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IRRADIATION PROCESSING DEPARTMENT

MONTHLY REPORT

NOVEMBER, 1962

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HANFORD ATOMIC PRODUCTS OPERATION

GENERAL ELECTRIC

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TABLE OF CONTENTS

<u>SUMMARY</u>	A-1
<u>MANUFACTURING</u>	
Production Operation	B-1
Reactor Operation Statistics	B-2
Reactor Operations	B-3
Applied Reactor Engineering	B-6
<u>RESEARCH AND ENGINEERING</u>	
Process and Reactor Development	C-1
Process Technology	C-7
Operational Physics	C-13
Testing	C-17
<u>FACILITIES ENGINEERING</u>	
Design Engineering	D-1
Equipment Development	D-3
Project Engineering	D-4
<u>FINANCIAL</u>	E-1
<u>REPORTS, TRIPS AND VISITORS</u>	F-1

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HW-75692

SUMMARY

MANUFACTURING

Reactor input production (MWD) was 4.4 per cent below forecast; 1.2 per cent below at the six old reactors and 8.5 per cent below at the K's.

Over-all time operated efficiency was 69.4 per cent (70.8 per cent forecast); 70.6 per cent at the six old reactors and 65.6 per cent at the K's. Efficiency was low at the K's due to a two-week outage for tube replacement instead of one week as forecast.

There was no increase in reactor record power levels. However, both K reactors reached their administrative limits of 4400 megawatts.

Ten ruptured fuel elements, six I&E natural and four I&E enriched, were removed from the reactors. Two of the natural metal ruptures were at D (bumpered), two at F, one at C, and one at KW. Two enriched failures were at C, one at DR (bumpered), and one at F.

On the tube replacement program, 6,264 have been replaced during the year-to-date.

RESEARCH AND ENGINEERING

Power levels for all reactors except the K's have been restricted by bulk outlet water temperature limits. Power levels at the K reactors are currently restricted by AEC administrative limits.

Three columns of overbore fuel were discharged from C Reactor prior to reaching goal exposure to inspect the elements for indications of incipient failures; none was found.

Laboratory data indicate that current instability limits in the Process Standards do not exactly apply to self-supported fuel elements, smooth-bore process tubes, and modified fittings. Until additional data are obtained, limits based on C Reactor overbore tests will be specified for all smooth-bore process tubes.

Data obtained from the use of the spatial-dependent kinetics model have provided more restrictive bases for speed-of-control Standards. However, elimination of unnecessary time delays in the safety circuit at B, D and F Reactors has resulted in higher limit curves than before in spite of the use of the new model. This new and versatile digital computer code is also being applied to other reactor safety and instrumentation problems.

Studies indicate that the buildup of gas in vertical safety rods filled with boron carbide will not be a problem. C Reactor's VSR channel 28 is scheduled to be enlarged and sleeved with graphite, and a B₄C-filled VSR is to be installed. This will be the first instance of sleeving a VSR channel.

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HW-75692

Operation of KER-1 and KER-2 Loops with dummy fuel loads was started at month's end after completion of the CGI-839 acceptance tests. KER-3 Loop remained shut down because of primary pump failures. Operation of KER-4 Loop continues the test of fourteen prototype N fuel elements with a goal exposure of 2100 MWD/T.

FACILITIES ENGINEERING

The 105-K Reactor zirconium process tube replacement program continued to receive top priority. Forty tubes were received November 28, and 46 additional tubes were shipped by the supplier the same date. An additional five sets of gunbarrel flange retaining ring grooves were enlarged on both the front and rear faces of the 105-KE Reactor, and Inconel X snap rings installed. Eleven prototype impact extruded inlet nozzles (making a total of twelve) were received and found acceptable. This completes the nozzle development program.

An improved six-foot long, double tapered boring bar was used to recondition eight channels at the 105-KE Reactor. Surface finish was improved and graphite removal increased as compared to similar attempts with a prototype cutter at the KW Reactor in October. The 450-500 mil graphite removal criterion was still not met, however, at the most severely distorted junctions. Alternate concepts for channel renovation are being actively investigated.

Modification of the HAP0-designed self-supported fuel element charging machine has been completed. Laboratory and on-reactor testing of the machine and alternate nozzle adapters is in progress. Fabrication of the two vendor-designed machines is under way but is two weeks behind schedule.

The planned program of non-destructive testing and inspection of the rear face crossheader previously removed from the 105-DR Reactor was completed; final report preparation is in progress. Although stress corrosion cracking was found to be prevalent in both crossheader and fittings, there was no evidence of approach to failure.

Testing of the redesigned joints in a flexible B sized VSR indicated strength characteristics comparable to the existing design while providing a greater degree of rod flexibility. An extra length B size flexible VSR is being fabricated for testing in the 105-C Reactor in conjunction with the planned installation of polycrystalline graphite VSR channel liners.

The modification and testing of equipment for VSR channel enlargement continues at an accelerated pace to permit on-reactor testing at 105-C Reactor.

Loops Nos. 1 and 2 on Project CGI-839 (Modifications of Fuel Element Test Facilities, 1706-KER) were completed and turned over to Research and Engineering's Coolant Testing Operation on November 21 for further testing and evaluation.

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HW-75692

RESPONSIBILITY

There was no significant change in responsibilities.

FORCE SUMMARY

	<u>Exempt</u>	<u>Non-Exempt</u>	<u>Total</u>
General	6	1	7
Research and Engineering	83	57	140
Manufacturing	391	1406	1797
Facilities Engineering	89	37	126
Financial	<u>17</u>	<u>11</u>	<u>28</u>
TOTAL	586	1512	2098

SAFETY, SECURITY AND RADIATION EXPERIENCE

There were 72 medical treatment injuries, no security violations, disabling injuries or radiation exposures exceeding operational control.

INVENTIONS

All persons engaged in work that might reasonably be expected to result in inventions or discoveries advise that, to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during the period covered by this report except as listed below. Such persons further advise that, for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

<u>Name</u>	<u>Date</u>	<u>Title</u>
E. Hollister	11-19-62	Nuclear Reactor Flexible Control Unit With Variable Strength and Product Facility.
D. B. Lovett	11-1-62	Porous Plug Flow Element For Flow Control of Gaseous Mixtures.

General Manager

AB Greninger:DLD:ewm

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MANUFACTURINGMANUFACTURING OPERATION

There were no discharge goal exposure adjustments initiated during November. Exposure levels were generally lower for all fuel models except K⁴N (natural). Tube replacement work at B and fuel element failures at D were largely responsible for the lower exposures. The production of some unclassified plutonium at KE resulted in an unusually high average exposure for K⁴N elements.

November Discharge Exposure (MWD/T)

<u>Regular Uranium</u>		<u>Enriched Uranium</u>	
<u>6 Old</u>	<u>2 K's</u>	<u>6 Old</u>	<u>2 K's</u>
646	728	787	858

Rail and truck shipments of Essential Materials were as follows:

Carload shipments for IPD	-	210
Carload shipments for other Depts.	-	147
Truck shipments for IPD	-	<u>166</u>
Total		523

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MONTH	REACTOR OPERATION STATISTICS - PROCESSING										
	B	C	D	DR	F	H	KE	KW	TOTAL HOURS	% OF TIME	
NOVEMBER, 1962											
INPUT PU (% OF FORECAST)	72.6	110.0	89.1	107.6	120.3	90.0	48.0	146.8	308.4	5.3	
TIME OPER. EFF. (% OVERALL)	42.1	73.9	72.1	84.7	76.2	74.7	41.5	89.7	131.8	2.3	
NEW TUBES INSTALLED	215	0	6	5	4	156	178	0	141.3	2.5	
WATER LEAKS - TUBE	3	0	2	0	1	1	0	0	604.9	10.5	
- VAN STONE	1	0	2	0	1	0	0	0	375.9	6.5	
FUEL ELEMENT RUPTURE	0	3	2	1	3	0	0	1	43.5	0.8	
HELIUM CONSUMED - M CU. FT.	341.2	712.3	651.9	474.8	652.5	379.8	240.6	333.4	97.7	1.7	
UTILIZATION OF REACTOR OUTAGE HOURS											
CHARGE - DISCHARGE	43.9	40.9	33.1	47.3	44.1	30.9	62.0	6.2	11.8	0.2	
RUPTURE REMOVAL		76.3	4.1	1.5	37.1			12.8	47.9	0.8	
WATER LEAK	36.0		61.5	11.9	22.7	9.2			1763.2	30.6	
TUBE REPLACEMENT	189.4	18.6	8.8	17.8	15.8	126.4	219.2	8.9			
MAINTENANCE	139.4	38.4	57.6	20.7	40.0	5.2	58.5	16.1			
STANDARD CHECK	0.5			9.2			5.0	28.8			
PRODUCTION TEST	2.9	10.1	35.5	1.1	0.7	4.2	42.1	1.1			
PROJECT WORK							11.8				
OTHER	4.7	3.4		0.4	10.9	6.2	22.3				
TOTAL	416.8	187.7	200.6	109.9	171.3	182.1	420.9	73.9			
REACTOR OPERATION STATISTICS - POWER											
RIVER WATER PUMPED - M GALS.	7049.0	-	6960.0	-	3353.0	3749.3	5481.2	8057.9	34650.4		
WATER TREATED - M GALS.	1419.1	4940.2	3963.0	2864.5	3310.7	3629.2	5455.4	8057.9	33640.0		
WATER TO REACTOR - GPM NOR.	89000	100000	87500	86200	89000	84100	206200	205500	947500		
FINISHED WATER - ANALYTICAL DATA											
TURBIDITY PPM AVG.	.002	.003	.003	.003	.003	.003	.004	.003	-	-	
PH AVG.	7.00	7.00	7.06	7.05	6.91	6.99	6.60	6.59	-	-	
CL ₂ RESIDUAL PPM AVG.	.05	.05	.10	.10	.05	.14	.20	.23	-	-	
DICHROMATE PPM AVG.	.98	1.39	.98	.98	1.01	.99	1.70	1.81	-	-	
STEAM GENERATED M LBS.	57828	-	74935	-	36170	41661	26996	26744	-	-	
EVAPORATION RATE/LB. OF COAL									-	-	
EVAPORATION RATE/GAL. OF OIL	9.24	-	8.58	-	8.64	8.05	116.6	102.0	-	-	
TOTAL KW - HR GENERATED							1528800	1596000	3124800		

B-C REACTOR OPERATION

In addition to the tube replacement outage in progress at the beginning of the month, B Reactor experienced five outages, as follows: Two to correct process tube water leaks, one to repair a tube outlet thermocouple, one Panellit scram caused by a partial flow restriction and one manual scram to replace a leaking front-face pigtail connector.

Four significant outages occurred at C Reactor; three of these were to remove ruptured fuel elements and one was a scheduled outage for tube and rear-face hardware replacement. In addition, a Panellit scram was experienced and the reactor was shut down once to replace a rear-face connector elbow.

At B Reactor, 214 process tubes were replaced in November for a total of 417 during the outage.

Savings of 14.0 hours of outage time were realized with the enriched core loading during two startups at B Reactor.

At B Reactor, the following Design Changes were completed:

- No. 462, "Vertical Safety Rod Timer," which provides VSR timing data.
- No. 605, "B, D, DR and F Process Tube Rib Height Reduction, Inlet End." Eighty-four of the eighty-seven tubes installed will now receive regular length production material.
- No. 608, "VSR-HCR Interlock and Removal of the XTA Transformer - B Reactor." This Design Change prevents the HCR's from being pulled before the VSR's during a reactor startup.
- No. 650, "Rear-face Neoprene Seal Replacement - 105-B and C." This work provides a new rear-face seal of Hyaplon 40 material.

A maintenance engineer received an internal deposition, measured initially at 0.45 microcuries of Mo^{99} while inspecting a VSR channel at B Reactor. The deposition was reduced by a factor of 20 in the succeeding two days. Also at B Reactor, a maintenance employee received detectable deposition of Co^{60} , Sc^{46} and Zn^{65} while performing VSR work. At C Reactor, skin contamination to 30,000 c/m and clothing contamination to 100,000 c/m were experienced by 12 employees as a result of raising a dummy gunbarrel in the pickup chutes. The personnel were successfully decontaminated.

D-DR REACTOR OPERATION

D Reactor experienced six shutdowns. Those which resulted in appreciable outage time were two outages due to failure of fuel elements and three outages due to process tube water leaks. DR Reactor experienced five shutdowns. Those contributing appreciable outage time were caused by failure of a fuel element, failure of a Panellit line fitting and an unexplained Panellit trip.

Indications of an earthquake were detected by galvanometer motion at both D and DR Reactors at 7:30 p.m., November 5. No other evidence was found. At DR Reactor, the rear face fog spray system actuated automatically on November 27. Investigation has failed to reveal the cause of the incident.

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Acceleration tests of the recently modified boiler control system at the Building 184-D Power House were carried out on November 16. Response was satisfactory from the four boilers which were in service.

The charging of bumper fuel elements in process tubes containing natural uranium was discontinued at DR Reactor following an evaluation of the economics which indicated that production and cost could be improved by returning to the use of smooth fuel elements.

The installation of rear Van Stone flange seal inserts in all D Reactor process tubes was completed.

F REACTOR OPERATION

Production during the month was limited by four outages, one of which was a carry-over from last month due to a water leak. Three subsequent outages were caused by fuel element failures in tubes installed in August, 1962.

During the outages a total of 196 tubes was probologged and only one required replacement due to severe external corrosion.

The two original motor driven 300 GPM fire and sanitary pumps in Building 183 were replaced with new 350 GPM units. The unavailability of spare parts and the need to satisfy increased requirements for sanitary water made the change necessary.

Instrument activities included the installation of three additional rear face vertical thermocouple bundles, completing 50 per cent of this program. In addition, 10 faulty thermocouple wells and 25 rear face temperature monitor thermocouples were replaced. A total of 184 pressure monitor Panellit gauges was adjusted.

Electrical activities included replacing the No. 23 vertical safety rod clutch, adjusting all horizontal control rod brakes and solenoids, and completing the installation of an interlock in the air supply line to the charge-seater.

During the month four process tubes were removed and replaced in the reactor due to a stuck rupture, severe external corrosion and two water leaks. A fifth tube was removed due to a water leak but was not replaced. Other mechanical activities included installing a new pilot valve on No. 9 horizontal control rod two-four way valve to improve reliability, cleaning the far side high tank line for a distance of 80 feet by means of a mechanically operated roto-rooter, and relocating the CO₂ purge system in Building 115 to improve line purging.

H REACTOR OPERATION

Reactor outages included one outage to locate and isolate a water leak, a Panellit scram due to a rear nozzle adaptor fitting failure, and an extended outage for tube replacement which continued through month end. A successful recovery was made from the Panellit scram.

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The reactor rear face was decontaminated reducing radiation levels to an average of 34 mr/hr prior to the extended outage. A total of 156 process channels was retubed including the 150 removed during the extended outage and six air channels left from previous removals. The retubing brought the total tubes installed in calendar year 1962 to 1573.

An inspection of the 190 annex pump Number 2 revealed extension of cracks in the first-stage impeller and scarring of the center sleeve bushing. A spare rotating assembly was installed and the unit was returned to normal service.

Leaks developed in the bottom of the ash sluice line due to erosion of the pipe. Temporary repairs were made pending replacement of the pipe.

A remote "C" work platform control panel was installed in the regulated tool room. This station facilitates movement of the platform and resetting of the radiation alarm during poison spline removal operations.

KE-KW REACTOR OPERATION

In addition to continuation of the unscheduled outage initiated in October, KE Reactor experienced six outages. Significant outage time resulted from one outage for planned tube replacement, one to correct a fluctuation in temperature and pressure of a process tube, and one to maintain graphite temperature within established limits. Investigation during the outage associated with a tube temperature fluctuation revealed a partially plugged venturi screen. To correct the condition the venturi was replaced, the crossheader screens cleaned and the related crossheader was flushed. KW Reactor outages were one to remove a fuel element failure and one to correct higher than normal temperatures in the bottom thermal shield coolant tubes. In the latter outage, investigation revealed a partial flow restriction at the inlet to individual cooling tubes due to sediment buildup. To prevent a recurrence the supply header was cleaned, all tube flows were checked and a new screen was installed in the water supply line.

Tube replacement crews replaced 178 tubes at KE Reactor during the tube replacement outage. Two additional tubes were removed and front-to-rear sheathed thermocouple stringers were installed to obtain graphite temperature measurements. A new Inconel sheathed geminol stringer was installed in RS-7 at KE Reactor, thereby returning the channel to service.

Vertical safety rods Nos. 40, 49 and 58 at KE Reactor were rehabilitated and returned to normal service. Three bent sections of rod No. 40 were replaced and one section was replaced in rods Nos. 49 and 50.

Modification of the reactor atmosphere drying system at both reactors (Design Change 514) was completed. The revision is designed to provide increased water removal from the circulated reactor gas atmosphere.

The west clearwell and east effluent flume at 183-KE were cleared of filter sand. In addition, fine gravel was placed in the untreated filter beds at

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183-KW thereby completing the planned program to reduce sand loss from all 183 filters.

APPLIED REACTOR ENGINEERING

MAINTENANCE PRACTICES OPERATION

The inventory of B-D-F type process tubes is approximately 1,600. Orders for C type tubes are complete. Delivery of K aluminum tubes is satisfactory and schedules are being maintained by the vendors.

SPECIAL OUTAGE SERVICE OPERATION

A special splitter with the blade, tang, and body cast in one piece was used successfully at B Reactor. Conventional process splitters continue to perform with approximately one per cent failure. Of the 405 tubes split at B Reactor, four splitter failures were experienced. No problem was experienced in removing the stuck splitters. The splitter blade diameter specification for the K Reactor blades has been reduced by 20 mils to eliminate any binding.

The tool developed by Equipment Development Operation for gunbarrel regrooving has proved superior to the one formerly used. Twenty-one reactor cuts have been made at a cycle time ranging from three to 15 minutes.

The average personnel exposure required to date for over 6,000 tubes is now 38.4 mr per tube for craftsmen and 12.4 mr per tube for supervisors.

The training of personnel on zirconium Van Stone technique has been started. Central Maintenance supervision will be the first group trained.

OC Schroeder
Manager, Manufacturing

OC Schroeder:DLD:ng

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RESEARCH AND ENGINEERING

PROCESS AND REACTOR DEVELOPMENT

REACTOR FUELS

Overbore Fuel Development

Three columns of overbore fuel were discharged prior to goal during the report period to permit visual inspection of the fuel elements. The inspection was made to check for indications of incipient fuel failures; none were found.

Self-Supported Fuel

The two columns of KVNS fuel in KW Reactor, charged on October 20, have reached an average exposure of 180 MWD/T. These columns are to be discharged short of goal (in early December) in a test of the new charging machine.

Other Fuel Programs

Examination in the 105-C Metal Examination Facility of 18 monitor columns of diffusion-bonded fuel elements (PT-IP-490-A-FP) has been completed. Five of the elements have been shipped to the Radiometallurgy Laboratory for destructive examination. The test consisted of irradiating both Sylcor and Hanford hot press fuel as well as AlSi canned fuel.

Miscellaneous

A ruptured fuel element from tube 2583-D, classified as a hole failure, was examined. The cause of the failure was found to be a penetration of the spire wall by groove pitting. Four additional hole failures are currently being examined for cause of rupture.

The use of Flo-Master ink to mark elements with monitor column position numbers has been discontinued. Several recent cases of these numbers being etched into the element canwall during irradiation prompted this action. Arrangements have been made to replace all monitor columns presently in reactor storage.

REACTOR ENGINEERING

Instability Limits for Smooth-Bore Process Tubes

Heat Transfer data obtained with a C-overbore process tube mockup in the laboratory indicate that current instability limits, as specified in the Process Standards, do not exactly apply to self-supported fuel elements, smooth-bore process tubes, and modified fittings. Additional data will be obtained with the K Zircaloy-2 process tube geometry by May, 1963. In the interim, limits based upon the C-overbore tests will be specified for all smooth-bore process tubes.

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STATUS REPORT OF PRODUCTION TESTS

<u>Test No.</u>	<u>Type Metal</u>	<u>Tubes</u>	<u>Reactor</u>	<u>Goal</u>		<u>Remarks</u>
				<u>Exposure</u>	<u>Current Exposure</u>	
IP-216-A	Normal prod. natural & enriched fuel elements	90	ALL	Normal variable goal		Provides for monitoring the performance of a sample of all normal production material to assist in development of a Quality Index for production fuel. Test is continuous.
IP-272-A	I&E self-supported fuel	69	C	Variable +200		Provides for testing of CIVN geometry fuel in C Reactor ribless zirconium tubes.
IP-381-A & IP-431-A	I&E self-supported fuel overbore size	62	C	800 MMD/T		Provide preliminary qualitative data regarding irradiation behavior of larger fuel element designs.
IP-409-A	I&E self-supported fuel	2	KW	600 MMD/T	180 MMD/T	Provide qualitative data to confirm the fuel geometry design.
IP-423-A	Oil-quenched natural uranium I&E fuel elements	120	F	Variable		Provide a comparison of dimensional stability of standard water-quenched uranium fuel cores and oil-quenched cores.
IP-477-A	Fourteen 23-inch N Reactor fuel elements, KER-4	1	KE	2100 MMD/T	390 MMD/T	Elements charged 9-26-62 to evaluate N fuel at N Reactor operating conditions.
IP-490-A	Diffusion bonded natural uranium I&E fuel elements	0	C	800 MMD/T		Elements charged 5-25-62 to provide a comparison of bond qualities of AlSi bonds and solid state diffusion bonds. Test discharged on 10-18-62 after second failure at an average exposure of 640 MMD/T.

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FUEL DESIGNATION CODES

OIIN Old Reactors, second I&E model, natural uranium element.
OIIINB Old Reactors, third I&E model, natural uranium bumper rail element.
OIIIEB Old Reactors, third I&E model, enriched uranium bumper element.
CIIN C Reactor, second I&E model, natural uranium element.
CIVNS C Reactor, fourth I&E model, natural uranium self-support element.
CVNS C Reactor, fifth I&E model, natural uranium self-support element.
CVINS C Reactor, sixth I&E model, natural uranium self-support element.
KVNS K Reactor, fifth I&E model, natural uranium self-support element.
NIEL N Reactor, inner tube, enriched uranium, first model.
NINL N Reactor, inner tube, natural uranium, first model.
NAEL N Reactor, concentric tube assemblies, enriched uranium, first model.

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K Reactor Retubing with Zircaloy-2 Process Tubes

Wolverine Tube shipped 40 tubes, plus five experimental tubes for mockup testing, and 400 nozzle inserts as of November 16, 1962. The primary delay in finished tube delivery has been due to borescoping.

Hazards Summary Reports

Preparation of Hazards Summary Reports for the Hanford production reactors continued.

REACTOR PHYSICS

Uranium Recycle

The per cent of recycled fuel in the enriched fuel present in the reactors at the end of October and discharged during October are given below.

Per Cent of Recycled Fuel in Enriched Fuel

	<u>B</u>	<u>C</u>	<u>D</u>	<u>DR</u>	<u>F</u>	<u>H</u>	<u>KE</u>	<u>KW</u>
October 31 Status	99	100	100	98	99	96	100	100
October Discharge	91	100	100	97	94	93	None	100

C Overbore Conversion Ratio Measurements

Eight tubes in the center of the 44-tube overbore block in C Reactor have been selected for conversion ratio studies. Two loadings of fuel from the region have been discharged at exposures of 800 MWD/T and 400 MWD/T, and a third loading is currently being irradiated to 800 MWD/T also.

Dissolution and analyses will not be done until all remaining E-N dissolutions and analyses currently underway are completed.

Safety Studies

New Speed-of-Control Bases for Standards

New bases for Speed-of-Control Standards have been written based on the spatial-dependent kinetics model; results are more restrictive than previously. A recent design change at the three oldest reactors (B, D, and F) which removed unnecessary time delays in the safety circuit has resulted in limit curves for these reactors which are higher than previously, in spite of the use of the new model.

Seismoscope Review

Several actions are being taken or planned to implement recommendations from a recent review of the seismoscope systems. Process Standards are being revised to omit the option of bypassing the LX trip from the seismoscope when

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the reactor power level is under two MW; all three pendulums at each reactor are to be set to trip at the MM5 level and connected in a two-out-of-three coincidence logic; the annunciation feature of the power-failure relay will be restored at those reactors where it has been removed; and investigations have started to remove some of the non-fail-safe features of the seismoscopes; for example, a flexible connecting wire around the piano wire suspension for the pendulum will probably be provided.

New Digital Kinetics Code

The code CLUMSY which solves the space-dependent kinetics equation (in one dimension) is now operable. To date, results of analog speed-of-control studies and eleven-node reactor instrumentation studies have been duplicated very well with this new and versatile code.

New Flexible VSR's

Calculations indicate that the buildup of gas in B₄C-filled vertical safety rods will not be a problem. Flexible B-sized rods, filled with vibratory-packed boron carbide, are being specified as replacement rods for troublesome channels in C Reactor. During the December retubing outage at C Reactor, VSR channel 28 is scheduled to be enlarged and sleeved with graphite, and a B-size flexible, B₄C-filled VSR is to be installed. This will be the first instance of a VSR sleeving.

RADIOLOGICAL ENGINEERING

Radiation Control Experience

The following table summarizes the radiation exposure experience of critical IPD classifications through 44 weeks of the 1962 badge year.

<u>Classification</u>	<u>Total Dose</u>	<u>No. of Employ- ees</u>	<u>Average Dose/ Employee</u>	<u>Extrapo- lated Year End Average</u>	<u>No. of Employ- ees over 3r Extrapolated Exposure</u>
Radiation Monitors	190274 mr	81	2349 mr	2776 mr	16
Processing Operators	523802	269	1947	2301	1
Pipefitters	245300	124	1978	2338	24
Millwrights	187319	104	1801	2129	11

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HW-75692

Lapse of Radiation Control

Distribution by Reactor and Component

	B	C	D	DR	F	H	KE	KW	IPD Totals
Processing	0	3	0	1	2	2	1	1	10
Maintenance	0	0	1	0	1	0	0	1	3
Suppl. Crews	0	0	0	0	0	0	0	0	0
Applied Reactor Engr.	1	0	0	0	0	0	1	0	2
Research & Engineering	0	0	0	0	0	0	0	0	0
Facilities Engineering	0	0	0	0	0	0	0	0	0
Central Maintenance	0	0	0	0	0	0	0	0	0
Reactor Areas	0	0	0	2	0	1	0	1	4
Assigned Totals	1	3	1	3	2	3	2	2	17
IPD General									

Vertical columns do not necessarily add up to the indicated totals, because, in some cases, a Lapse of Control may be chargeable to more than one component.

Effluent Activity Data

The table below shows average reported concentrations of selected radio-nuclides from reactor effluent samples taken during October, 1962. All units are 10⁻¹² curies/ml.

Reactor	p32	As76	Zn65	Np239	Cr51
B	5.0	57	89	130	920
C	8.5	74	16	200	660
D	4.0	53	16	73	250
DR	2.2	56	26	99	340
F	9.1	40		No Valid Samples	
H	4.1	35	10	48	220
KE	8.4	39	22	70	450
KW	7.3	34	8	62	370

All reactor water plants were at a nominal alum feed rate of 18 ppm.

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HW-75692

PROCESS TECHNOLOGY

REACTOR POWER LEVEL LIMITATIONS

During this report period, the primary limitation to reactor power levels for all reactors except the K Reactors has been bulk outlet temperature limits. Power levels at the K Reactors are currently restricted by the AEC administrative limits.

PROCESS STANDARDS

HW-46000 B, Process Standards - Reactor

Two revised process standards were issued during the month. These were:

Process Standard A-020 - "Tube Outlet Water Temperature - Annulus Boiling Limit"

Operation in excess of the annulus boiling limit (ANB) is no longer permitted in the standard. Panellit gauge response to a pressure change is adversely affected if the associated tube is boiling. The standard was accordingly revised.

Other changes to the standard were inclusion of R values to represent a greater latitude of mixer slug usage; new curves to represent annulus boiling limits, when either the top or bottom of the annulus is the limiting factor; and authorization to use rear crossheader profile pressures when available, which will permit higher ANB limits.

Process Standard H-020 - "Handling Irradiated Enriched U-235 Slugs"

A section of this standard was re-written to cover criticality limits for discharge and storage of experimental slugs enriched up to 5.0 per cent U-235 by weight.

HW-46000 F, Process Standards - Reactor

Three revised process standards were issued during the month. These were:

Process Standard A-030 - "Pressure-Flow During Reactor Shutdown"

Changes made in this revision to the standard are as follows:

1. Minimum flow requirements to the reactor were lowered.
2. Initial flow reductions to crossheaders must now be made according to ΔP gauges in conjunction with the ΔP tables.
3. Crossheader throttling valves are now required to be opened wide upon failure of ΔP gauge.

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HW-75692

4. A setting was specified for the low-flow alarm which is actuated by the ΔP gauge.
5. The ΔP table was expanded to include higher tube powers.
6. Anticipated pressure drop values were given for each process tube cap removed along a given row.
7. Water level in the rear riser must not be greater than 40 inches above the bottom crossheader.
8. ΔP gauge use for setting and maintaining proper flow on the bottom three crossheaders was required.
9. Reference to the process guide was deleted. Basic considerations attending a ruptured tube were included in this revision.

Process Standard C-110 - "Ball 3X System"

Ball 3X hopper functional test requirements and frequency were revised. The functional test now specified permits removal of the balls from the hoppers prior to checking the operation of the dump gate. A sample of balls from each hopper is to be inspected to ensure they meet quality specifications listed in the standard.

The functional testing frequency was reduced to testing seven hoppers every six months, rather than all hoppers once per year.

Process Standard H-020 - "Handling of Irradiated Enriched U-235 Slugs"

Revisions to this standard are identical to those made for HW-46000 B, above.

HW-46000 H, Process Standards - Reactor

One revised standard was issued during the month. This was:

Process Standard C-140 - "Speed-of-Control Criterion"

To date, curves have not been presented for H Reactor to show power level limitations based upon speed-of-control criteria. Recent investigations into the speed-of-control requirements indicated a larger excursion in the bottom of the reactor than was originally predicted for a reactor power level excursion under speed-of-control considerations. This resulted in making power level limitations, under speed-of-control criteria, more restrictive than was formerly believed necessary. Therefore, a process standard is now presented to show power level limitations based upon VSR drop times, graphite temperatures, and flux squared weighted exposures.

HW-46000 K, Process Standards - Reactor

Two revised standards were issued during the month. These were:

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HW-75692

Process Standard A-040 - "Process Water Pressure Trip Settings"

Pressure trip settings were provided in this revision to the standard to establish pressure values which will initiate starting the steam-driven process water pump in 190 and the diesel-driven pumps in 182 building. These pumps were installed under Project CGI-844 to upgrade backup water systems for the K Reactors.

Process Standard H-020 - "Handling of Irradiated Enriched U-235 Slugs"

Revisions to this standard are identical to those made for HW-46000 D, above.

The abstract for the K manual was corrected and updated to reflect the standards changes made during the past year.

HW-27155 Rev1, Process Standards - Water Plant

The index for this manual was corrected and updated to reflect changes made to the water plant standards during the past year.

PROCESS CHANGE AUTHORIZATIONS

Seven PCA's were issued during the month to permit temporary deviation from Process Standards - Reactor, HW-46000. These were:

PCA #2-132 - "V-73 Valve, K Reactors"

Process Standard A-022 specifies that above a certain bulk outlet water temperature, a signal for the V-73 valve to open will initiate a #1 scram at the opposite reactor; actual opening of the valve will be delayed five seconds after initiation of the scram signal.

Modifications to the last ditch backup system under CGI-844 made this requirement obsolete.

This process change authorized a waiver of the two obsolete requirements for the V-73 valve, listed above.

PCA #2-133 - "Graphite Thermocouple Stringers, F Reactor"

Process Standard C-040 specifies that F Reactor contain seven serviceable graphite thermocouple stringers. The standard also requires replacement of faulty stringers within three months from the time of failure. During May, 1962, a graphite thermocouple stringer failed, resulting in F Reactor having less than the required number of stringers. Fabrication of a replacement stringer was nearly completed when a second stringer failed.

Authorization was given until November 26, 1962, to operate without the required number of graphite stringers until a second replacement can be fabricated.

6-9

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PCA #2-134 - "Emergency Coolant Backup, K Reactors"

On October 23, 1962, the three diesel-driven pumps in the last ditch water system were inadvertently started while KW Reactor was shut down and KE Reactor was operating. Activation of the diesel pumps caused plugging of crossheader screens at KW Reactor.

Authorization was given to close the last ditch water supply valve to the KE clearwell for approximately 30 minutes while the similar valve at KW clearwell remained closed. In addition, flushing of various piping legs was authorized under the specific conditions of the PCA to eliminate from the system the particulate matter responsible for screen plugging at KW Reactor.

PCA #2-135 - "Emergency Coolant Backup, K Reactors"

During the outage at KE, authorization was given on October 30, 1962, to do additional flushing to the crosstie system to complete flushing of pipe legs which could not be accomplished under the conditions described in PCA #2-134, above.

PCA #2-136 - "Thermal Shield Cooling, KW Reactor"

Increased power levels and graphite temperatures have made compliance to bottom thermal shield coolant temperature limits difficult to meet. However, temperatures in the bottom thermal shield and the temperature gradient through the concrete foundation appear acceptable.

Authorization was given until the first outage after December 1, 1962, to increase temperature limits on bottom shield coolant according to provisions of the PCA.

PCA #2-137 - "Tube Power and High-Pressure Dump Limits - KER Loops"

Process Standard K-010 limits the tube power in KER 3 and 4 due to the inadequacy of the primary loop's safety valve capacity to accommodate pressure increases which could occur with a full length N-type fuel charge. Modifications were made to the loop pressure relief system under Design Change No. 549 to provide dump valve actuation upon receipt of an over-pressure signal.

This process change authorized until December 5, 1962, the following: 1) increasing maximum tube power in loops 3 and 4 to design limit, 2) utilization of the process tube exit pressure alarm circuit on all loops for the high pressure dump circuit, and 3) increasing the high pressure dump trip settings to the values stated in the PCA.

PCA #2-138 - "Increased High-Flow Trip Settings for Single-Pass Operation"

Process Standard K-030 specifies the maximum permissible high-flow trip settings for KER 3 and 4 facilities. This trip is intended to shut down the reactor in event of supply water line rupture between orifice and tube.

This process change authorized until December 7, 1962, an increase in high-

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HW-75692

flow trip settings from 92,000 lbs./hr. to 103,000 lbs./hr. while on single-pass operation. Analysis indicates the expanded trip setting to be adequate, and, in addition, potential for supply line rupture should be very low on single-pass operation at low pressure and temperature.

PROCESS ASSISTANCE

One engineer audited conformance to process standards on all Processing Operations' shifts by making 17 inspections at each reactor during the report period.

RUPTURE EXPERIENCE

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Tube Power at Failure (kw)</u>	<u>Exposure MWD/T</u>	<u>Type of Failure</u>
11/2/62	3266-D	CZ-894-D	I&E NB	1153	786	Hole
11/3/62	4167-F	SY-014-A	I&E E (0.94%)	998	593	Side- Other
11/4/62	1888-C	KC-114-A	I&E E (0.94%)	1373	605	Side Hot-Spot
11/11/62	3648-KW	KF-365-A	I&E N	1662	416	Side Hot-Spot
11/13/62	1675-DR	KY-887-D	I&E EB (0.94%)	1137	950	Hole
11/14/62	1364-F	KZ-342-A	I&E N	1241	539	Side- Other
11/14/62	1282-C	KI-032-A ¹	I&E N	1296	523	Uncl.
11/22/62	3867-F	KZ-440-A	I&E N	1085	591	Side- Other
11/26/62	1458-C	KC-126-A	I&E E (0.94%)	1262	778	Side Hot-Spot
11/27/62	2777-D	KZ-411-D	I&E NB	1214	783	Hole

¹Six-inch internally and externally cooled natural uranium fuel element with attached water-mixer spool.

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HW-75692

Legend

I&E NB - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium which have projections (bumpers) welded to the fuel element jacket.

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

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

I&E EB - This is the symbol for internally and externally cooled production reactor fuel elements which have projections (bumpers) welded to the fuel element jackets. The uranium cores are enriched in U-235 and the weight per cent U-235 in the core material is stated.

Hole - Failure on the internal surface of an I&E piece probably caused by water penetration through a weld.

Side-Other - Failure probably caused by corrosion or water penetration of the external can wall or other unknown mechanism.

Side Hot-Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Unclassified - The failure did not logically fall into any of the usual types.

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HW-75692

OPERATIONAL PHYSICS

PILE PHYSICS ASSISTANCE

An unusually high rupture incidence has resulted in poor operating continuity over the report period. In addition, B, H, and KE Reactors were shut down for a significant part of the report period for tube replacement.

Mixers are currently being placed in all new charges at B, and F is expecting to follow suit shortly; no significant physics effects are expected.

SUMMARY OF OPERATING DATA OF PHYSICS INTEREST FOR THE MONTH OF NOVEMBER, 1962

Reactor	B	C	D	DR	F	H	KE	KW
ECT in November (1)	1515	1620	1470	1520	1480	1500	2495	2515
12-Month Average ECT	1495	1670	1480	1480	1480	1520	2510	2540
Equil. Scram Time (2)	23-27	23-27	18-22	18-22	15-18	13-17	20-25*	25-30*
Recording Period -								
From:	10-23	10-23	10-23	10-24	10-22	10-22	10-23	10-23
To:	11-18	11-19	11-20	11-20	11-16	11-16	11-19	11-19

*Equilibrium scram recoveries are not attempted at the K Reactors.

- (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 which may elapse between scram and first indication while still permitting a successful scram recovery.

B Reactor - J. R. Fredsall

During the most of the report period the reactor has been shut down for a tube replacement outage. Four hundred seventeen tubes were replaced, making a total of 1110 new tubes for the year to date.

The use of mixer slugs has been resumed to reduce top of annulus corrosion encountered in new tubes; their use presents no special reactivity or control problems.

C Reactor - D. W. Constable

C Reactor has experienced a number of ruptures during the past two months. No correlation has been apparent between rupture incidence and slug position. Spline flux traverse data have not indicated any severe front-to-rear flux peaking. There have been several localized power variations during the period in which the ruptures occurred which may have contributed to the problem.

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HW-75692

D Reactor - D. G. Albertson

Operation has been intermittent during the report period, with a large number of outages.

Nonequilibrium losses have increased, and ECT has remained low, primarily due to the continued nonequilibrium operating status of the reactor.

The physics aspects of differences between a 32-piece bumper loading and a 34-piece standard loading were discussed with operations management.

A manual scram was initiated when a SCM indicated period of ~ 60 seconds abruptly changed into an indicated 7 second period. The incident was explained when a shorted connector was found in the circuitry during the next outage.

DR Reactor - D. G. Albertson

There were a number of outages during the report period due to spurious Panellit trips, a rupture, and a water leak; even so, average ECT during the report period was the highest since the Ball 3X drop of 1961. (The report-period average was 1520, and the previous 12 months' average was 1480.)

The samarium dip experienced after the central block discharge was passed without operational control problems.

F Reactor - A. W. Medcalf

Spline flux-traverse data indicate no abnormal flux peaking, and no heat cycling has occurred in regions of recent ruptures.

Increased process tube corrosion has resulted in the Processing decision to resume the use of mixer elements in fuel charges, perhaps in the next outage; no physics-related problems are anticipated.

H Reactor - E. L. Conner, Jr.

The operating continuity has been very good. An excessive water collection rate required an outage during which two leakers were found; no significant reactivity or flux distribution effects were observed. Another tube replacement outage will be taken 11-24-62 when 150 fringe process tubes will be replaced.

KE Reactor - L. L. Grumme

A new monthly production record was set for the plant during October, resulting from the exceptionally good operating period in which the reactor operated continually for 32 days. This long run was capped by a week-long tube replacement outage, in which 200 tubes were replaced.

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HW-75692

KW Reactor - R. A. Chitwood

A shutdown caused by excessive bottom thermal shield temperatures following the startup of 11-13-62 required a shutdown. Flushing of the affected cooling tubes resolved the problem, averting the need for adjacent fringe poison protection.

High turnaround levels (one recently at 3700 MW) have resulted in reducing nonequilibrium losses to approximately 0.2 equilibrium day per startup.

PROCESS PHYSICS STUDIES

Reactor Safety Studies

A second report of the status of safety instrumentation criteria studies is in rough draft stage. This report covers rate-of-rise analog results, K Reactor high level results, and 11-node high level calculations for the older reactors. The "Trip" program, which incorporates pile period equations for IBM 7090 calculation, is now in running order. This program will calculate low level compounding rates, and its use will complete the spectrum of high level, linear-rate-of-rise, and low level protection based on current technology.

Data correlating octant monitor indications with tube outlet temperatures show good agreement during power level increases. Correlation between the summed front and rear chambers in a given corner with adjacent tube outlet temperatures is good at all times, but this relation varied by nearly a factor of two with respect to central tube temperatures due to normal changes in operating rod configurations. These data support similar indications from the analog nodal studies regarding octant monitor effectiveness.

Control Efficiency Studies

Reactivity evaluations for a small E-N demonstration loading for a K Reactor indicate that the correct reactivity level can be easily achieved with five different column-pattern staggering arrangements. The main planning problems for such a test, aside from installation of zirconium tubes in the appropriate block, will be concerned with procurement, fabrication, and testing of the special fuel and target elements.

Approximately 20 "gray" splines are expected to arrive on plant shortly and to be available for production testing. These splines, for use in fine distribution control at equilibrium, were fabricated by the normal sintering technique but with varying concentrations of boron. Another approach has been followed by a second vendor, namely to keep the boron concentration the same but to change spline blackness by varying the thicknesses of aluminum cladding and of the enclosed poison layer. Calculations were performed to estimate the relative dose rates from different cladding alloys proposed. The 6063 alloy has been specified as a cladding based on indications that it would cause dose rates only a factor of two greater than normal and is desirable from the fabrication standpoint. Should this alloy cause

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HW-75692

unforeseen radiation problems, a return to the 1100 alloy as a cladding material might be required.

The design and fabrication of the prototype system for automatic flux distribution control is making good progress in Instrument Development Operation. Operational Physics will write a production test shortly after the first of the year for trial of this prototype system.

Reactor Fundamentals Training

Weekly classes for Reactor Specialists and Reactor Operators, respectively, continued during the month.

A four-hour information meeting on reactor fundamentals was given on November 13 as part of the radiation monitoring training program for new members.

Participation continued during the month in the Reactor Analyst pilot classes for the operator certification program and in the preparation of physics lecture and text material for that program.

DECLASSIFIED C-16

TESTINGIRRADIATION TESTING OPERATIONIrradiations

Sample and experiment irradiations were handled as follows:

Reactor	Test Hole	Facility	Request No.	No. of Samples	Material-Purpose
KE, KW	2B, 2A	Quickie	HAPO-184	20	Washington Designated Program
KE		Process Channel	HAPO-098	20	Graphite (burnout rate study)
KW		Process Channel	HAPO-098	12	Graphite (burnout rate study)
B		Process Channel	HAPO-098	20	Graphite (burnout rate study)
D		Process Channel	HAPO-098	15	Graphite (burnout rate study)
KW	2B, 2C	Hot Graphite	HAPO-177	8	Graphite (radiation damage study)
F	E	Quickie	HAPO-219	3	Strontium (tracer isotope production)
F	E	Quickie	HAPO-272	3	GRAPHIKOTE (radioactive build-up of process tube lubricant)
KW	4C	Snout	HAPO-236	1	Molybdenum (fast neutron damage study)
KE	2A	General Purpose	HAPO-245	1	Zirconium (electrical resistivity test)
KW	4C	Snout	HAPO-274	1	Cobalt (production of gamma source)
KE	2B	Magazine	HAPO-265	1	Boron-aluminum spline (boron burnout rate study)
KE, KW	2D, 2A	Quickie	HAPO-252	4	Arsenic (tracer isotope production)
KE, KW	2D, 2A	Quickie	HAPO-254	4	Effluent water salts (effluent water radioisotope reduction study)
KE, KW	2D, 2A	Quickie	HAPO-249	2	Graphite (radiation damage study)
KE	2D	Quickie	HAPO-256	1	Plutonium (fission yields of heavy plutonium isotopes)
KE	2B	Magazine	ORNL-172	2	Cesium (isotope production)
KE	2B	Magazine	ORNL-178	7	Zinc (isotope production)
KE	2B	Magazine	ORNL-179	3	Silver (isotope production)
KE	2B	Magazine	ORNL-195	3	Tantalum (isotope production)
KE	2B	Magazine	ORNL-198	1	Antimony (isotope production)
KE	2B	Magazine	ORNL-196	4	Tin (isotope production)
KE	2B	Magazine	ORNL-202	2	Iron (isotope production)
KE	2B	Magazine	ORNL-204	1	Mercury (isotope production)
KE	3565	Front-to-Rear	HAPO-264	3	UO ₂ (corrugated fuel element)
KE	2D	Quickie	HAPO-223	6	Flux monitor foils (flux rate of KE Quickie)
KW	4B	Snout	HAPO-258	3	Molybdenum (fast fission damage study)
KW	4C	Snout	HAPO-270	1	Uranium (crystal structure formation study)

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HW-75692

Reactor	Test Hole	Facility	Request No. of No.	Samples	Material-Purpose
		*Gamma	HAPO-171	1	Plastics and rubber (damage study)
		*Gamma		2	Concrete (damage study)

*Gamma irradiation facility is located in 105-KE Building storage basin

H-1 Loop

Corrosion test No. 2, PT IP-450-D - Irradiation of corrosion specimens in the H-1 Loop has operated 675 hours at the following reference conditions: temperature - 550 F, pressure - 1800 psi, and coolant pH 4.5 adjusted with phosphoric acid.

HAPO-266

Three corrugated natural uranium I&E fuel elements were charged in the 3565 KE Reactor test facility.

HAPO-226

A tungsten-clad W-UO₂ cermet sample was irradiated at a cladding temperature of approximately 2100 C in the 4C Snout facility at KW Reactor.

HAPO-236

Two zirconium creep capsules were discharged and one new creep capsule installed at KW Reactor.

Vertical Bowing

Tube No. 4574-B

Up .09" at 9' since 6-15-62

Down .04" at 20' since 6-15-62

Borescoping Activities

Process Channels, KW Reactor - Several channels were examined before and after broaching and/or drilling to determine the damage to trunnion blocks from these operations. This was in support of the tube replacement program.

Process Channels, KE Reactor - Several channels were examined before and after drilling with a new type drilling tool. This was in support of the tube replacement program.

VSR Channel 38, C Reactor - This channel was examined to determine the cause of blockage. A liner had fallen into the channel, completely blocking the channel.

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C-18

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HW-75692

COMPONENT TESTING OPERATION

Irradiated IPD Fuel Element Examination - 105-C Facility

Examinations were completed on fuel elements from 43 tubes requiring 241.88 fuel examination units.

Number of Tube Charges

Production Test

9	PT 216-A, Quality Certification Program
17	PT 381-A, Overbore Test Facility at C Reactor
17	PT 490-A, Evaluation of Diffusion-Bonded Fuel Elements

Photographs of five ruptured fuel elements were taken: two from C Reactor, two from F Reactor, and one from KW Reactor.

Irradiated N Fuel Element Examination - KE Facility

Density measurements and detailed visual examinations were made on 14 NAEI fuel element assemblies discharged from KER-4 on November 24. One element assembly was measured in the profilometer.

Process Tube Corrosion Monitoring Program

In-reactor measurement of 819 process tubes was completed. The number of tubes measured for each reactor and document numbers of reports issued are as follows:

<u>Reactor</u>	<u>Number Tubes Probologged</u>	<u>Report No.</u>	<u>HW-Number</u>
C	30	69	75351
KW	153	70	75409
F	48	71	75429
B	50	72	75446
KE	192	73	75504
F	24	74	75519
KW	85	75	75579
KE	200	76	75580
F	25	77	75605
C	12	78	75606

Visual examination was completed on 17 process tubes as follows:

<u>Reactor</u>	<u>Number of Tubes</u>	<u>Reason Removed</u>	<u>HW-Number</u>
B	3	Leakers	75485
KW	2	Corrosion studies	75520
D	4	Corrosion studies	75527
F	1	Leaker	75614
DR	2	Leaker and corrosion studies	75636
H	2	Outlet flange failure and leaker	75637
D	3	Two outlet flange failures and one leaker	75638

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HW-75692

Critical Reactor Component Examination

An examination was made of the front face flexible connectors on newly installed and adjacent tubes at 105-KW Reactor. The detailed report of the examination was issued October 30.

Panellit System Programs

Gauges repaired, calibrated by Maintenance	54	
Gauges meeting calibration criteria	40	(74.9%)
-previous month		(94.4%)
In-board gauge reliability examination	1193	
Gauges meeting examination criteria	1144	(95.9%)
-previous month		(98.2%)
-average for past year		(94.4%)
Response time determination	1193	
Gauges meeting response criteria	1192	(99.9%)
-previous month		(100.0%)
-average for past year		(99.7%)
In-board Bourdon coil examination	5108	
Non-leaking coils	5093	(99.9%)
-average rate past two years		(99.8%)

A total of 140 crossheader gauges and 48 KER-loop associated Panellit gauges were processed for the KE and KW Reactors.

COOLANT TESTING OPERATION

KER Loop Operation

KER-1 - The loop was chemically cleaned using a procedure recommended by NPR Engineering. In-reactor recirculation with dummy fuel elements was started on November 23 after completion of the required CGI-839 acceptance tests. PT IP-536-A authorizes charging dummy fuel elements.

KER-2 - In-reactor recirculation with dummy fuel elements charged was started on November 23 after completion of the required CGI-839 acceptance tests. PT IP-536-A authorizes charging dummy fuel elements.

KER-3 - Remained shut down because of primary pump failures.

KER-4 - Testing of fourteen 23-inch NAEI fuel elements as authorized by PT IP-477-A continued. The objective of the test is to evaluate the irradiation behavior of N Reactor fuel elements at conditions equivalent to or more severe than those expected in N Reactor. In-reactor recirculation operating conditions are 285 C maximum, 1555 psi and pH 10.

1706-KE Single-Pass Tube Operation

<u>Tube</u>	<u>Production Test</u>	<u>Water Supplied</u>	<u>Corrosion Inhibitor</u>	<u>pH</u>
SP-1 (2952-KE)	IP-476-AL	Deionized		
SP-2 (3050-KE)	IP-524-AL	Normal process	1.8 ppm dichromate	6.6
SP-3 (4355-KE)	IP-520-A	Pilot plant	1.8 ppm dichromate	6.6
SP-4 (4456-KE)	IP-520-A	Pilot plant	1.8 ppm dichromate	6.6
SP-5 (4557-KE)	IP-524-AL	Service	0.2 ppm quachrom glucosate	6.6
SP-6 (4863-KE)	IP-524-AL	Service	0.2 ppm quachrom glucosate	6.6
SP-7 (4963-KE)	IP-449-A	Deionized		
SP-8 (5063-KE)	IP-449-A	Deionized		

KE Reactor Outage Requirements

One unscheduled outage was charged to production testing. The October 30 outage was a result of momentary loss of suction pressure to the pump supplying two single-pass tubes. A total of 21.3 outage hours was charged to production tests as listed below.

<u>Production Test</u>	<u>Description</u>	<u>Hours</u>
IP-449-A	Charge-discharged, probologged and installed new front cap on SP-7; installed new sample line on SP-7 and SP-8	6.5
IP-476-AL	Charge-discharged, installed new orifice on SP-1	2.5
IP-477-A	Replaced outlet thermocouples on KER-4	3.0
IP-524-AL	Charge-discharged SP-2, SP-5, SP-6, 4561-KE, 4660-KE	7.4
IP-536-A	Leak checked and charged dummies in KER-1 and KER-2	1.9

Out-of-Reactor Facility Operation

TF-1 - Corrosion testing of A-212 carbon steel, 304 stainless steel and Zircaloy-2 at 300 C, 1600 psi and pH 10.0 was completed.

TF-2 - Testing to investigate the use of spring-loading to reduce the impact corrosion of Zircaloy-2 was continued. Operating conditions are 300 C, 1800 psi and pH 10.0.

TF-3 - The test to evaluate nucleate boiling on the surface of a Zircaloy-2 heater was completed. Additional nucleate boiling tests are being prepared.

TF-4 - Cyclic decontamination testing using the alkaline permanganate-dibasic ammonium citrate procedure without nitrogen purging was continued. Three cycles have been completed.

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TF-5 - Testing to compare the corrosion inhibition of ammonia versus lithium hydroxide in a carbon steel system was continued. Operating conditions are 290 C, 1400 psi and pH 10.0

TF-7 - Testing to determine the effectiveness of phosphoric acid and sodium dichromate as corrosion inhibitors at pH 4.5 was completed. A new test was started to evaluate fretting corrosion on a PRTR process tube at PRTR operating conditions. The operating conditions are 530 F, 1125 psi and pH 10.0. The test sections contain the following materials:

1. A PRTR fuel element for fretting corrosion studies.
2. Two NIN fuel elements and two dummy fuel elements for corrosion testing.
3. A KSE3 fuel element for corrosion testing.

TF-8 - Uniform corrosion testing of A-212 carbon steel, 304 stainless steel and Zircaloy-2 was continued. Present operating conditions are 700 F, 3300 psi and pH 10.0.

TF-13 - Heat transfer studies continued at 700 F and 125 psi.

TF-15 - Corrosion testing of stainless steel, Zircaloy-2 and Stellite was continued. Operating conditions are 900 F, 4800 psi and pH 9.0 with ammonium hydroxide and hydrazine added.

TF-17 - NPR Secondary System Prototype - Installation of the facility has been completed. The acceptance test procedure has been prepared and the acceptance tests are scheduled to be completed by November 28.

Design Test 1134 - Hydrostatic Cycling of NPR Pipe Sections - Testing of the sixteenth specimen is in progress. Testing of three specimens was completed during the report period.

H C Fullmer

for Manager, Research and Engineering

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FACILITIES ENGINEERING

DESIGN ENGINEERING

Rear Face Crossheader Examination

The planned program of non-destructive testing and inspection of the rear face crossheader removed from the 105-DR Reactor has been completed. The preparation of a final report on this inspection program is underway. Additional destructive and non-destructive inspection of the crossheader did not indicate any results significantly different from those previously reported. Although relatively severe stress corrosion cracking was found to be present in both the crossheader and crossheader fittings it was not possible to establish a finite life expectancy on the crossheader at this time; however, no evidence of rapid deterioration of the crossheader is currently apparent.

105-K Zirconium Retubing Program Design

An additional five sets of gunbarrel flange retaining ring grooves have been enlarged on both the front and rear face of the 105-KE Reactor and Inconel X snap rings installed. The prototype gunbarrel grooving tool continued to function satisfactorily during this work. A decision has been made to utilize Inconel X as the standard material for all of the new snap and retaining rings which will be installed on this program. This material was selected in preference to other materials which were evaluated due to its stress corrosion resistance and availability. The final group of 12 prototype impact extruded inlet nozzles has been received and found to be acceptable. The receipt of this additional quantity of nozzles has completed the nozzle development program and provided a basis for the fabrication of the total nozzle order. The installation specification for the retubing program has been completed and is being routed for final approval.

Graphite Distortion

Testing of the redesigned joints in a flexible B sized VSR has been completed. These tests indicated that the new joint design possesses strength characteristics equal to the existing design, yet provides a greater degree of rod flexibility. Fabrication work is underway on an extra length of B size flexible VSR. This rod will be installed in the 105-C Reactor on a test basis in conjunction with the planned installation of polycrystalline graphite VSR channel liners. The modification and testing of equipment for VSR channel enlargement continues at an accelerated pace to permit on-reactor testing at 105-C Reactor. Model II chain drive reamer has been equipped with limited depth cutters and tested successfully in the mockup. The fabrication of a full set of cutters is underway. The VSR channel thermal shield boring machine is being modified to reduce cutter chatter and increase drive shaft torque capacity.

D-1

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Rear Crossheader Expansion Joints - 105-H Reactor

Agreement has been reached regarding a change in the type of crossheader expansion joint to be installed on the rear face of 105-H Reactor. The prototype expansion joints which are installed are of the Dresser coupling type utilizing asbestos gasket material as a water seal. Service experience to date with these prototypes has indicated that under current reactor rear face operating conditions, this type of expansion joint is unsatisfactory due to leakage. Agreement has been reached that the design for the full reactor installation will be revised to provide for the installation of a conventional metallic corrugated bellows. Design is proceeding on this revised basis.

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EQUIPMENT DEVELOPMENT

105-K Reactor Zirconium Tube Program - Development

On November 19, 1962, eight channels at 105-KE Reactor were reconditioned using a six-foot long, double tapered boring bar. Improved surface finish and increased depth of cut were accomplished, but development for greater graphite removal at the most severely distorted junctions will continue. Inquiries have been made to off-site vendors for fabrication of boring bars of higher modulus material. Investigations are under way to develop a new technique of graphite removal or to reduce forces applied to the graphite during drilling operation. Contacts have been initiated with several firms requesting proposals for alternate methods. Concurrently, concepts to stabilize the boring bar with expanding pilots are being investigated.

Fabrication of subassemblies for the four work platform-mounted drilling machines has been completed. Final assembly has been initiated and is scheduled for completion during December.

Self-supported Fuel Element Charging

Modification to the HAP0-designed charging machine resulting from the on-reactor testing of October 20, 1962, has been completed. Testing of the modified machine and of alternate adapter prototypes is in progress in the laboratory. Additional on-reactor tests will be conducted as reactor shutdowns occur.

Fabrication of the two vendor-designed charging machines is progressing but is behind schedule. Current completion promise is mid-December for the Pacific Steel Products machine and the end of December for the Union Machine Works machine. Two-hundred prototype magazines are scheduled for delivery in late January.

Prototype High Speed Scanner

The prototype high speed scanner has been operating continuously since repair of the auxiliary refrigerated cooling system. Total operating hours to date are 15,824.

Design Test Service

The N-Reactor program utilized 710 hours of engineering effort for design service.

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PROJECT ENGINEERING

CGI-839, Modification of Fuel Element Test Facilities, 1706-KER

KER Loops 1 and 2 were completed and turned over to Coolant Testing on November 21, 1962, for further testing and evaluation. Phase I ATPs have been completed with minor exceptions. Pump No. 561, recently overhauled by the vendor, failed in the thrust bearing.

CGI-844, 100-K Area Coolant Backup

A report on old cross-tie line cleaning has been issued and preparation to do the work is under way.

CGI-883, Increased Process Water Flow, 100-K Area

Electrical punch list items are now being cleaned up. The final electrical system ATP remains to be completed.

The final acceptance was signed November 21, 1962, with exceptions on the vibration in the 1500 HP low lift pump motors and insufficient cooling capacity to the 190 ventilation system. Fifteen-hundred HP low lift pump, Motor Serial No. 2, was shipped to the vendor at Sunnyvale, California, for analysis as to the cause of its vibrating. Tests started November 16, 1962. Several faulty connections have been located and repaired.

CGI-905, Interim Modifications for Coolant Backup, 100-B, C, D, DR, F, and H

Beneficial use of the first area was not achieved November 15, 1962, as planned due to higher priority of outage work on Project CGI-839, and a two-day delay due to labor problems.

After rehabilitation of the surge suppressor valve by a vendor representative, it was proven that normal valve seal leakage would prevent complete cycling by the accumulator pressure. Accordingly, the cycling requirement was dropped from the ATP.

CGI-939, Analog to Digital Converter System for Temperature Monitoring, B, C, D, DR, F, and H Reactors

Field preparation work is continuing at 105-D and DR Reactors. The vendor of the electronic equipment has been advised that the differential mode voltage noise tolerance specifications must be achieved before delivery.

CAI-940, Installation of Oil Burning Facilities in Lead Boiler, 184-H

The design criteria has been approved by the Commission. Copies were delivered to AEC Engineering November 26, 1962.

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CGI-966, Safety Circuit Trip Identification Systems, 105-B, C, D, DR, F
and H Areas

The bid package for the electrical assemblies was returned by HOO-AEC with the request that the specification be rewritten to afford a functional requirement for the static switch components. The "Cypak only" specification was the result of extensive development and testing of various static switching devices and successful prototype installation at 105-DR Reactor. Justification documents are being prepared for submission to the AEC.

CGI-967, High-Speed Scanning System for Temperature Monitors, KW Reactor

A construction work release was issued to authorize the relocation of the thermal shield lead wire at the KW Reactor. This is part of the anticipated electrical noise reduction work required for proper operation of the high-speed scanner. The purchase specification for the high-speed scanner is being revised at the request of HOO-AEC.

MJA-47, Pressure Monitor Modification and Repair, 105-B, D, DR, and F

Information has been received from the AEC Procurement that the vendor has accepted the contract for Panellit gages modifications.

AR-P-25041, Portable Television Equipment for Eight Reactors

AEC Procurement advised Facilities Engineering Operation on November 21, 1962 that additional procurement delays have been incurred because of their interpretation of bids received and, at this time, no definite date could be set for awarding the contract.

R-20520, K Retubing

Forty tubes were received on November 28, 1962. Forty-six more were shipped by the vendor on the same date.

CPFF Construction Service Contractor-Liaison

Issued six new work orders and supplemented one old job for a total of \$49,116 to J. A. Jones Construction Company.

Plant Forces Work Review

The Labor Standards Board approved one job for assignment to plant forces, estimated to cost \$2,475.

Manager, Facilities Engineering

RT Jessen:dgm

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FINANCIAL

GENERAL AND PERSONNEL ACCOUNTING

US-AEC has concluded the review of the FY-1964 PA&C budget and the items previously deleted have not been reinstated. In addition, US-AEC consolidated the Plant Acquisition and Construction budget and the Equipment not Included in Construction Projects budget under the title, "Appropriation - Capital, Plant and Equipment". The change was made as a result of the House Appropriations Committee report which indicated that the equipment budget properly belonged in the capital portion of the appropriating legislation.

An additional change effected by US-AEC has been the addition of a new budget data sheet, 64-AE-2, entitled, "Construction Planning and Design," in the amount of \$5.0 million. The additional item is intended to provide for the development of precise information and reliable estimates in advance of proposals for authorization.

PRODUCT COST AND BUDGETS

Reactor Plant midyear budgets are essentially complete and have been approved by operating management.

Several meetings were held with N Reactor Department personnel and others involved with implementing the transfer of NPR responsibility to that Department. The transfer of personnel and applicable budget funds are being made in an orderly manner.

AUDITING

During the month revisions of three HAPO and ten IPD Organization and Policy Guides were issued. One new IPD Guide was issued and one was cancelled. Comments were submitted for the Department relative to proposed revisions to a HAPO OPG covering Conflicts of Interest and Company OPG covering the directive policy on the compliance with antitrust laws.

Twenty-three revisions or cancellations of AEC Manual Chapters were reviewed for their effect on IPD operations. Proposed modifications to Appendix B to the Contract were reviewed.

As a result of the review of assigned periodicals by the various Sections, subscriptions totaling approximately \$100 will not be renewed.

The General Accounting Office has notified the AEC that audit work has been completed on the records through June 30, 1959.

BUSINESS AND INFORMATION SYSTEMS

The preventive maintenance program was discussed with all the Maintenance Managers and with one or two exceptions received their enthusiastic support. A presentation will be made to the Plant Managers in the early part of December at which time a decision will be made as to the area where the pilot installation will be made.

R. E. Thomas
for Manager, Finance

SH Small:ch

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SIGNIFICANT REPORTS ISSUED

<u>Number</u>	<u>Class'n.</u>	<u>Author</u>	<u>Date</u>	<u>Title</u>
HW-75434	Unclass.	E Hollister	10/30/62	DT-1150 - 105-K Reactor Flexible HCR Fatigue Test, Ten Foot Section.
HW-75448	Unclass.	DE Cooley	10/31/62	DT-1151 - Evaluation of New P Reactor Size Flexible VSR Joint Design.
HW-75326	Unclass.	MH Schack DH Curtiss	10/19/62	DT-IP-537-AE Inconel-X Retaining Rings for 100-K Zirconium Retubing Program.
HW-75528	Unclass.	RB Bixler DH Curtiss	11/7/62	DT-IP-537-AE Supplement A Inconel-X Retaining Rings for 100-K Zirconium Retubing Program.
HW-74631	Unclass.	HC Copeland NF Fifer	11/7/62	Improvements to Gamma Monitoring Systems for 105-KE and 105-KW Engineering Concept Report.
HW-75493	Secret	KD Coughren FJ Kempf CA Munro	11/19/62	Review of Reactor Graphite Distortion Problems.
HW-75123	Unclass.	GE Peck	11/8/62	A Study of Methods for Improving the Hydraulic Characteristics of the 100-K Coolant Backup Line.
HW-75164	Secret	DF Watson	11/13/62	CGI-844, 100-K Coolant Backup System Design Basis.
HW-75628	Secret	JW Ballowe	11/26/62	Production Planning Study (Typical Reactor).
HW-75357	Unclass.	A Russell EA Wegener	10/23/62	DT-IP-538-AE Test Drilling of K Reactor Process Tube Channels.
HW-75493	Secret	KD Coughren FJ Kempf CA Munro	11/19/62	Review of Reactor Graphite Distortion Problems.
HW-75400	Unclass.	GF Howden FJ Kempf A Russell	11/2/62	PT-IP-542-AE, Installation of Channel Lining Sleeves in Two VSR Channels at 105-C Reactor.
HW-75404	Unclass.	JM Goff, Jr.	10/26/62	Test to Determine Forces to Break a "C" Overbore Zirconium Tube.

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HW-75692

<u>Number</u>	<u>Class'n.</u>	<u>Author</u>	<u>Date</u>	<u>Title</u>
HW-75525	Conf.	WEB Lander	11/15/62	Design Test 1136 - Interim Test Report, 105-K Reactor Zirconium Tube Channel Mock-up.
HWS-8278	Unclass.	R Sherrard	10/10/62	Procurement Specification for Cable to Resistance Temperature Detector Integral Assembly.
-	Unclass.	GF Howden	11/20/62	VSR Channel Sleeving Procedure for PT IP-542-AE.
-	Unclass.	JM Goff, Jr.	10/23/62	Comments on Technical Bases for NPR Process Standards, Section 1.5 Reactor Control and Nuclear Instrumentation System.
-	Unclass.	KG Hawkins	11/8/62	Design Test 1111 - Interim Report NPR Flareless Tubing Fittings.
-	Unclass.	JR Spink	11/9/62	Design Tests, 105-K Zirconium Tube Program.
-	Unclass.	M Pociluyko	11/1/62	Environmental Test Facility Status Report.

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HW-11500

TRIPS

<u>Name</u>	<u>Firm & Location</u>	<u>Date</u>	<u>Purpose</u>
V. G. Blanchette	Bonneville Power Admin.	11/8/62	Attend BPA Customers Meeting in support of studies on electric power supply systems at BAPC.
D. L. Hovorka	Norfin, Inc., Union Machine Works, Pacific Steel Prod. Co., Seattle, Washington Western Gear Everett, Washington	10/31 to 11/2/62	To discuss graphite tooling problems with prospective vendors.
P. B. McCarthy	Pacific Steel Prod. Co., Union Machine Works, Seattle, Washington	11/16/62	To observe fabrication of self-supported fuel charging machines.
C. A. Munro	National Carbon Co. New York City, N.Y.	11/12/62	To discuss graphite machining and graphite removal techniques with prospective vendors.
	A. D. Little Co., Dynatech, Inc., Cambridge, Mass.	11/13/62	
	GE-Gen. Engin. Lab. Schenectady, New York	11/14/62	
	National Carbon Co. Cleveland, Ohio	11/15/62	
	Elliott Tool Co. Springfield, Ohio	11/16/62	
R. T. Jaske	GE-Gen. Engin. Lab. Schenectady, New York	11/14 to 11/15/62	Attend Systems Engineering Symposium.
R. T. Jessen	Norfin, Inc. Union Machine Works, Pacific Steel Prod. Co. Seattle, Washington	11/2/62	Discuss graphite tooling problems and charging machine progress.
F.A.R. Stainken	S. Dakota State College Brookings, South Dakota	11/5 to 11/6/62	Represent Manufacturing Section in BS/MS recruiting.
S. S. Jones	Chas. T. Main, Inc. Boston, Mass.	10/27 to 10/31/62	Consultations regarding system.
R. S. Bell	Washington State Univ. Pullman, Washington University of Idaho Moscow, Idaho	11/8 to 11/9/62	Recruit technical personnel.

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HW-75692

<u>Name</u>	<u>Firm & Location</u>	<u>Date</u>	<u>Purpose</u>
G. F. Owsley	Univ. of North Dakota Grand Forks, N.D.	10/28 to 11/7/62	Recruiting of BS-MS candidates.
	N. Dakota State Univ. Fargo, North Dakota		" " "
	S. Dakota State College Brookings, South Dakota		" " "
O. H. Greager	Washington, D.C.	11/24 to	Attend American Nuclear
F. W. Van Wormer		12/1/62	Society Meeting.
	New York, N.Y.		Attend meeting of GETHC.
R. H. Meichle	Washington, D.C.	11/24-12/7	Attend American Nuclear
L. L. Grumme		11/25-12/1	Society Meeting
	Oak Ridge National Lab. Oak Ridge, Tennessee		Reactor physics discussions.
R. V. Dulin	Knolls Atomic Power Lab. Schenectady, N.Y.	11/24 to 12/2/62	Obtain information on testing practices.
	New York, N.Y.		Attend ASME Meeting.
R. Nilson	Univ. of Washington Seattle, Washington	11/28 to 11/30/62	Recruiting of PhD candidates.
D. H. Curtiss	Wolverine Tube Co. Inkster, Michigan	10/28 to 10/31/62	Review status of Zircaloyed process tube order.
H. A. Kramer	Public Utility District Wenatchee, Washington	10/29/62	Discuss Columbia River temperature control.
C.F. Quackenbush	DeLaval Steam Turbine Co. Trenton, New Jersey	11/6/62	Discuss pump impeller problems.
	New York City, N.Y.	11/7 to 11/8/62	Attend meetings of Materials Task Force of the Committee on Nuclear Piping.
W. E. Cawley	General Electric Co. San Jose, California	11/9/62	Consultation on metallurgical problems.
A. McDonald	Westinghouse Mfg. Co. Sunnyvale, California	11/15 to 11/21/62	Assist in analysis of K pump motor vibration problems.
F. F. Vlacil	Alcoa Co. New Kensington, Pa.	11/16/62	Discuss aluminum process tube specifications and materials.
	General Electric Co. Crotonville, New York	11/19 to 11/20/62	Participated in Fifteenth Regional Plant Engineering and Maintenance Meeting.

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HW-3564

VISITORS

<u>Name</u>	<u>Firm & Location</u>	<u>Date</u>	<u>Purpose</u>
D. Wohlgemuth D. Johannson	Bonneville Power Admin. Portland, Oregon	11/14/62	To discuss the new BPA load frequency control system.
N. H. Meyers A. W. Moody	General Electric Co. Pasco, Washington Seattle, Washington	11/15/62	To discuss scope and time estimates for the IPD Electrical Distribution System audit.
W. G. McCarthy	Pacific Steel Prod. Co. Seattle, Washington	10/27/62	To observe reactor practices during element charging.
R. W. Zarella G. E. Barb	Rockwell Mfg. Co. Seattle, Washington	11/5 thru 11/9/62	To make revisions on Rockwell valves.
A. R. Day	Byron-Jackson Co. Los Angeles, California	11/12 thru 11/18/62	To witness startup of pumps in KER Loops 1 and 2 and dis- mantling of Byron-Jackson Pump No. 368561.
A. W. Moody	General Electric Co. Seattle, Washington	11/15/62	Discuss matters relating to IPD electrical audit.
N. H. Meyers	General Electric Co. Seattle, Washington		
T. Stephens	Kaiser Engineers Oakland, California	11/19 to 11/20/62	Discuss NPR metallurgy.
R. Latham	Gray Tool Company Houston, Texas	11/27/62	NPR metallurgy.
J. Kinzer	Atomics International Canoga Park, California	10/29 to 10/31/62	Discussion of irradiation programs.
H. C. Peterson	Panellit, Inc. Richland, Washington	11/7/62	Discussion of corrosion problems.
R. G. Austin	Foxboro Instrument Co. Seattle, Washington	11/15/62	Functional check of equipment.

END

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