operational Physics	10	9	3	3	1	2
Testing	19	18	25	27	2	2
	75	72	41	43	4	5

Administration: J. S. Stoakes, Specialist, Administration, Termination for Transfer to Battelle Northwest, 7/15/65.
L. V. Barker, Transferred from Supervisor of Coolant Testing to Specialist, Administration, 7/15/65.

Process Technology: F. A. Snyder, Engineer II, Retired ROF, 7/31/65.

Operational Physics: M. J. Henry, RTG Transferred from NRD, 7/1/65.
G. C. Masche, Engineer, Transferred to APED, 7/30/65.

Testing: M. L. Sheldon, Secretary, on Leave of Absence, 7/9/65.

[redacted]

RESEARCH AND ENGINEERING

PROCESS AND REACTOR DEVELOPMENT

REACTOR FUELS

Depleted Uranium Irradiations

The status of the E-D loads at B and KE Reactors as of July 20, 1965, is as follows;

	B Reactor	KE Reactor
Exposure, MWD/T	1760	2025
% Pu-240	21.2	21.5
Kilogram/ton	1.9	2.2

The depleted uranium irradiations are continuing without difficulty. No indications of potential problems have been observed. Supplements to the authorizing documents have been issued to allow extension of the irradiation time to produce 25 wt% Pu-240. Analysis of dimensional change data from the three depleted uranium columns discharged from the KE Reactor at 1500 MWD/T shows that the outside diameters are increasing with exposure while the average warp has decreased from previously observed values. This behavior is consistent with that of standard fuel elements. Additional monitor columns are scheduled for discharge in early August.

Thoria Irradiations

Two thoria failures occurred during the report period, one in the C Reactor fringe loading and the other in the KW Reactor central zone loading. These bring the total number of thoria failures to 20. The failure in the KW Reactor occurred in a lot which had received additional inspection during manufacture and is the only one which has occurred in the 24,000 thoria elements produced under the tighter inspection criteria.

All central-zone thoria loadings have been discharged. Reloading of the fringe tubes of the D and KW Reactors with thoria loadings is complete; the remaining reactor fringe zones will be recharged with thoria loadings in early August.

Longer Fuel Program

The authorizing document to permit the irradiation of ten-inch, oil-quenched enriched fuel elements has been approved. Charging of the test elements is scheduled for an August outage.

[redacted]

STATUS REPORT OF PRODUCTION TESTS

Test No.	Type Metal	Tubes	Reactor	Goal Exposure	Current Exposure	Remarks
IP-216-A	Normal production natural and enriched fuel elements.	22	All	Normal variable goal.		Provides for monitoring the performance of a sample of all normal production material to assist in development of Quality Index for production fuel. Test is continuous.
IP-669-A	Depleted U target elements.	92	B	2200 MWD/T	1760 MWD/T	Irradiation of ten tons of depleted elements for production of 18 w/o Pu-240. Irradiation extended to permit production of up to 25 w/o Pu-240.
IP-694-A	Depleted U target elements.	74	KE	2400 MWD/T	2025 MWD/T	Irradiation of 12 tons of depleted elements for production of 18 w/o Pu-240. Irradiation extended to permit production of up to 25 w/o Pu-240.
PITA-31	ThO_2 target elements.	193	KW	175 operating days		Initial loading of thoria elements in fringe zone process tubes for production of clean U-233. Elements charged during September 30, 1964, outage. Discharge and recharging occurred July 6, 1965.
PITA-31	ThO_2 target elements.	166	D	165 operating days		Production of clean U-233. Elements charged during October 19, 1964, outage. Discharge and recharging occurred July 16, 1965.
PITA-31	ThO_2 target elements.	168	B	160 operating days	184 operating days	Production of clean U-233. 140 columns of elements charged during November 14, 1964, outage; 28 columns charged during January 7, 1965, outage.

STATUS REPORT OF PRODUCTION TESTS (cont'd.)

Test No.	Type Metal	Tubes	Reactor	Goal Exposure	Current Exposure	Remarks
PITA-31	ThO_2 target elements.	168	C	165 operating days	153 operating days	Production of clean U-233. Elements charged during December 24, 1964, outage.
PITA-31	ThO_2 target elements.	190	KE	150 operating days	167 operating days	Production of clean U-233. Elements charged during December 31, 1964, outage.
PITA-33	ThO_2 target elements.	131	KW (core)	47 operating days		Production of clean U-233. Elements charged during January 4, 1965, outage. Charge-discharge accomplished March 1, 1965, and May 4, 1965. Final discharging accomplished during July 6, 1965, outage.
PITA-35	ThO_2 target elements.	89	KE (core)	42 operating days		Production of clean U-233. Elements charged during April 10, 1965, outage. Charge-discharge undertaken on May 20, 1965. Final discharge accomplished during June 27, 1965, outage.

[redacted]

[redacted]

[redacted]

REACTOR ENGINEERING

Downcomer Flow and Temperature Limits

Experimental data have been obtained of the downcomer pressures at the KE Reactor for both shutdown and operating conditions. These initial results are inconclusive, and a full check of the pressure sensing line location, operation, and calibration will be required before full evaluation of the test results can be completed.

Zircaloy Process Tube Hydriding

Seventeen additional nozzle inserts were removed from the KE Reactor and analyzed for hydrogen. The total hydrogen content varied from 29 to 332 ppm, compared to a range of 86 to 570 ppm obtained from the first 24 nozzle inserts removed from KE. No correlation between the hydrogen content of the nozzle inserts and process tubes has been determined at present.

The high-frequency, eddy-current hydride detector was tested on four tubes in the KW Reactor on July 9, 1965. The readings obtained appeared meaningful and were reproducible. Two of the tubes were removed for hydrogen analyses to further evaluate the detector.

F Reactor Storage Basin Test

The F Reactor storage basin heat generation test was successfully conducted as planned. The main water supply to the basin was shut off about six days and fourteen hours after shutdown. During the 24-hour test period, the basin temperature rose linearly at a rate of about 0.8 C per hour. This corresponds to a heat generation rate of 3740 kw. A flow of approximately 500 gpm was returned to the basin on July 3. The ΔT measured was 28 C; this corresponds to a measured heat generation rate of about 3680 kw. From theoretical heat decay data, the heat generation rate of the fuel in the basin is estimated at 3900 kw.

The test clearly showed that neither significant channeling nor stratification occurs in the basin at the conditions tested. Essentially no variation in temperature was noted front-to-rear, side-to-side, or top-to-bottom in the basin with zero and 500 gpm coolant flow rates. At a flow rate of about 1200 gpm imposed just prior to turning off the water, it appeared that a difference of 2-3 C existed between the top and bottom of the basin with the coldest temperature at the bottom.

An apparent basin leak rate of 120 gph was found from the level drop below the lowest weir while water was shut off. Order of magnitude calculations indicate that a significant portion of this could have been due to evaporation.

[redacted]

Ribbed Zircaloy Process Tubes

The Electron Beam Techniques plant was visited on June 21, 1965, to inspect the three ribbed tubes being fabricated there. It was found that the vendor has experienced several problems which will delay completion of the tubes by about one month. The most serious problem has been straightening of the tubes after welding of the ribs. The 16-foot sections end up with about five inches of bow when they are removed from the welding fixture. Straightening these in a three-roll straightener cracked one section and caused one of the ribs to break loose in another. Some "break-out" of the weld was found in two tubes to misalignment of the rib and weld bead. Also, the combined welding and straightening operations have resulted in some shortening of the tubes.

Graphite-Water Vapor Reaction Studies

The first graphite test blocks have been removed from a large heated mock-up which is designed to investigate the water vapor reaction with K-size graphite blocks under simulated K Reactor conditions. After operation for a three-week period at 950 C and with gas containing water vapor equivalent to an inlet dewpoint of +30 F flowing across the blocks, the blocks were found to be severely oxidized. The oxidation was so rapid that the downstream sections of the eight-foot long test section were essentially unoxidized because there was no water left in the gas at that point. Some indication of the speed of this reaction at these conditions may be seen by considering that essentially all the water reacted over a length of several feet of block while the gas was traveling at about 11 inches per second. Little oxidation was observed in the interior of the blocks indicating that the rate of reaction was so rapid in comparison to the diffusion rate of water through the block that essentially all reaction took place on the surface.

REACTOR PHYSICS

High Power Level Trip Protection

Calculations were made of the maximum reactivity insertion rates permissible to assure adequate automatic high level protection is provided by the zone temperature monitor system (ZTM) for the three smaller reactors.

Satisfactory protection can be provided to B and D Reactors from five per cent of level to full level if the rod withdrawal is limited to one HCR at a time with a withdrawal time no shorter than 110 seconds. Calculations have not been completed for C Reactor, but the corresponding minimum time will be about 130 seconds for removing one rod.

A similar study was made for the K Reactors using the High-Speed Scanner system. The simultaneous withdrawal of two HCR's (simultaneous withdrawal of four HCR's is physically possible) at the K Reactors falls safely within the fixed trip feature of the scanner system for tube powers at and near equilibrium. For peak tube powers of 75 per cent of equilibrium and the fixed trip on outlet temperature only, the minimum withdrawal time for two HCR's at a time should be increased from the present 55 seconds to about 65-70 seconds.

The effect of linear rate-of-rise trip on rod withdrawal time, which will be included in the high-speed scanner system at the K Reactors and is being procured as a separate instrumentation system at the smaller reactors, has not been determined.

Slower RTD response time assumption, as may be necessary, depending on the results of the current RTD development and testing program, could require even slower rod withdrawal rate.

Critical Mass

The effect on k_∞ of the amount of free metal in UO_3 water mixtures was investigated using the GAMTEC II computer code. The results were compared with experimental data on k_∞ for $UO_3 + H_2O$ mixtures. The following k_∞ values were obtained:

	$UO_3 + H_2O$ (1.034 w/o U-235)(H/U=5) Calculated	$UO_3 + H_2O$ (1.034 w/o U-235)(H/U=5) Experimental	$U + H_2O$ (1.034 w/o U-235)(H/U=5) Calculated
k_∞	0.997	1.000	1.014

Based on further computational extrapolations for a uranium enrichment of 0.96 w/o U-235, it was established that a mixture of UO_3 and five per cent metallic uranium particles, homogeneously distributed in the UO_3, would be safe from a criticality standpoint under any conditions. These studies are necessary for shipping agglomerate materials off-site.

RADIOLOGICAL ENGINEERING

Radiation Control Experience

The following table summarizes the radiation exposure experience for critical IPD classifications through 26 weeks of the 1965 badge year:

Classification	Total Dose	No. of Employees	Average Dose Per Employee	Extrap-olated Year End Average	No. of Employees Over 3 R Extrapolated Exposure
Radiation Monitors	91000 mR	54	1685 mR	3435 mR	46
Processing Operators	272390	190	1434	2923	94
Pipefitters	58030	61	951	1939	5
Millwrights	56790	57	996	2030	5

[redacted]

Radiation Occurrences

Six Radiation Occurrences were reported during the period. Two involved uncontrolled exposure to personnel during spline insertion operations. In both cases the splines stuck upon insertion and withdrawal caused activation of the radiation control alarm. Two involved the uncontrolled shipment of radioactive material or contaminated equipment. In one of these cases, radioactive krypton was received on plant and handled without radiation control. The other cases involved: (1) an unposted entry to a radiation zone which caused an employee to enter the zone without protective clothing, and (2) contamination in a truck bed found on a routine survey.

	Distribution by Reactor and Component							
	B	C	D	F	H	KE	KW	Totals
Processing				1			1	2
Maintenance				1	1			2
Supplemental Crews				1				1
Research and Engineering			1					1
Outside IPD			1					1
	0	0	2	2	1	0	1	6

Vertical columns do not necessarily add up to indicated totals because, in some cases, a Radiation Occurrence is chargeable to more than one component.

Effluent Activity Data

The table below shows the average concentrations of five radionuclides from effluent samples in June 1965. All units are 10^{-12} curies per milliliter.

Reactor	As-76	P-32	Zn-65	Cr-51	Np-239
B	144	10.7	9.2	340	135
C	207	8.8	26.6	935	220
D	51	6.3	18.7	250	91
F	85	11.0	21.4	320	150
KE	42	7.2	10.0	135	56
KW	68	5.6	10.9	150	81

There were no significant changes made in the treatment of reactor coolant during the month. The F Reactor was shutdown for deactivation on June 25, 1965.

[redacted]

Dose Rate Telemetering

The dose rate telemetering system fabricated by Tracerlab Company arrived on July 14, 1965. The testing and evaluation program conducted to date show that there have been no failures on the part of the vendor to meet the specifications. The installation of the equipment is planned for KE Reactor during the first unscheduled outage in August.

F Reactor Confinement System Tests

Confinement system tests are being performed in association with the deactivation of the F Reactor. On July 10, 1965, the first of the tests was made using iodine-128 as a tracer. The iodine-128 was injected into the supply air stream for the discharge area. "May-pack" samplers for determining iodine concentration in air were set up to sample air from several locations in the exhaust duct. Analysis showed a 99.4 per cent efficiency for retention of I-128 between the discharge area and the outlet of the charcoal filters. Much of this efficiency was due to plate-out in the exhaust system. This test will be rerun to verify results.

Repeat of the above test with the fog spray activated showed complete removal of iodine in the discharge area.

On July 16, a test was performed to investigate the potential of foam to trap noble gases and halogens. About 14.5 curies of argon-41 were released in the work area and 138 curies of iodine-128 were released into the supply air to the discharge area. A 45,000 cfm foam generator installed in the confinement system from which the filters had been removed just upstream of the reactor stack. It was activated at the same time the tracers were released and was operated for about 10 minutes.

The Atmospheric Physics group of Battelle-Northwest lofted a 35-pound lift, blimp-type balloon above the stack which supported a hose for sampling air from the stack plume just above the foam as it was released. This sampled air was pumped into a Kanne Chamber located in the ground-level stack instrumentation shack. The chamber showed background reading while the foam was released. After the foam generation ceased, the Kanne Chamber showed an abrupt rise in reading and slowly returned to background. This is a good indication that the radioactive tracers were well encapsulated in the foam during its release.

Additional tests are scheduled.

Production Fuels Radiation Emergency Alarms

At the request of Production Fuels, radiation emergency alarms were reviewed in view of future development work with uranium fuels enriched up to two per cent. Two additional alarm systems were recommended to cover 3716 Building and the 303 storage building where the higher enrichment metal will be present. An additional recommendation was made to consider a wide area alarm system which would cover all buildings and facilities in the 303 Area instead of adding alarms as needed.

PROCESS TECHNOLOGY

PROCESS STANDARDS

HW-46000 B, Process Standards - Reactor

Five revised standards were issued during the report period. These were:

Process Standard D-030 - "Process Tube Replacement and Stuck Fuel Element Removal"

The hydrostatic test pressure for newly installed tubes was reduced. Process tube probe measurements were authorized to determine tube acceptability if installation forces exceeded specified values.

Process Standard D-060 - "Emergency Evacuation of Personnel"

The standard was updated to terminology used in current emergency planning. A requirement to replace caps on process tubes prior to evacuation was added. A requirement for locking out rod power switches was deleted since interlocks now in service already accomplish this requirement.

Process Standard F-010 - "Process Material"

Zirconium tube prints were specified. A new spline lubricant was authorized. Gas atmosphere pressure requirements during rear-face decontamination were reduced.

Process Standard H-030 - "Shipment of Irradiated Fuel Elements"

The standard was completely revised. References to C and J slugs were deleted. Enriched uranium fuel formerly designated 0.96 w/o U-235 has been revised to 0.95 w/o U-235, which more accurately represents the actual isotope content. Shipping requirements for irradiated fuel transfer to the Separations Plant were simplified.

Process Standard H-040 - "Processing Various Enrichments and/or Physical States of Uranium"

The standard was expanded to permit handling fully enriched uranium.

HW-46000 K, Process Standards - Reactor

Three revised standards were issued during the report period. These were:

Process Standard D-060 - "Emergency Evacuation of Personnel"
Process Standard H-030 - "Shipment of Irradiated Fuels"
Process Standard H-040 - "Processing Various Enrichments and/or Physical States of Uranium"

The revisions to these standards were essentially identical to the revisions reported for the same standards in HW-46000 B above.

HW-27155 Rev. 1, Process Standards - Water Plant

Two revised standards were issued during the report period. These were:

Process Standard 190-B-010 - "Process Water Piping"

The standard was revised to delete special requirements related to H Reactor and to combine the requirements of 190-B-080 into Standard 190-B-010.

Process Standard 190-B-070 - "Emergency Water Requirements - B, C, and D Water Plants"

The standard was re-issued to delete requirements for deactivated water plants and to provide requirements for operating the refised export system and the new diesel-powered last-ditch system for B and C Reactors.

PROCESS CHANGE AUTHORIZATIONS

Nine Process Change Authorizations were issued during the report period. These were:

PCA #5-32 - "Reactor Building Exhaust Fans - Diesel Engines, KE and KW Reactors"

The process change authorized removal from service of one diesel-driven confinement system exhaust fan for a three-day period.

PCA #5-33 - "Halogen Monitor, Confinement System - C Reactor"

Authorization was given to operate without a confinement system halogen monitor for approximately 30 hours provided all process tubes remained capped during the period.

PCA #5-34 - "Confinement System, Fog Spray - F Reactor"

The process change authorized removal of the filtered water supply from the confinement system fog spray for a two-hour period to inspect an orifice plate in the line. All process tubes were required to be capped during the period.

PCA #5-35 - "Water Shutoff Times - B-C-D"

The process change deleted authorization to use infinite water shutoff time curves since the curves could be nonconservative for channels with voids in the reactor graphite.

PCA #5-36 - "Gas Atmosphere O_2 Requirements - C Reactor"

The process change authorized continued operation with O_2 content higher than authorized for a 24-hour period provided the gas pressure across the unit was maintained at 0.08 inches water gauge and the O_2 and N_2 content were continually decreasing.

[redacted]

PCA #5-37 - "Empty Tube Limitation, Final Discharge - F Reactor"

The process change authorized an 806 tube discharge set up over the originally specified 800 tubes as an alternate to immediate removal of some stuck charges at an estimated outage time loss of six to eight hours.

PCA #5-38 - "Vertical Bowing Measurements - C Reactor"

The process change authorized a delay of vertical bowing measurements in the top center of the reactor for a period of two months to permit completion of irradiation of thoria charged in the tubes.

PCA #5-39 - "Storage Basin Requirements - H Reactor"

Authorization was provided to extend basin temperature monitoring frequency from every eight hours to every 24 hours provided no additional irradiated metal was added to the basin.

PCA #5-40 - "Emergency Water System Trip Settings - K Reactors"

Authorization was given to set the VLWP 30 psi above the value specified in the standard. The change was required to optimize the installation and use of new "O" ring pressure switches.

TEMPORARY NUCLEAR SAFETY SPECIFICATIONS

Two Temporary Nuclear Safety Specifications were issued this period. These were:

TNS #3-65 - "Processing 1.25 w/o U-235 Enriched Uranium Solution"

The specification provided detailed criticality control instructions for receiving, processing, storing, and shipping fissile materials reclaimed from process solutions.

TNS #4-65 - "Processing Fuel Elements Used in the Hot-Die-Sizing Program"

The temporary specification authorized the use of all applicable specifications in HW-79800, "Nuclear Safety Specifications - Production Fuels," for the fuel elements listed in the TNS. The fuel elements listed in the TNS have minor differences in the inside and outside diameters from those specified in HW-79800.

MEMORANDUM OF PROCESS STANDARDS RELAXATION

One memorandum was issued during the report period. This was:

Memo. #5-6M - "C and D Reactors"

The memorandum documented the schedules for use of the zone temperature monitor in the reactor safety circuit for C and D Reactors.

[redacted]

NUCLEAR SAFETY CONTROL INSTRUCTION

One Nuclear Safety Control Instruction was issued during the report period. This was NSCI #1-65. The instruction provided critical mass control specifications to the Transportation and Maintenance Operation for handling an Atomic International NAA 115-2 Fuel Assembly.

AUDITING

During the report period, one engineer audited conformance to Process Standards by making 18 inspections at each reactor.

FUEL FAILURE EXPERIENCE

Production Fuel

Failure Date	Tube Number	Lot Number	Type of Material	Tube Power at Failure (kw)	Exposure MWD/T	Type Failure
7/5/65	4558-KW	KK-452-A	I&E E (0.94%)	1443	404	SH
7/11/65	3293-B	KZ-254-A	I&E N	759	223	SD
7/16/65	2668-D	KZ-252-A	I&E N	1140	429	SH
7/19/65	2782-C	KC-314-A	I&E E (0.94%)	1411	761	SH
7/22/65	2964-KW	KK-452-A	I&E E (0.94%)	1728	485	SH
7/28/65	3264-C	CP-808-M	I&E NS	1205	839	EM

Target Fuel

Failure Date	Tube Number	Lot Number	Type of Material	Tube Power at Failure (kw)	Per Cent of Goal	Type Failure
7/28/65	3853-C	TC-1250	Solid Thoria	112	114	EM

Legend

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The fuel is irradiated in ribbed process tubes. The weight per cent U-235 in the core material is stated.

I&E N - This is the sumbol for internally and externally cooled production reactor fuel elements of natural uranium. The fuel is irradiated in ribbed process tubes.

I&E NS - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium which have projections welded to the fuel element jacket. The fuel is irradiated in ribless process tubes.

[redacted]

First Character

S	Side	Failure occurred on the side of the fuel element.
U	Unknown	Location of failure is not known.
E	End	Failure occurred at the end of the fuel element.

Second Character

H	Hot-Spot	Failure caused by accelerated high temperature corrosion attack.
D	Mechanical Damage	Failure caused by mechanical damage to the fuel element.
N	Not examined	Failure has not been examined.
M	Defect	Failure caused by a defect in fuel fabrication.

[redacted]

OPERATIONAL PHYSICS

Pile Physics Operation

Flattening efficiency and nonequilibrium losses were both maintained near the 12-month average. A water leak at C Reactor resulted in extending the period of nonequilibrium operation subsequent to the startup of July 9. F Reactor was shut down for deactivation on June 25.

Irradiation of fringe thoria blankets continued at all five production reactors. The depleted material in the E-D block at KE has reached an accumulated exposure of approximately 2000 MWD/T and that at B approximately 1700 MWD/T.

SUMMARY OF OPERATIONAL DATA OF PHYSICS INTEREST
FOR THE MONTH OF JULY, 1965

Reactor	B	C	D	KE	KW
ECT in July (1)	1445	1460	1555	2340	2130
12-Month Average ECT	1420	1505	1450	2340	2205
Equilibrium Scram Time (2)	22	23	18	30	30
From:	6-21	6-19	6-22	6-22	6-26
To:	7-20	7-19	7-20	7-22	7-22

(1) Effective Central Tubes: This value is defined as pile power level divided by the average power of the ten most productive tubes in the reactor.

(2) This is defined as the maximum time in minutes which could elapse between scram and half-up and still permit a successful scram recovery using hot startup procedures. Equilibrium scram recoveries are not attempted at any of the reactors, and hot startup procedures are currently not authorized.

B Reactor - J. R. Langton

Operating continuity during the report period was excellent, and flattening efficiency has also continued to improve. The exposure of the depleted material in the enriched-depleted block reached approximately 1700 MWD/T during the month.

C Reactor - J. R. Heald

A rupture of process tube 4675, the top central channel, on July 8 introduced a large volume of water into the C Reactor moderator. Data obtained during startup indicated a reactivity loss of approximately 850 c-mk. The water effectively poisoned the entire far side of the reactor, so that during the time shortly after startup only the near side of the reactor exhibited tube outlet temperatures appreciably different from inlet temperature.

The technique of high-CO_2, high-graphite-temperature operation was used in an attempt to dry the reactor without recourse to special loading of enriched material. This attempt was successful, and after roughly 60 hours of operation the stack had been dried sufficiently to permit return to normal operation.

D Reactor - R. L. Miller

Flattening efficiency at D Reactor continued to be high with ECT roughly eight per cent above the 12-month average. The shutdown of June 29 terminated a 29-day operating period and was followed by a two-week operating period.

F Reactor - G. C. Masche

Final shutdown of F Reactor for deactivation occurred at 4 pm on June 25, slightly over 20 years after first critical (February 25, 1945).

KE Reactor - G. D. Baston

KE Reactor experienced good operating continuity and high flattening efficiency. The depleted material in the E-D block reached an accumulated exposure of roughly 2000 MWD/T.

KW Reactor - R. A. Dieterich

The last of the core thoria load at KW Reactor was discharged during the outage of July 5. During the subsequent startup (on July 15), the F elevator broke down, severely hampering post-turnaround spline removal. Although operating flexibility was limited, interim methods of spline removal were quickly established, and operation returned to normal after a few hours. Operating continuity during the remainder of the report period was good.

PROCESS PHYSICS STUDIES

Reactivity and Control Studies

A compilation of the parameters used in deriving the control strengths of the production reactors has been prepared in document form and will be issued shortly as RL-REA-2326. A guide for quickly checking fuel loading against enrichment limits in the water-cooled reactors, based on the parameters in RL-REA-2326, is in the final draft stage.

A curve-fitting routine has been added to the SSA code, and the entire SSA050 and SSA100 system used for prediction table generation and accountability normalization is now complete.

Production-Related Studies

The thoria blankets in KW and D Reactors were recharged during the month under authorization of Supplement VI of PITA-31. Replacement of the thoria blankets in the B, C, and KE Reactors is scheduled for late July and early August.

A survey was made of Hanford capabilities for U-233 production from thoria assuming that smaller diameter enriched fuel could be made available for the smaller reactors. Under these conditions total plant production would be equivalent or slightly greater than the plutonium-only case; U-233 would comprise approximately 13 per cent of total plant production according to the results of this survey study.

The E-D loads in the B and K reactors for production of high Pu-240 plutonium in depleted uranium continued to perform well. Average exposures in the B and KE blocks, respectively, exceeded 1700 and 2000 MWD/T during the report period.

Startup losses during the first half of 1965 were up approximately 0.1 effective day loss per startup compared to the first half of 1964, reflecting additional conservatism employed during the contractor transition period. Averages for the first half of 1965 were 0.312 effective day loss per startup for all five production reactors, 0.282 for C and the K's, and 0.343 for B and D. Corresponding averages for the first half of 1964 were 0.210 for all five, 0.181 for C and the K's, and 0.239 for B and D.

A new spline monitor shield and roller assembly, which will prevent lateral movement of the spline with respect to the probe and thus remove a major source of error in flux traverses, will be installed at the B, C, KE and KW Reactors. Drawings of the shield and roller assemblies have been completed by Facilities Engineering, and preparation of the design change by the Irradiation Testing Unit is under way. A similar assembly is already in use at the D Reactor. An additional benefit will be realized by the removal of most of the water from the spline, and thus the water-related shadowing, before the spline is exposed to the probe assembly.

Reactor Fundamentals Training

The fourth programmed learning text for operating personnel on Reactor Physics Concepts, "Control of the Pile Reaction," forwarded last month to the Reactor Personnel Certification group, has been reviewed by that component for final publication. Its issuance will complete the formal Operational Physics program of the last several years for reactor fundamentals training for operating personnel. In-plant training meetings by the assigned pile physicists will be carried out as in the past.

TESTING

PLANT ASSISTANCE - IPD

Corrosion Testing Facilities

TF-18 Operating conditions are 130 C, flow 60 gpm, 2.5 ppm sodium dichromate. Objective is to condition the system and establish operational stability.

Irradiated Process Tube Measurements

Wall Thickness Gauge (eddy-current type - WTG)

Reactor	No. of Tubes Measured	Report No.	RL-REA
B	110	18	2278
D	67	19	2397
C	18	30	2400
F	240	21	2401
Total	435		

Ex-Reactor Visual, Weight and Micrometer Measurements

Reactor	No. of Tubes Measured	Tube Samples Measured	Reason Examined
B	1	9	external leaker
C	1	20	external leaker
D	3	3	(a)
F	4	173	(b)
Total	9	205	

(a) 2 tubes - investigate cause of medium-to-severe blip on WTG trace
1 tube - determine nature of mechanical damage in tube
(b) PT IP-750 - Raw Water as a Reactor Coolant

Zircaloy tubes 2557 and 3075 KW were reassembled in the basin as to location in the reactor. Thirty-six samples were sawed from the two tubes and labeled for shipment to Battelle Northwest Laboratories for hydride analysis.

Critical Reactor Component Examination

At the request of the respective reactor Processing groups, all front-face flexible connectors were examined at KW Reactor and the six remaining snap rings were examined at KE Reactor.

Special Services

Assistance was provided the Testing Methods Unit, PNWL, on July 9 in on-reactor testing of a prototype eddy-current hydride detector and a prototype thermoelectric hydride detector. Tests were conducted in four Zircaloy tubes at KW Reactor.

Pressure Monitor System Programs

In-board Bourdon coil examination	6440	
-non-leaking coils	6439	(99.98%)
-average past two years		(99.9%)
Gauges receiving failure analysis	19	
Gauges received from Central Services	428	
-gauges accepted	410	
-acceptance rate this month		(95.8%)
-acceptance rate past month		(94.6%)

One thousand seventy-eight model 156 type pressure monitor gauges have been processed for KW Reactor and 1043 model 154 type pressure monitor gauges with model 156 type dial stops have been processed for KE Reactor to date.

Borescoping Activities - In-reactor channels were examined with the borescope as follows:

Reactor	Channel	Motion Picture Record	Purpose*
KE	VSR 50	No	2
KE	VSR 51	No	2
KE	VSR 49	Yes	2
KW	HCR 8	No	2
KW	VSR 33	No	2
KW	VSR 41	No	2
KW	VSR 59	No	2
KW	VSR 50	No	2
KW	VSR 42	No	2
KW	VSR 51	No	2
KW	2557	No	1
KW	5079	No	1
C	VSR 17	Yes	2

*1 - Routine maintenance support
2 - VSR-HCR channel problem

The following F Reactor process channels were examined before overboring of the graphite. Motion picture records were taken after the overboring operation.

2981	3083
2982	3183
2983	4085
3081	4282

HCR B channel was borescoped and a motion picture record made to ascertain the effect of overboring adjacent process tube channels.

Srline Traverses - Front-to-rear flux distribution data were taken as follows:

Reactor	No. of Tubes
KW	5

Vertical Bowing Measurements - Vertical displacement measurements were taken as follows:

Reactor	Channel or Tube	Comparison to Previous Data
B	3074	No previous data
KW	2170	No previous data
KW	4170	No previous data
D	4674	Down .13" at 19' since 8-64
C	4674	Down .53" at 21' since 12-64

Graphite Core Sampling - Graphite core samples were removed from VSR channel 24 at F Reactor.

TESTING AND IRRADIATION SERVICES - OTHER DEPARTMENTS, CONTRACTORS

Irradiations - Non-loop - Routine sample irradiations were handled as follows:

Reactor	Test Hole	Facility	Request Number	No. of Samples	Material-Purpose
D		Process channel	HAPO-098	20	Graphite (burnout rate determination)
KW		Process channel	HAPO-098	18	Graphite (burnout rate determination)
F		Process channel	HAPO-098	40	Graphite (burnout rate determination)
KW	2A	Magazine	HAPO-119	32	Graphite (cold graphite irradiation)
KW KE	2A 2D	Quickie	HAPO-172	8	Effluent water (activation analysis)
KW KE	2A 2D	Quickie	HAPO-184	52	Washington Designated Program
KW	3B	General Purpose	HAPO-236	1	Tensile specimen (creep rate study)

[redacted]

Reactor	Test Hole	Facility	Request Number	No. of Samples	Material - Purpose
KE	2D	Quickie	HAPO-252	2	Arsenic (tracer isotope production)
C		Process tube	HAPO-288	4	Impacted UO_2-PuO_2 fuel bundle (irradiation stability)
D		PCCF	HAPO-302	1	Zeolites (H^3 buildup determination)
B		Process tube	HAPO-303	9	Uranium (swelling test)
KE	2D	Quickie	HAPO-321	1	Bioassay samples (activation analysis)
D		PCCF	HAPO-331	8	Iodine (reactor confinement test)
KW	2B	Snout	HAPO-331	2	Argon (reactor confinement test)
KW		Process tube	HAPO-335	6	Zirconium tube samples (hydriding evaluation)
KW	0074	General Purpose	HAPO-223	14	Flux monitors (flux determination program)
KW	2B	Snout	HAPO-223	1	Flux monitor (flux determination program)
KW	2B	Snout	HAPO-223	5	Cobalt shapes (production rate study)

Special irradiations were handled as follows:

Irradiation of SNAP-8 Fuel Element Capsule NAA-115-2 - An enriched uranium-zirconium fuel element capsule,(Atomics International Division of North American Aviation) NAA-115-2 was charged into the bottom front-to-rear test hole 0074 KE Reactor.

Ex-Reactor Pressurized Water Loops

TF-3 - Testing continued to provide long-term corrosion data at N Reactor alternate primary coolant water conditions. Operating conditions are 293 C, 1350 psig, and pH 10.0 adjusted with lithium hydroxide.

TF-7 - Corrosion and equipment testing continued. Operating conditions are 277 C, 1125 psig, pH 10.0 adjusted with ammonium hydroxide. The test sections contain the following material:

1. PRTR fuel element for fretting corrosion
2. Two dummy fuel elements, two NIN1 fuel elements and coupons for ALK-15 crevice corrosion tests
3. A metallic spiral-wound, asbestos-filled gasket for caustic corrosion cracking
4. Special NPR type inner fuel elements for fretting corrosion
5. One KSE3 fuel element for uniform corrosion testing

6. Two coupon holders for film buildup studies
7. One Zr-2 specimen for caustic attack testing.

Legend

NIN1 - N Reactor, inner tube, natural, first model
KSE3 - KER Loops, single tube, enriched, third model

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