IRRADIATION PROCESSING DEPARTMENT

MONTHLY REPORT

OCTOBER 1963

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HANFORD ATOMIC PRODUCTS OPERATION

GENERAL ELECTRIC

RICHLAND, WASHINGTON

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IRRADIATION PROCESSING DEPARTMENT
MONTHLY REPORT
OCTOBER, 1963

Compiled By
IPD Personnel
November 15, 1963

Work performed under Contract No. AT(45-1)-1350 between the Atomic Energy Commission and the General Electric Company.

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- Operational Physics
- Testing

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- Equipment Development
- Project Engineering

FINANCIAL

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MANUFACTURING

Reactor MWD input production for October was 0.7% above forecast. A 13.3% underrun of forecast by the K Reactors was balanced by an 8.7% overrun at the smaller reactors.

Over-all time operated efficiency for October was 78.0% (77.0% forecast): 86.6% at the smaller reactors and 52.2% at the K's. The low efficiency at the K's (7.6% below their forecast) resulted largely from two unscheduled outages and an overrun of the forecast allowance for tube replacement.

No new power level or production records were established during October.

One overbore and nine normal size fuel element failures were removed from the reactors: four I&E enriched and six I&E natural. Two of the enriched ruptures were at B, one at DR and one at KW. Three of the natural metal ruptures, including two watermix pieces, were at D, one at B and one at F. The other natural metal rupture was an overbore fuel element being irradiated under a Production Test at C Reactor. Three of the October ruptures were in material designated for the unclassified plutonium program.

Three internal and four rear Van Stone leaks were corrected. A total of 650 new process tubes, including 611 zirconium, was installed.

PRODUCTION FUELS

A total of 639 tons of natural and enriched uranium fuel elements was produced during October, 106% of forecast.

Canning line operation continued through the month at a rate of eight lines per day resulting in a total of 104 canning line shifts for the month.

Canning line efficiency was 98.7% for October.

Bare core inventory at month's end was 1595 tons, a 2.9 months' supply, including 40 tons of dingot fuels.

Finished fuel inventory at month's end was 1691 tons, a 2.8 months' supply, including 133 tons of dingot fuels.

The manufacturing yield of regular natural fuels remained at the high level experienced in September. Yields of other fuels were slightly lower but were above forecast.

A test was conducted on an alternate deoxidizing compound during the month. Although the material performed well as a deoxidizer, some problems were
encountered with residue on the aluminum components and with required concentrations of the compound in the cleaning solution.

All six of the stuck sleeve removers have been installed at the quench machines and are working well. Marred surface rejects, caused by stuck sleeves, have been substantially reduced. A longer sleeve life is also being experienced because of less severe treatment in removing stuck assemblies.

Shakedown and debugging of the new double-spindle automatic welders is proceeding satisfactorily with one welder ready to operate upon completion of an evaluation of the acceptance test material. The second welder is ready for weld testing except for modification to the flash shields. The electrical check-out on the third welder is proceeding satisfactorily.

Work in process was at normal level at month's end. The only fuel elements which were backlogged were 5000 watermix elements which were canned near month's end and were awaiting the attachment of the watermix spools, prior to autoclaving and transfer to storage.

Nine normal size fuel elements failed in the reactors during October. Three fuel failures in D Reactor were attributed to cladding groove corrosion. Of the remaining six failures sustained in other reactors, three were classified as side hot spots, one as side mechanical damage, one as unknown, and the other has not been examined.

The provisional process specifications (HW-77683) for the hot die sizing process were issued.

Testing and evaluation of 740 natural hot die sized fuel elements processed for a third Production Test is essentially complete. An over-all yield of 71.1% was achieved.

Thirteen of the 19 fuel charges prepared by the hot die sizing process for irradiation under PT IP-616-A were charged in C Reactor late in September. The remaining columns are scheduled to be charged as soon as reactor space is available.

Approval was received from the AEC for the procurement of four tons of thorium oxide and two tons of thorium metal to demonstrate Hanford capability for producing U-233 low in 232 contaminant.

RESEARCH AND ENGINEERING

Power levels at all reactors were restricted by the 95 C bulk outlet temperature limit.

Twenty-five columns of enriched self-support fuel were discharged from KW Reactor using displacement-discharge techniques. Discharge forces of only 500 pounds maximum were required for those columns containing fuel fabricated to a 92 mil support height specification and irradiated to an average exposure.
of 620 MWD/T; those meeting a previous 97 mil support height specification and irradiated to 1130 MWD/T required discharge forces averaging 3200 pounds.

Ten more tests of the export system were performed. No unusual stresses were observed. The test data are now being analyzed and compared with theoretical predictions of the system's transient characteristics.

Results from analysis of thorium metal targets irradiated in F Reactor were more favorable than those from the previous irradiation of material in capsules. These data serve to verify the prediction that a portion of the U-232 content of the capsule material was due to a γ,n reaction on Th-232. The predominant source of the gammas evidently was the hard capture gamma in the aluminum surrounding the capsule. A proposal for production of 25 kg of U-233 has been prepared and forwarded to the AEC.

The concentration of sodium dichromate in reactor cooling water was reduced from 1.8 to 1.4 ppm at all plants with the exception of 100-C, which is on a half-plant test comparing water of 1.8 ppm dichromate and 1.0 ppm dichromate concentrations.

Irradiations in the KER facility continued in support of the N Reactor Department. Loop KER-1 is operating with a special thermocouple train to evaluate the crud formation and decomposition characteristics in a coolant system employing ammonium hydroxide for pH control. Exposure of a lithium-aluminum target element in KER-2 continued. Irradiation testing of regular N-fuel assemblies continued in KER-3 and KER-4; they have reached exposures of 1210 and 825 MWD/T against goals of 1500 and 2100 MWD/T, respectively.

FACILITIES ENGINEERING

Between October 12 and October 28, 611 zirconium and 28 aluminum tubes were installed in the 105-KE Reactor. There are now 1154 zirconium tubes at 105-KW and 1776 at 105-KE. To date, 4545 tubes have been received on plant of which 3700 have been accepted.

The two prototype SSFE charging machines built by the Union Machine Works were used on-reactor on two separate occasions. At each outage the high support, high exposure enriched fuel elements could not be displacement discharged. Investigation revealed that both prototype machines were developing less thrust than the design goal of 4000 pounds. Subsequent to the last outage, modifications to the hydraulic system for each prototype have been completed with both machines now capable of exerting up to 5000 pounds thrust.

Delivery of the 400 all-magnesium magazines, ordered from Dow Metals Company, is delayed by a strike at the factory. Preliminary investigation on the feasibility of all-plastic magazines has been completed. Discussions are under way with several vendors to determine interest and cost of furnishing prototype plastic magazines.
The Mark II prototype linear rate-of-rise instrumentation has completed 6520 hours with no failure. The dual indicating meters are scheduled for return by the vendor in early November.

Testing of candidate materials for VSR channel lining has been completed. Based on the results of this test program, further effort will be concentrated on polycrystalline or high strength impregnated graphite.

Work on the RLOO-AEC authorized study to determine the power recovery potential of the five smaller reactors started on October 7. Enough preliminary physics calculations have been made to permit starting formation of the system heat balance and flow sheets.

On September 22, a secondary impeller failed in one of the 275 HP pumps in the KER Loops (Project C01-839, Modifications to Fuel Element Test Facilities). Since this is the third impeller to fail in this manner in these pumps, a letter has been sent to RLOO-AEC requesting a review of this situation with the pump vendor.

RESPONSIBILITY

There were no significant changes in responsibilities.

FORCE SUMMARY

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<th>Non-Exempt</th>
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<td>2</td>
<td>9</td>
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<tr>
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<td>56</td>
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<td>Manufacturing</td>
<td>396</td>
<td>1376*</td>
<td>1772</td>
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<td>Production Fuels</td>
<td>103</td>
<td>399</td>
<td>502</td>
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<tr>
<td>Facilities Engineering</td>
<td>89</td>
<td>36</td>
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<td>20</td>
<td>14</td>
<td>34</td>
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<td><strong>TOTAL</strong></td>
<td>705</td>
<td>1883</td>
<td>2588</td>
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*Includes 10 N Reactor replacement trainees.

SAFETY, SECURITY AND RADIATION EXPERIENCE

There were 107 medical treatment injuries, two security violations, and no disabling injuries. A radiation exposure exceeding operational control occurred when a Processing Operator dislodged an irradiated spline from a spline coiler.
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.

<table>
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<tr>
<td>C. E. Frantz</td>
<td>A Device for Measuring the</td>
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<td>Inside Diameter of Zirconium</td>
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<td>Process Tubes</td>
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<td>G. L. Boehrs</td>
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<tr>
<td>G. F. Jacky</td>
<td>A Device for Maintaining</td>
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<td>in Chemical and Electro-Chemical</td>
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<td>Treatment Baths</td>
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<td>P. L. Lee</td>
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<td>G. F. Jacky</td>
<td>Electrolytic Passivation of</td>
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<tr>
<td>W. I. Clark</td>
<td>Stainless Steel Surfaces in</td>
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<td>B. Griggs</td>
<td>a Continuously Regenerated</td>
</tr>
<tr>
<td>D. D. Hays</td>
<td>Electroless Nickel Plating System</td>
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AB Greninger: DLD: bm

General Manager

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There were no discharge goal exposure changes during October. The exposure value of the material discharged equaled the record figure set last month. Some change in the discharge mix (enriched vs. regular) was responsible for a 3% increase in Pu-240 content over that experienced last month.

**OCTOBER DISCHARGE EXPOSURE (MWD/T)**

<table>
<thead>
<tr>
<th>Regular Uranium</th>
<th>Enriched Uranium</th>
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<tr>
<td>Smaller K's</td>
<td>Smaller K's</td>
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<tr>
<td>767</td>
<td>965</td>
</tr>
<tr>
<td>956</td>
<td>883</td>
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Rail and truck shipments of Essential Materials were as follows:

- Carload shipments for IPD: 298
- Carload shipments for other Depts.: 105
- Truck shipments for IPD: 100

Total: 503
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<thead>
<tr>
<th>Month</th>
<th>Reactor Operation Statistics - Processing</th>
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<tr>
<td></td>
<td>B</td>
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<tr>
<td>Input Pu (% of Forecast)</td>
<td>105.2</td>
</tr>
<tr>
<td>Time Oper. Eff. (% Overall)</td>
<td>86.3</td>
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<tr>
<td>New Tubes Installed</td>
<td>4</td>
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<tr>
<td>Water Leaks - Tube</td>
<td>0</td>
</tr>
<tr>
<td>- Van Stone</td>
<td>3</td>
</tr>
<tr>
<td>Fuel Element Rupture</td>
<td>3</td>
</tr>
<tr>
<td>Helium Consumed - M Cu. Ft.</td>
<td>106.0</td>
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<th>Utilization of Reactor Outage Hours</th>
<th>Total Hours</th>
<th>% of Time</th>
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<td>Charge - Discharge</td>
<td>43.5</td>
<td>15.9</td>
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<tr>
<td>Rupture Removal</td>
<td>21.8</td>
<td>3.8</td>
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<td>Water Leak</td>
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<td>Project Work</td>
<td>0.6</td>
<td>0.7</td>
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<tr>
<td>Other</td>
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<tr>
<td>Total</td>
<td>101.7</td>
<td>51.8</td>
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<th>Reactor Operation Statistics - Power</th>
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<td>River Water Pumped - M Gals.</td>
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<td>Water Treated - M Gals.</td>
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<tr>
<td>Water to Reactor - GPM NOR.</td>
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<tr>
<td>Finished Water - Analytical Data</td>
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<tr>
<td>Turbidity ppm avg.</td>
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<tr>
<td>pH avg.</td>
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<tr>
<td>Cl2 Residual ppm avg.</td>
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<td>Dichromate ppm avg.</td>
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<tr>
<td>Steam Generated M Lbs.</td>
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<tr>
<td>Evaporation Rate/Lb. of Coal</td>
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<tr>
<td>Evaporation Rate/Gal. of Oil</td>
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<tr>
<td>Total Kw-Hr Generated</td>
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B-C REACTOR OPERATION

B Reactor experienced six outages: three caused by ruptured fuel elements and three resulting from Panellit gauge trips during the splining operation. Two of the ruptures were enriched material and the third was dingle metal.

Three outages occurred at C Reactor: one caused by an unexplained Panellit gauge trip (0.3 hour), one caused by a power failure relay trip (0.4 hour) when a coil in the No. 8 process pump motor shorted to ground, and one caused by a ruptured fuel element.

The following design change work was completed at B Reactor:

No. 680 - Flux Level Annunciator Modification  
No. 742 - Sub-Critical Monitor Positioner Control Revision  
No. 728 - HCR Hose Guides  
No. 743 - C Platform Safety Clearance Devices

At C Reactor, vertical safety rods Nos. 36 and 41 do not fulfill the drop time criteria and are considered inoperable.

The No. 8 process pump at 190-C Building tripped off the line because of a fault in the stator windings. The stator was removed and sent to a vendor in Portland, Oregon, for repairs.

Pending further studies regarding the effectiveness of sodium silicate as a carbon steel corrosion inhibitor, the addition of this material to the process water for the reactor high tanks was discontinued.

A class "A" overhaul was completed on the No. 1 boiler at Building 184-B. During this overhaul a hole was discovered in the steam chest on the turbine draft fan. The hole was welded to prevent a flow of steam around the throttle valve.

A Processing Operator at B Reactor received an estimated 15 rad exposure to the right hand when he dislodged a coiled, irradiated spline from the spline coiler. Details of this incident will be reported in a formal investigation report.

D-DR REACTOR OPERATION

D Reactor experienced four outages; three were caused by failure of fuel elements and the other by failure of a rear Parker fitting which connects the nozzle to the flexible connector. D Reactor had two outages; one was caused by a fuel element failure and one by incorrect jumpering of a Panellit gauge.

The nominal pH of process water to the near one-half of D Reactor was lowered from 7.0 to 6.6 on October 18. The other one-half of the reactor had been
supplied with low pH since January, 1963 under Production Test IP-442-A. The addition of 10 ppm sodium silicate to the D and DR Reactor high tank water was discontinued because of ineffectiveness as a corrosion inhibitor.

Process tube wall thickness measurements at DR Reactor revealed evidence of external tube corrosion in six of 32 tubes measured in the lower five tube rows. This brings to 22 the number of such tubes known to exist in these rows.

Construction of a 1200 sq. ft. unirradiated metal storage room was completed at D Reactor. The room, designed to facilitate metal storage and handling, is located adjacent to the far side of the work area. Installation of photo-cell and tightwire systems was completed on the charging platforms at D and DR Reactors (Design Change 743). These systems provide added clearance protection to the reactor face while the platform is in motion. The four obsolete Beckman Model RXG amplifiers in the flux monitor system at DR Reactor were replaced with Beckman Model V amplifiers (Design Change 201) in order to reduce the possibility of spurious reactor scrams and to decrease maintenance expense.

F REACTOR OPERATION

Production was limited by two shutdowns: one to correct process tube water leaks and the other to remove a fuel element failure. There were 1125 process tubes leak tested and results disclosed one internal leaking tube and one rear Van Stone leak. The fuel element failure was discharged by using a maximum pushing force of 3500 pounds. The fuel element failed due to mechanical damage, probably caused by the charging machine.

The 182-F Building export system equipment operated properly through the nine steps of PT IP-599-AI, "Trip-Off of Electrical Export Pumps" conducted October 8, 10 and 11.

The No. 1 export pump at 182-F Building was on automatic start control from October 22 to month's end. The 100-B Area export pump was down for repairs.

The half-plant low alum test (PT IP-549-A) continued with a minimum feed of 6 ppm during the month.

Addition of filter media to the 183-F Building process water filters (12) was completed on October 1.

Third party inspections revealed no deviations from standards on the 184-F Building Nos. 1 and 3 boilers and the 182-F Building oil accumulator and air receivers.
Major maintenance activities supporting Process needs included the following: leak tested 1125 tubes; replaced two tubes and 19 rear face gaskets; replaced 10 rear lug rings, 12 water connectors, and two VSR clutch plates; installed two rows of Panellit gauges; completed modifications to the 105-F Building criticality alarm; and made three partial exploratory excavations for repairing effluent line couplings.

Helium consumption has been reduced about 55 per cent at present operating levels as a result of operating on Production Test IP-593-J, "Evaluation of Gas Loss Rate and Graphite Dioxide Rate at Higher Carbon Dioxide Concentration".

H REACTOR OPERATION

Production was interrupted by two minimum outages, each followed by a scram from which recovery was made. The minimum outage causes were failure of a rear nozzle adapter and the slippage of a vertical safety rod from its upper limit switch.

Failure of the rear nozzle-to-connector adapter was due to progressive cavitation. Eleven additional adapters were found to have significant cavitation and were replaced.

The winch clutch mechanism of vertical safety rod No. 24 was replaced with a reconditioned spare during the minimum outage initiated by slippage of this rod. The low limit dropout voltage was reduced from 40 volts to 30 volts. A change of oil specification to high temperature oil was made to reduce oil film on the clutch plates.

During an outage, a water leak in the far rear riser was observed in the form of a spray from the weep hole of a hanger patch pad. Examination indicated that the fault was within the area of the patch pad. Stoppage was achieved by threading and plugging the weep hole.

KE-KW REACTOR OPERATION

The one KE Reactor outage, an extended scheduled outage for process tube replacement, started October 8. As of month's end, 611 zirconium and 28 aluminum tubes were installed.

KW Reactor was shut down for metal processing on October 1, concluding a 34.6-day period of continuous operation. In addition, an outage was required to remove a fuel element failure; a short duration Panellit scram occurred during the subsequent start-up. On October 29, the reactor was shut down to correct a faulty (front face) flexible connector and remained down to perform process tube replacement work.

During flush discharge of process tubes within the tube replacement pattern at KE Reactor, a fuel element became lodged in the rear basin scum gutter. The element was removed by widening the scum gutter opening and lifting out the piece with a tong and snare arrangement. The gutter openings were covered at the beginning of flush discharge but one was apparently knocked loose by
the metal stream. To prevent a recurrence, perforated covers were welded over the gutter openings. The original covers were bolted in place.

Ninety tons of filter media were added to the 183-KE filters during the month to restore them to proper level. Plans were made to perform similar restoration work at the 183-KW filters.

Two new heat exchangers for the area ethylene glycol heating system were installed at 150-KW. Similar replacement work is under way at 150-KE. The new heat exchangers are equipped with cupro-nickel tubes.

Decontamination efforts prior to the process tube replacement work at KE Reactor reduced average radiation levels of the rear face by 60 per cent. The tube replacement block average radiation level was reduced to 26 mr/hr.

**APPLIED REACTOR ENGINEERING**

**Spare Parts Procurement**

Six vertical safety rods of the universal segmented design had been received by month's end, five of B-D-F Reactor type and one of K Reactor type.

**Equipment Maintenance Standards**

New standards were issued for the Fuel Rupture Monitoring Systems at KE and KW Reactors. These two brought the total issued to date to 54. Twenty-seven additional standards were being routed for signature approvals at month's end.

**Maintenance Tooling and Procedures**

An improved technique for the forming of Van Stone flanges on zirconium process tubes was demonstrated on KE Reactor during its October outage. This procedure, in which the gas-operated forming tool is used with one roll instead of two, reduced defective flanges from 7.9 per cent to 4.3 per cent. Moreover, subsequent re-forming of defective flanges further reduced tube loss to virtually zero.

**In-Plant Engineering**

**Electrical**

A design change (DC-810) was prepared which provides for trip circuit extensions at Buildings 165-KE and KW from the 4.16 KV bus differential lock-out relays to the 13.8 KV transformer primary breakers. The benefits from this circuitry are (1) additional bus zone coverage by bus fault protective relays and (2) faster fault clearing when faults occur in the present unprotected zone.

An evaluation report outlining a proposal for meeting the basic criteria for a high reliability power source for primary and secondary critical
instrumentation at all reactor areas was forwarded to Facilities Engineering to clarify the basic functional requirements for this work.

**Mechanical**

Design changes were prepared providing for formal authorization of the use of universal flexible vertical safety rods in the D, DR, H, KE and KW Reactors.

Engineering assistance was given B-C Maintenance with the inspection and correction of a small crack in the far-side rear riser of B Reactor. Examination showed the crack to be at the junction between riser top and the riser vent. Repair by welding was recommended.

**Instrument**

Means for improving the control of gas composition and pressure at all reactors were studied in conjunction with the Processing Operations. Based on the prototype system installed at C Reactor, it is not feasible to control gas composition automatically with such a large system capacity and such a low circulation flow. The time lag in the present pressure control is too large. A proposal for an effective system is being prepared for Processing comments.

A new circuit has been designed, assembled and tested which will permit the seismoscope at all reactors to be connected to a "two-out-of-three" trip matrix. Design embodies solid state construction and (through use of a small Ni-Cd battery) operation up to twenty-three hours without power.

Engineering assistance is being given the plant Maintenance Operations with the modification of pH meters at all six of the smaller reactors. To permit closer and more accurate pH control, the range of these meters is being changed from 0-14 to 6-8 pH.

**Industrial**

Stop watch observations of poison spline insertion and removal were completed at all reactors. Activity charts and cycle times, with suggestions for improvements to the splining systems, were submitted to the Processing Operations.

At KE Reactor, a study was made to analyze rear face contamination experience and to devise methods and procedures for use by Processing in minimizing and controlling contamination during (1) tube replacement and (2) normal charge-discharge operations.
A review of all B-C plant audio-visual instruction programs and pictorial methods manuals was completed. A composite report defining the updating or revision required was prepared for action guidance.

OC Schroeder
Manager, Manufacturing

OC Schroeder:DLD:bm
PRODUCTION FUELS

ALSI SHOP

Operating efficiency of the canning lines exceeded the forecast at 98.7 per cent for the month.

Manufacturing yields during October were maintained at the relatively high levels experienced during the previous month. The average welding yield of self-support fuels improved slightly to 97 per cent for the month.

The production of special lithium-aluminum control rod elements for N Reactor was completed, after which fabrication of solid lithium-aluminum elements was resumed.

Production of projection fuels during October was:

<table>
<thead>
<tr>
<th>Natural U</th>
<th>Enriched U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tons Produced</td>
<td>197</td>
</tr>
<tr>
<td>Finished Inventory</td>
<td>503</td>
</tr>
</tbody>
</table>

Acceptable Fuel Elements (Tons)

<table>
<thead>
<tr>
<th>Natural</th>
<th>ENRICHED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>93.2</td>
</tr>
</tbody>
</table>

Per Cent of Forecast

|          | 111 | 106 | 72 | - | 158 | | - | - | 263 | 75 | - | 106 |

Manufacturing Yields

| October  | 96 | 95 | 93 | 79 | 87 | | - | - | 90 | 85 | - |
| Forecast | 90 | 90 | 90 | - | 84 | | 90 | 90 | 90 | 85 | 84 |
| Previous Month | 95 | 94 | 90 | 84 | 86 | | - | - | 93 | - | 82 |

(1) Includes 7.0 tons of upstream fuels

DECLASSIFIED
Operating Conditions, Incidents, and Improvements

Reclamation of AlSi slops has been under way since September, 1963. During the first 19 days of October, 259 eight-inch and 225 six-inch pieces were processed by components and returned to the lathes as good pieces. Approximately four hundred pieces have been sent to storage during the month, which represents about 85 per cent of all AlSi slop rejects.

Down time recorders have been received and are being installed on the three projection welders. Procedures and instructions for the recorders are being prepared. This improvement will be of significant value in establishing accurate down time records and in pinpointing equipment problems.

Reclamation of weld reject fuels and production of four-inch normal uranium fuel elements was scheduled and performed in the Pilot Plant during October.

Autoclave Failures

There were no autoclave failures experienced in regular production during October.

MATERIALS

Fuel Recovery

The neutralization and recovery of uranium from spent acid from the N Fuels fabrication facility continued at relatively high throughput rates.

The following AlSi fuel elements were processed through the fuel recovery facilities during October:

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eight-inch Natural</td>
<td>15,046</td>
</tr>
<tr>
<td>Six-inch Enriched</td>
<td>6,528</td>
</tr>
<tr>
<td>Watermix</td>
<td>172</td>
</tr>
<tr>
<td></td>
<td>21,746</td>
</tr>
</tbody>
</table>

Hanford Test Reactor

Available reactor time was utilized as follows: 379 routine production tests were performed (235 go-no-go and 144 drift tests) representing about 70 per cent of the available time, with the remainder being utilized for special testing.

Inventories

<table>
<thead>
<tr>
<th>Inventory Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bare Core Inventory</td>
<td>1595 tons</td>
</tr>
<tr>
<td>Finished Fuel Inventory</td>
<td>1691 tons</td>
</tr>
<tr>
<td>Work in Process</td>
<td>161 tons</td>
</tr>
</tbody>
</table>
Scrap

Six shipments of metallic uranium scrap were made during the month. AlSi scrap totaled 41.0 tons of natural material and 3.6 tons of enriched. NRD shipments included 8.9 tons of natural and 24.0 tons of enriched scrap. A total of 525 empty boxes was also shipped during October.

FUELS ENGINEERING

Quality Control

The accumulation rate of upstream fuel elements is indicated by the following breakdown of material accumulated from August 30 through October 18, 1963.

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>Per Cen. of Total Upstream Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marred Surface</td>
<td>998</td>
<td>43.8</td>
</tr>
<tr>
<td>Inclusions</td>
<td>98</td>
<td>4.3</td>
</tr>
<tr>
<td>Stains</td>
<td>14</td>
<td>0.6</td>
</tr>
<tr>
<td>Rail Weld Rejects</td>
<td>63</td>
<td>2.8</td>
</tr>
<tr>
<td>Low Rails</td>
<td>587</td>
<td>25.7</td>
</tr>
<tr>
<td>Bond Rejects</td>
<td>389</td>
<td>17.0</td>
</tr>
<tr>
<td>Facing Rejects</td>
<td>132</td>
<td>5.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,281</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

A canned fuel element, which had been processed through the autoclave, was found to have a white streak running along its length. Normally, the 8001 Jacket is a uniform gray color after the autoclave test. The can was sectioned and polished through the streak areas. Examination of the sample revealed that the metal contained large particles of NaAl₃ segregated into a band just beneath the surface. Since the surface was quite free of this compound which gives the metal its dark gray color, the white streak was formed. No further evidence of segregation was observed in other cans processed from the same shipment.

Most recent data from the Quality Certification Program are consistent with the downward trend in warp of standard production material reported last month. Average post-irradiation warp of twenty-five (25) columns canned during October and November 1962 was approximately 4.5 mils. In addition to the reduction in average warp, there is objective evidence that variability in warp between fuel elements has been reduced.

Rupture Experience

A total of ten fuel element failures occurred in the reactors during October, 1963.
<table>
<thead>
<tr>
<th>Fuel Element Type</th>
<th>Tube and Reactor</th>
<th>Exposure (MWD/T)</th>
<th>Rupture Classification</th>
<th>Failure Date</th>
<th>Canning Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enriched Bumpered</td>
<td>1469-DR</td>
<td>1178</td>
<td>Unknown--Not Examined</td>
<td>10-1-63</td>
<td>12-5-62</td>
</tr>
<tr>
<td>Natural Watermix</td>
<td>1260-D</td>
<td>734</td>
<td>Side Groove Corrosion</td>
<td>10-2-63</td>
<td>10-4-62</td>
</tr>
<tr>
<td>Enriched Non-Bumpered</td>
<td>3359-B</td>
<td>546</td>
<td>Side Hot Spot</td>
<td>10-8-63</td>
<td>6-14-63</td>
</tr>
<tr>
<td>Natural Bumpered</td>
<td>1464-D</td>
<td>794</td>
<td>Hole Groove Corrosion</td>
<td>10-11-63</td>
<td>4-9-63</td>
</tr>
<tr>
<td>Natural Non-Bumpered</td>
<td>2797-F</td>
<td>476</td>
<td>Side Mechanical Damage</td>
<td>10-13-63</td>
<td>7-9-63</td>
</tr>
<tr>
<td>Enriched Non-Bumpered</td>
<td>3670-KW</td>
<td>613</td>
<td>Side Hot Spot</td>
<td>10-16-63</td>
<td>6-26-63</td>
</tr>
<tr>
<td>Natural Watermix</td>
<td>1063-D</td>
<td>795</td>
<td>Side Groove Corrosion</td>
<td>10-21-63</td>
<td>10-4-62</td>
</tr>
<tr>
<td>Enriched</td>
<td>3794-B</td>
<td>729</td>
<td>Side Hot Spot</td>
<td>10-24-63</td>
<td>4-9-63</td>
</tr>
<tr>
<td>Natural Non-Bumpered</td>
<td>2178-B</td>
<td>538</td>
<td>Side Hot Spot</td>
<td>10-25-63</td>
<td>6-17-63</td>
</tr>
<tr>
<td>Natural Dingot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Self-Support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overbore</td>
<td>1464-C</td>
<td>269</td>
<td>End Defect</td>
<td>10-29-63</td>
<td>4-9-63</td>
</tr>
</tbody>
</table>

The frequency of ledge and/or groove corrosion failures has increased. Three failures of this type occurred in October, and two in September. Significantly, all of these failures (plus the last previous "corrosion failure" in April 1963) have occurred on the near side of D Reactor. Since mid-March, the coolant pH has been controlled at 6.6 on the far side and 7.0 on the near side of this reactor. All other reactors have for some time been controlling coolant pH at 6.5.

Uranium Technology

A system has been completed by which feedsite uranium processing and product data can be rapidly and economically analyzed. Input for this system consists of eight punched cards for each ingot. These cards contain charge makeup,
Uranium Technology - contd.

casting, chemical impurities, rolling, heat treating, final inspection, dimensional inspection, and UT-2 grain size data for all I&E material. This data is stored on a continuous magnetic tape file, and any data generated within the current year will be available. The cost of one computer "pass" will be from $35 to $70, depending on the complexity of the particular job.

Continued support which has been given to the HAPO product diversification efforts has been in the area of feed material procurement and reactor element fabrication and has involved procurement inquiries, cost studies, process studies, and specification preparation.

a. High Pu-240 Program

The depleted uranium feed material specifications, originally prepared in June, were revised in accordance with new information and discussions with NLO. Substantial technical and business liaison are involved in the procurement of this material.

b. U-233 Program

The Atomic Energy Commission has approved the procurement of four tons of thorium oxide and two tons of thorium metal by IPD for feasibility studies and for the production of a 0.5 to 2.0 kg sample of U-233 for UCRL. Delivery of the metal and oxide is expected by December 1, 1963.

A Production Fuels Task Force of engineering, manufacturing, materials and financial personnel has prepared cost estimates and a proposal for processing about 75 tons of thorium oxide elements to produce 25 kg of U-233. The Task Force plans also to develop plans and costs for the assembly of elements in support of possible large-scale production efforts.

Special fine-grained enriched and natural uranium cores for all product models were received from NLO for use in preparing a large supply of grain size standards for inter-site tester control. These cores will be re-tested, identified, logged and used as primary and secondary calibration standards. Some of the standards will be returned to NLO for their use to prevent the inter-site biases that have resulted in the rejection and return of large quantities of fine-grained material from HAPO to NLO.
The external bond test continues to perform satisfactorily with the new calibration procedures, standards, and control charts. Work is progressing on the redesigned internal bond test probes. Formal prints are ready for the new probe head design.

The fabrication of artificial standards for use with the closure (UT-4) testers and covering all production fuel models has been completed. Work is progressing on standards for hot die sized and depleted uranium fuel elements. The formal drawings for all UT-4 standards are complete.

AISI Process Development

A new method of canning furnace temperature calibration is being explored wherein the AISI cooling curve is measured with the same equipment used to calibrate the canning furnace temperature measuring equipment. Information developed to date indicates that the improved accuracy of this method will result in a substantial reduction in the special enriched material external thin wall reject rate with no reduction in the average thermal spread between operating temperature and the first thermal arrest of the bath metal.

A test was conducted to determine the effect of lathe oil contamination of fuel element weld quality. The lathe oil contaminant appeared to have no detrimental effect prior to nitric etching of the weld surface; however, a drastic difference was noted after etching. Nineteen of 200 control welds were found to contain isolated pits or voids. The first 50 of these test welds inspected were rejectable because of highly porous or "spongy" weld metal. Moderate contamination of the outer weld surface with lathe oil is known to exist in the AISI Shop and the appearance of the test welds is identical to that of welds rejected for porosity.

A new steel sleeve design was evaluated during the month and performed very well. The new sleeve was designed to prevent AISI slops that occur during pressure quench and also to provide a better pressure bell-to-sleeve air seal. The AISI slop defective rate was 0.1 per cent using the new sleeves, as compared to approximately 0.5 per cent for the standard sleeve.

The provisional process specifications for ultrasonic welding have been supplemented to allow the use of an oil as an alternate for the soap lubricant. Use of oil was instituted for both self-supports and elliptical bumpers. A cold solvent degreasing process to remove the oil prior to autoclaving has proven unsatisfactory. Thorough vapor degreasing is required.

Alternate Process Development

Irradiation of the self-supported, natural hot die sized fuel elements, prepared for the initial production test (IP-546-A) in C Reactor, has progressed without incident to about 82 per cent of goal exposure. Post-irradiation measurements of two columns discharged at 400 MWD/T have been taken and the data is being analyzed.
The use of tubing for cladding hot die sized fuel elements was demonstrated. Both smooth wall and integral ribbed fuel elements were produced. Smooth wall elements were produced using 0.055, 0.070, and 0.085 inch outer tubes in conjunction with 0.055 inch inner tubes. Four and eight integral ribbed fuel models were produced with 0.085 inch outer tubing; however, the four-ribbed type was not as successful as the eight-ribbed model. Use of a four-ribbed die having the same rib design as the eight-ribbed die apparently causes a metal flow problem. A redesigned four-rib die is being obtained for evaluation.

An order for aluminum-silicon alloy components to evaluate hot die sizing process capabilities and resistance of high silicon alloys to corrosion has been modified. Price and delivery quotations on tubing fabricated from the four different alloys have been requested.

Seven hundred and forty (740) eight-inch natural ingot uranium cores were plated for the third hot die sizing process production test. Of the 8.38 per cent rejected, 2.6 per cent were for off cycle, 1.7 per cent for cracked uranium, 2.8 per cent for plating rack malfunctioning, and 1.2 per cent for process control. Plate thickness was controlled between 0.5 and 1.1 mils on the middle seven inches of the core surface, with a median of 0.8 mils. The cylindrical surface 1/2 inch from the ends measured between 0.6 and 1.5 mils with a median of 1.2 mils. Plate continuity, as determined by the muffle furnace test (20 minute exposure in a 600 C air atmosphere furnace followed by air quench) was satisfactory with only two oxide blisters formed on 23 cores tested. These defects were confined to plating rack contact point areas.

Assembly of an eight core plating rack, prototypical of the rack to be used in the automatic plating machine, was completed. In addition, a rack testing station was installed near the laboratory plating line. The testing station includes a plating tank and associated equipment essentially simulating the automatic plating machine. This equipment is being used to evaluate plating rack design prior to procurement.

Equipment Design and Development

A suitable technique was developed for applying oil to self-support rails by means of an oil dip tank and a centrifuge for removing excess oil.

An automatic rail feeder designed for the ultrasonic welders is now in check print status. This feeder will receive the rails in line from two vibratory bowl feeders. Bids have been received for the vibratory bowl feeders and delivery is scheduled in January 1964.

A contract with a commercial vendor to provide prototype quality control gauging equipment for self-supported fuel elements is now approaching approval, with completion of the contract expected by March 1964.
A work order was approved to develop an automatic machine to end mill and weld fuel elements produced by either the AISi or hot die sizing process. It is tentatively planned to use two on-site machining heads and a concept for facing and welding which does not require rotation of the fuel element during either facing or welding.

**PLANT FACILITIES**

**Status of Active Construction Projects**

**CAF-954 - High Pressure Autoclave Development Facility**

ABC Directive No. 210, Modification No. 1, dated October 22, 1963, authorized abandonment of this project. No further reports on this project are planned.

**CAF-961 - Consolidated 303 Area Services Facility - Phase I**

The detailed design drawings and specifications for the Material Handling Facility (313 Building addition) were reviewed and discussed with the AEC. The Architect-Engineer's schedule is 67 per cent, and his progress is estimated to be 59 per cent. The project proposal revision to request the construction funds is being routed for comment and approval.

**CAF-973 - Steam Distribution Line Modifications 300 Area**

The fixed-price contractor is about 54 per cent complete as compared with a schedule of 75 per cent. Late delivery of pipe expansion joints has delayed the progress. The AEC has extended the directive completion date to February 15, 1964. Due to excavation, the railroad siding south of the powerhouse is out of service. Vitro Engineering has Title III responsibility.

**CAF-979 - Pilot Scale Plating Equipment - 300 Area**

The contractor for the design and fabrication of the electroplating machine is about 65 per cent complete on the design phase and plans on completion by December 1, 1963. A revised project design schedule, incorporating the contractor's design, has been prepared and is being routed for approvals before submission to the AEC. The original schedule was issued before this contract was consummated and scheduled total design completion September 15, 1963. The revised completion date will be December 15, 1963. The delay is primarily due to problems encountered in negotiating a design-fabricate contract. Because of further delays in project completion which would be involved if a fixed price contract were to be let for the installation of the equipment, the AEC has been requested to consider installation by the Labor Service Contractor. General Electric has Title III responsibility on this project even though it is AEC managed.
CAI-994 - Utilities Extension - 300 Area

Design by Vitro Engineering is approximately 95 per cent complete with a scheduled completion date of November 1, 1963. Construction funds have been authorized. Vitro also has Title III services for this project.

CAI-107 - Boiler Replacement for Additional Steam Generating Capacity - 384 Building - 300 Area

The comment draft of the boiler specification has been reviewed and is being revised by the Architect-Engineer. Design progress is 20 per cent complete as compared with a schedule of 7 per cent. Design completion is scheduled for February 1, 1964. Only interim design funds have been authorized as this is a FY 1964 PAC line item.

CAI-120 - Utilization of PRTR Waste Steam in 300 Area Distribution System

The project proposal requesting $145,000 for piping systems extensions and modifications was forwarded to the AEC on October 29, 1963.

Equipment Modifications

Two of the newly installed double spindle automatic welders are ready for testing and production use, and the third is awaiting the results of the welding test runs.

Installation of the autoclave crane and associated equipment is completed except for a brake on the new trolley. The crane is in operation.

A recent inspection of the trichloroethylene recovery system revealed that cracks had developed in the recovery tanks adjacent to welds. Although the unit is no longer within the warranty period, the failure is premature. The vendor expressed concern and developed a procedure for repair utilizing a liquid steel compound. The vendor has requested permission to observe the actual installation and determine the extent of their liabilities or obligations in this installation.

Utilities

<table>
<thead>
<tr>
<th>Statistics</th>
<th>October</th>
<th>September</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum steam generated (M lbs/hr)</td>
<td>86</td>
<td>60</td>
</tr>
<tr>
<td>Total steam generated (M lbs)</td>
<td>35,758</td>
<td>28,061</td>
</tr>
<tr>
<td>Total condensate returned (M lbs)</td>
<td>8,072</td>
<td>5,766</td>
</tr>
<tr>
<td>Coal Consumed (tons)</td>
<td>1,808</td>
<td>1,345</td>
</tr>
<tr>
<td>Evaporation rate</td>
<td>9.89%</td>
<td>10.43%</td>
</tr>
<tr>
<td>Efficiency - actual</td>
<td>77.0</td>
<td>81.3</td>
</tr>
</tbody>
</table>

DECLASSIFIED
Statistics - contd.

<table>
<thead>
<tr>
<th></th>
<th>October</th>
<th>September</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency - optimum</td>
<td>82.2</td>
<td>81.9</td>
</tr>
<tr>
<td>Import sanitary water (M gals)</td>
<td>139.3</td>
<td>144.5</td>
</tr>
<tr>
<td>Peak water flow (gpm)</td>
<td>5,400</td>
<td>5,800</td>
</tr>
<tr>
<td>Peak water consumed in 24 hours (M gals)</td>
<td>5.0</td>
<td>5.2</td>
</tr>
<tr>
<td>Compressed air production (M scf)</td>
<td>42,000</td>
<td>38,226</td>
</tr>
</tbody>
</table>

There were two reductions in compressed air pressure during the month. Both pressure drops, each of which was only of a few minutes duration, were attributed to equipment failure caused by a transfer valve on the air dryer failing to operate properly.

Overhaul of No. 6 boiler has been completed, and it has been returned to service. Completion was delayed slightly due to the necessity to procure a new safety valve for one that had leaked during test.

Plant Services

Training classes for both Instrument craft trainees and Electrician craft trainees in the use of test equipment and trouble shooting techniques were started this month. Sessions for electricians on closed circuit television and on refrigeration fundamentals and maintenance procedures for pipefitters were also conducted. The use of programmed instruction methods of training is being investigated.

WN Mobley
Manager, Production Fuels

WN Mobley:HFT:sh
PROCESS AND REACTOR DEVELOPMENT

REACTOR FUELS

K Reactor Self-Support Fuel

During the KW Reactor outage of October 16, 1963, 25 enriched self-support fuel columns were discharged. Fourteen of these fuel columns, irradiated to an exposure of 620 MWD/T, contained elements fabricated to a minimum support height specification of 92 mils. Discharge by displacement-discharge techniques of these columns was accomplished without problems. The maximum force required to displace these columns was 500 pounds. This force contrasts with an average force of 1500 pounds required for columns of enriched elements meeting the earlier support height specification (97 mils) at about the same exposure.

The remaining 11 enriched self-support columns discharged contained elements meeting the 97 mil support height specifications irradiated to 1130 MWD/T. The forces required to displace these columns averaged 3200 pounds.

The ten columns of KVNS fuel elements charged into KW Reactor under authority of Production Test IP-572-A, Supp. A, are currently at an average exposure of 500 MWD/T. These elements were charged to evaluate the effects of displacement charging on the irradiation behavior of the self-support fuel. Discharge of the ten fuel columns is scheduled for average tube exposures of 800 MWD/T.

Hot-Die-Sized Fuel Elements

Eighteen columns of hot-die-size diffusion-bonded natural uranium fuel elements in C Reactor currently have average tube exposures of 590 MWD/T. These elements were charged under authority of Production Test IP-516-A as the initial irradiation step for this fuel concept. The elements are scheduled for discharge at 800 MWD/T.

Thirteen columns of 0.947 w/o U-235 enriched hot-die-size diffusion-bonded fuel elements were charged into C Reactor under authority of Production Test IP-616-A, during the September 21, 1963, outage. The columns were charged with 28 elements and are operating at tube powers about 92 per cent of the surrounding tube powers. Current exposure of these columns is 200 MWD/T with discharge of the columns scheduled for 1000 MWD/T.
<table>
<thead>
<tr>
<th>Test No.</th>
<th>Type Metal</th>
<th>Tubes</th>
<th>Reactor</th>
<th>Goal Exposure</th>
<th>Current Exposure</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP-216-A</td>
<td>Normal prod. natural and enriched fuel elements.</td>
<td>57</td>
<td>All</td>
<td>Normal variable goal.</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>IP-272-A</td>
<td>I&amp;E self-supported fuel.</td>
<td>69</td>
<td>C</td>
<td>Variable + 200</td>
<td></td>
<td>Provides for testing of CIVN geometry fuel in C Reactor ribless zirconium tubes.</td>
</tr>
<tr>
<td>IP-381-A and IP-431-A</td>
<td>I&amp;E self-supported fuel overbore size.</td>
<td>62</td>
<td>C</td>
<td>800 MWD/T</td>
<td>590 MWD/T</td>
<td>Provides preliminary qualitative data regarding irradiation behavior of larger fuel element designs.</td>
</tr>
<tr>
<td>IP-546-A</td>
<td>I&amp;E self-supported, hot-die-sized fuel.</td>
<td>18</td>
<td>C</td>
<td>800 MWD/T</td>
<td></td>
<td>Initial irradiation of hot-die-size diffusion-bonded fuel elements. Test columns charged on 7-27-63. Test will provide information for evaluation of relative corrosion characteristics of this new fuel. Two fuel columns discharged at 410 MWD/T.</td>
</tr>
<tr>
<td>Test No.</td>
<td>Type Metal</td>
<td>Tubes</td>
<td>Reactor</td>
<td>Goal Exposure</td>
<td>Current Exposure</td>
<td>Remarks</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------</td>
<td>-------</td>
<td>---------</td>
<td>---------------</td>
<td>------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Supp. A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP-614-A</td>
<td>Metallic thorium target elements.</td>
<td>1</td>
<td>F</td>
<td>60</td>
<td>Operating Days</td>
<td>Initial irradiation of metallic thorium target elements in support of the U-233 Program. Three target pieces charged into one central zone process tube on 9-12-63. Tube discharged on 10-9-63 after accumulating about 20 days exposure according to modified irradiation plans.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP-616-A</td>
<td>I&amp;E self-supported, enriched hot-die-sized fuel.</td>
<td>13</td>
<td>C</td>
<td>1000 MWD/T</td>
<td>240 MWD/T</td>
<td>Elements charged to evaluate dimensional distortion and corrosion characteristics of the enriched element design. Test column charged on 9-21-63.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REACTOR ENGINEERING

Examination of KE Reactor Moderator Stack

During the October KE Reactor outage for Zircaloy retubing, 11 VSR channels are being measured and their condition recorded with motion-picture equipment.

Export System Transient Tests

Ten more tests of the system have been conducted, under the authority of Production Test IP-599-AI, "Trip-Off of Electric Export Pumps," HW-78181. All tests were successfully accomplished, and no unusual stresses were observed during the testing program. The test data are being analyzed and compared with theoretically-developed predictions of the system's transient characteristics.

Test of Damaged Section of DR Reactor Inlet Crossheader

The removed damaged section(1) was pressurized until it failed. Internal pressure at failure was 5780 psig. The stress in the header wall of failure is calculated to be 54,216 psi. Failure occurred at the junction of the bypass branch and the header, on the underside of the branch, in the weld at the point where severe bending resulted because of the deflection of the branch pipe. As pressure increased in the section, the header cross section returned to normal. This reversal of the bending caused by the incident caused a brittle failure in the weld.

REACTOR PHYSICS

Alternate Products

Recycle

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

<table>
<thead>
<tr>
<th>Per Cent of Recycle Fuel in the Enriched Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>September 30 Status</td>
</tr>
<tr>
<td>September Discharge</td>
</tr>
</tbody>
</table>

a  No enriched fuel discharged.

The ppm U-232 reported last month for the 82.8 ppm Th-230 sample for the 27.7 day irradiation was in error; the correct value is 20.6.

Analysis of thorium metal targets irradiated in F Reactor for 20 days at a 2200 m/s flux of $4.2 \times 10^{13}$ n/cm$^2$/sec gave the following results:

<table>
<thead>
<tr>
<th>Samples</th>
<th>U-233 g/ton Thorium</th>
<th>ppm U-232</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thorium Metal</td>
<td>500</td>
<td>1.4</td>
</tr>
<tr>
<td>(Low Th-230)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These results are more favorable than the capsule data. They verify a prediction that the higher-than-expected U-232 content in the capsule material was partially due to a $\gamma,n$ reaction on Th-232. The predominant source of the gammas was undoubtedly the hard capture gamma in the aluminum surrounding the capsule.

Although the ($\gamma,n$) contribution is significant, it is not large enough to account for the difference in the predicted ($n,2n$) reaction rate from that given in the U-233 proposal document HW-76847. Therefore, unless there is a significant gamma-ray ($E > 6.34$ MeV) background, the ($n,2n$) flux calculated in HW-76847 is not correct. A more complete analysis of the fast flux is being made to determine what the correct ($n,2n$) reactions are.

Based on the thorium data from the F Reactor irradiation and three-group reactivity matching calculations, the following physics numbers are believed to be the best available at this time for the 25 kg U-233 production proposal.

<table>
<thead>
<tr>
<th>U-233 PHYSICS DATA 60% DENSITY OXIDE TARGET BDF REACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>------</td>
</tr>
<tr>
<td>1 (Core)</td>
</tr>
<tr>
<td>2 (Fringe)</td>
</tr>
</tbody>
</table>

There will be a 2.8 per cent loss in the plutonium conversion ratio in the E metal in the first case and a 1.8 per cent loss in the second case. There will also be plutonium losses due to the reduction in total reactor power and the substitution of 94 material for normal material.
Calculations were made to establish the dose rates to be expected from U-233 containing 1 ppm U-232, resulting from the irradiation of thorium. One to two months following chemical separation of the irradiated thorium, the dose rate in air from the finished product would build up to that experienced with Pu-239. Six to 12 months following chemical separation, the dose rate would build up to an order of magnitude higher than that from Pu-239. The concentration of U-232 in the U-233 affects the dose rate proportionally.

**Speed-of-Control**

B Reactor has reduced the per cent helium in the reactor to 40 per cent, thereby increasing the maximum stringer temperature to about 730°C. Speed-of-control limits under the higher temperature conditions will be lowered, but they will not be below present power levels over the forecasted exposure range.

KW Reactor had six slow VSR's after a scram on October 16, 1963. Four of the six rods were fringe rods, and three were adjacent. However, by startup time the faulty rods had been repaired to meet Process Standard requirements. The startup was made, but the reactor scrambled shortly thereafter. A second startup (secondary cold) was successful, but, three rods were out of Standards' requirements by this time. VSR's #30 and #24 had drop times of 3.66 and > five seconds, respectively. These two rods are also adjacent. Rod #52 had a drop time of 2.29 seconds. Using void coefficients for the KV lattice, power level limits were obtained for a rod drop time of 2.3 seconds (time of rod #52). To compensate for two adjacent rods out of service, the power level limits were conservatively reduced by 20 per cent. This did not restrict KW Reactor below administrative limits.

**Critical Mass Studies**

The revision of the Bases for the Process Standards for the storage, transportation, and fabrication of I&E fuel elements is continuing.

Since there exists a great need for nuclear safety standards for storage and shipment of enriched U and UO₂ solutions and scrap, temporary bases covering these materials are being prepared.

**RADIOLICAL ENGINEERING**

**Radiation Control Experience**

The following table summarizes the radiation exposure experience of critical IPD classifications through 40 weeks of the 1963 badge year:
An irradiated slug lodged in the scum gutter of the KE discharge area during flush discharge operation on October 9, 1963. The scum gutter is located on the rear wall at about the water level of the discharge area basin. Dose rates up to 20 r/hr were encountered during entries made to remove it. About 20 employees received doses ranging from 300 to 900 mr.

Lapse of Radiation Control

Distribution by Reactor and Component

<table>
<thead>
<tr>
<th>IPD</th>
<th>Processing</th>
<th>Maintenance</th>
<th>Suppl. Crews</th>
<th>Special Outage Service</th>
<th>Reactor Area</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>DR</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>F</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KE</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KW</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Effluent Activity Data

The table below shows average concentrations of selected radionuclides from reactor effluent samples taken during September 1963. All units are $10^{-12}$ curies/ml.
Reactor | P-32 | As-76 | Zn-65 | Np-239 | Cr-51
--- | --- | --- | --- | --- | ---
B | 2.1 | 90 | 3.8 | 167 | 368
C | 6.7 | 152 | 5.4 | 182 | 606
D | 5.0 | 81 | 5.6 | 115 | 480
DR | 6.4 | 116 | 5.8 | 178 | 948
F | 10.5 | 121 | 5.1 | 187 | 695
H | 13.0 | 60 | 6.9 | 98 | 562
KE | 4.5 | 24 | 6.2 | 58 | 235
KW | 6.7 | 32 | 6.7 | 82 | 271

During September 1963 the concentration of sodium dichromate in the reactor cooling water was reduced from 1.8 to 1.4 at all treatment plants except 100-C. At 100-C, one-half the reactor was cooled with 1.8 ppm dichromate water while the other side with 1.0 ppm dichromate water under provisions of a production test.
PROCESS TECHNOLOGY

REACTOR POWER LEVEL LIMITATIONS

Power levels at all reactors were restricted by the 95 C bulk outlet temperature limit.

PROCESS STANDARDS

HW-46000 B, Process Standards - Reactor

One standard was revised and issued during the report period. This was:

Process Standard D-040 - "Earthquake-Seismoscope Operation"

This revision updated and clarified requirements concerning the seismoscope system. Authorization was included to bypass the seismoscope 30 minutes and the low sensitivity pendulum contact spacing was reduced to 1.3 millimeters.

HW-46000 D, Process Standards - Reactor

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

Process Standard D-040 - "Earthquake-Seismoscope Operation"

Revision to this standard is identical to that for HW-46000 B, above.

Process Standard A-050 - "Panellit System Control"

Requirements relating to PCCF tubes were simplified to reduce delays in reactor startups. PCCF Panellit gauge observation is required during PCCF charging only, and bypassing a gauge for up to two hours has been authorized to effect sensing line repairs.

HW-46000 F, H, Process Standards - Reactor

One standard was revised and issued for each of these manuals during the report period. This was:

Process Standard D-040 - "Earthquake-Seismoscope Operation"

Revision to this standard was identical to that for HW-46000 B, above.

HW-46000 K, Process Standards - Reactor

One standard was revised and issued during the report period. This was:

Process Standard D-040 - "Earthquake-Seismoscope Operation"

The low sensitivity pendulum contact spacing was changed from 2.6 millimeters to 1.3 millimeters in this revision.
PROCESS CHANGE AUTHORIZATIONS

Twenty-eight Process Change Authorizations were issued during the report period: 17 to permit deviation from Process Standards - Reactor, HW-46000; seven to permit deviation from Process Standards - Water Plant, HW-27155 Rev. 1; and three to permit deviation from Process Equipment Standards, HW-41000. These were:

PCA #3-92 - "Removal From Service, Export Pumps - B, D, F, and H Areas"

This process change authorized shutting off the electric pumps supplying the export system for a period of one hour or less to install manually operated slow closing air admission valves to the 200 Area high points on the export line. The requirements included valving off the surge suppressors; having personnel stationed at each 182 Building to manually control the steam-driven export pumps; and maintaining communications with all 182 and 200 Area stations during the course of the work.

PCA #3-93 - "Process Water pH Increase During Shutdown - B-C Reactors"

A pH increase to 7.6 during reactor shutdown was authorized pending completion of routing of a standards revision.

PCA #3-94 - "Temporary Removal of Automatic Start Facility - K Reactors"

Authorization was given to take the last-ditch diesel system off of automatic start to install a modification to the battery power supply provided an operator was stationed to start the diesels of needed.

PCA #3-95 - "Leaking Hoke Valve in Panellit Gauge Sensing Line - DR Reactor"

Continued reactor operation was authorized with a leaking Panellit gauge sensing line provided the pressure loss did not exceed 10 psi.

PCA #3-96 - "Ball 3X Channel #50, Obstruction - KE Reactor"

Operation with channel #50 at KE Reactor out of service was authorized since poison compensation was made for the inoperable ball 3X hopper in a manner meeting the intent of the standards.

PCA #3-97 - "Flux Monitor Low-Trip Settings - K Reactors"

This PCA extends the provisions of PCA #3-59 to provide more time for evaluation of flux monitor response. PCA #3-59 provided supplemental requirements on the low-trip settings to avoid an inadvertent ball drop.

PCA #3-98 - "Panellit Gauge Accuracy Requirement - B Reactor"

Extension of the expiration date of PCA #3-56 was authorized to allow additional time for installation of reworked Panellit gauges. PCA #3-56 authorized operation with Panellit gauges accurate to within 9 psi provided the high trip was reduced 10 psi.
PCA #3-99 - "Thermal Shield Coolant Visiugage Operation - D Reactor"

Continued operation was authorized with two adjacent faulty visiugages because a determination by alternate means indicated flow existed.

PCA #3-100 - "Functional Test, Crossheader Check Valves - D Reactor"

Manpower considerations warranted extension of check valve functional test completion to the next minimum outage.

PCA #3-101 - "Vertical Traverse - F Reactor"

This process change authorized additional time to obtain vertical traverses which were delayed due to equipment malfunction.

PCA #3-102 - "Ball 3X Hopper Check - F Reactor"

Vacuum pump failure necessitated extension of the ball hopper functional tests to the first outage in November, 1963.

PCA #3-103 - "Delinquent Unit Motion Readings and Equipment Checks - B Reactor"

Authorization was given to defer several delinquent functional checks until the next minimum outage.

PCA #3-104 - "Confinement Charcoal Filter Sampling - D Reactor"

A delay of sampling until October 11, 1963, was authorized for over-due filter samples.

PCA #3-105 - "Vertical Traverse of Process Tube - D Reactor"

Outage scheduling conflicts warranted deferment of vertical traverses to the next minimum outage.

PCA #3-106 - "Temporary Re-routing of Process Water Piping to KER Loops 3 and 4 During Reactor Shutdown - KE Reactor"

This process change authorized use of a temporary piping arrangement for coolant supply and specified the procedure for achieving adequate backup coolant protection.

PCA #3-107 - "Ball Hopper Inspection - DR Reactor"

Authorization was given to delay ball 3X hopper testing until November 15, 1963.

PCA #3-108 - "Water Collection, Gas Atmosphere - KE Reactor"

This process change authorized continued operation with water collection in excess of 24 galls per day provided the inlet dewpoint was maintained at less than -15 F and water collection was less than 100 gallons per day.
PCA #3-109 - "Confinement System Fans - B Reactor"

Operation with one steam-driven confinement fan as automatic backup was authorized, provided the other steam-driven exhaust fan would be manually started if a BPA power interruption occurred and provided all process tubes remained capped during this period.

PCA #3-110 - "High Rear Face Activity Following Discharge - KE Reactor"

Because of high radiation readings in the discharge area, the fog spray was being operated. Shutting off the fog spray was authorized when it was determined the fuel element jacket on an uncooled fuel element would not reach aluminum melting temperature.

PCA #3-111 - "Steam-Driven Export Pump - D Reactor"

Removal of the D Area export steam turbine for necessary repairs was authorized provided the other three export turbines were automatically available and procedures existed for restricting 200 Area and N Area flow within 15 minutes after a BPA power interruption.

PCA #3-112 - "Vertical Traverse - DR Reactor"

Postponement of vertical traverses until December 2, 1963, was authorized. Equipment malfunction prevented obtaining traverses on schedule.

PCA #3-113 - "Steam-Driven Export Pump - D Reactor"

Provisions of this PCA are identical to those in PCA #3-111, above.

PCA #3-114 - "Remove Steam From Emergency Exhaust Fans - C Reactor"

Authorization was given to remove the steam supply to the confinement exhaust fans for 10 hours to repair a steam supply valve, provided all process tubes remained capped and no cutting or welding in contaminated areas was undertaken.

PCA #3-115 - "Reactor Shield Coolant - C Reactor"

Continued operation was authorized while the reactor thermal shield bulk effluent temperature indicator was out of service, provided the reactor would be shut down if a 10 per cent flow loss occurred.

PCA #3-116 - "C Work Platform Photocell Interlock - B Reactor"

Bypassing the photocell interlock during reactor operation was authorized provided assurance existed that the C work platform would not be moved during this period.

PCA #3-117 - "Steam-Driven Export Pump Maintenance - B Area"

Removal of the steam-driven export pump from service for necessary mainten-
ance was authorized provided the three remaining export steam turbines were automatically available and procedures existed for restricting 200 and N Area flow within 15 minutes after a BPA power interruption.

PCA #3-118 - "Steam-Driven Export Pump Maintenance - H Area"

Provisions of this process change were identical to those in PCA #3-117, above, except that H turbine repair was required.

PCA #3-119 - "Horizontal Bowing Measurements - B, H, KE, and KW Reactors"

This PCA postpones procurement of horizontal bowing measurements until March 2, 1964, because location for bowing measurements will be changed in the near future.

MEMORANDUM OF PROCESS STANDARDS RELAXATION

This memorandum on gas atmosphere pressure requirements at C Reactor extended the provisions of the previous memorandum for one week to permit evaluating the effectiveness of rear-face bellows foaming.

TEMPORARY NUCLEAR SAFETY SPECIFICATIONS

TNS #2-63 - "Shipment of "J" and "C" Metal"

This TNS defines the requirements for shipment of "J" and "C" metal slugs and also "J" metal scrap.

TNS #3-63 - "Shipment of Category I and II Enriched Uranium"

This TNS authorizes deletion of the limit to the number of rail cars containing the above material that may be shipped during a specified period.

PROCESS GUIDES

A letter deleting Process Guide #8, HW-56000, was issued. Recent changes in philosophy concerning the export system have invalidated this guide.

PROCESS ASSISTANCE

One engineer audited conformance to Process Standards on all Processing Operations' shifts by making 13 inspections at each reactor during the report period.

RUPTURE EXPERIENCE

<table>
<thead>
<tr>
<th>Failure Date</th>
<th>Tube Number</th>
<th>Lot Number</th>
<th>Type of Material</th>
<th>Tube Power at Failure</th>
<th>Exposure MWD/T</th>
<th>Type Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/1/63</td>
<td>1489-DR</td>
<td>KY-361-U</td>
<td>I&amp;EB (0.94%)</td>
<td>1015</td>
<td>1178</td>
<td>UN</td>
</tr>
<tr>
<td>10/2/63</td>
<td>1266-D</td>
<td>KY-053-D</td>
<td>I&amp;EB (0.94%)</td>
<td>1095</td>
<td>734</td>
<td>SG</td>
</tr>
<tr>
<td>10/8/63</td>
<td>3359-B</td>
<td>KY-499-B</td>
<td>I&amp;EB E (0.94%)</td>
<td>1227</td>
<td>546</td>
<td>SH</td>
</tr>
<tr>
<td>Date</td>
<td>Tube Number</td>
<td>Lot Number</td>
<td>Type of Material</td>
<td>Tube Power at Failure</td>
<td>Exposure MWD/T</td>
<td>Type Failure</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
<td>------------</td>
<td>------------------</td>
<td>-----------------------</td>
<td>----------------</td>
<td>--------------</td>
</tr>
<tr>
<td>10/11/63</td>
<td>1464-D</td>
<td>CZ-040-D</td>
<td>I&amp;E NB</td>
<td>1191</td>
<td>793</td>
<td>HG</td>
</tr>
<tr>
<td>10/13/63</td>
<td>2787-F</td>
<td>KZ-687-C</td>
<td>I&amp;E N</td>
<td>1104</td>
<td>476</td>
<td>SD</td>
</tr>
<tr>
<td>10/16/63</td>
<td>3670-KW</td>
<td>KK-409-H</td>
<td>I&amp;E E(0.94%)</td>
<td>1634</td>
<td>613</td>
<td>SH</td>
</tr>
<tr>
<td>10/21/63</td>
<td>1063-D</td>
<td>KD-053-D</td>
<td>I&amp;E EB</td>
<td>1183</td>
<td>795</td>
<td>SG</td>
</tr>
<tr>
<td>10/23/63</td>
<td>3784-B</td>
<td>KZ-687-A</td>
<td>I&amp;E E(0.94%)</td>
<td>1246</td>
<td>729</td>
<td>SH</td>
</tr>
<tr>
<td>10/25/63</td>
<td>2178-B</td>
<td>UZ-095-A</td>
<td>I&amp;E N</td>
<td>1196</td>
<td>538</td>
<td>SH</td>
</tr>
<tr>
<td>10/29/63</td>
<td>1464-C</td>
<td>CP-804-D</td>
<td>I&amp;E NS</td>
<td>1374</td>
<td>269</td>
<td>EM</td>
</tr>
</tbody>
</table>

**Legend**

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 jacket. The fuel is irradiated in ribbed process tubes. The uranium cores are enriched in U-235 and the weight per cent U-235 in the core material is stated.

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. The fuel is irradiated in ribbed process tubes.

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 symbol 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.

**First Character**

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

Six-inch internally and externally cooled natural uranium element with attached water-mixer spool.
<table>
<thead>
<tr>
<th>Second Character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Not Examined Failure has not been examined.</td>
</tr>
<tr>
<td>G</td>
<td>Groove Corrosion Failure caused by groove pitting corrosion attack.</td>
</tr>
<tr>
<td>H</td>
<td>Hot-spot Failure caused by accelerated high temperature corrosion attack.</td>
</tr>
<tr>
<td>D</td>
<td>Mechanical Damage Failure caused by mechanical damage to the fuel element.</td>
</tr>
<tr>
<td>M</td>
<td>Defect Failure caused by a defect in fuel fabrication.</td>
</tr>
</tbody>
</table>
OPERATIONAL PHYSICS

PILE PHYSICS PLANT ASSISTANCE

Plant equilibrium and nonequilibrium efficiencies (related to flattening effectiveness and startup losses respectively) were generally satisfactory during the month.

Adverse flux distributions and associated flux distribution control problems, partially attributable to the mechanics of zirconium retubing, caused tangible nonequilibrium losses at the K reactors, however. An unscheduled outage at the KE Reactor was associated with poison spline manipulations as part of an effort to control a localized hot spot, and unavoidable delays in the post-turnaround spline removal process resulted in significant nonequilibrium losses at KW Reactor.

Operation under increased graphite temperature limits (PT IP-593-J) proceeded satisfactorily at B and F Reactors, with only minor reductions in flattening efficiency. Operating experience at B and F is currently being analyzed, and procedures are being developed accordingly for early extension of the production test to the other production reactors.

Two reactors, C and DR, recorded average nonequilibrium losses for the report period of only 0.1 equilibrium day per startup. H Reactor flattening efficiency reached the highest recorded point to date for the E-N loading (1550 ECT).

SUMMARY OF OPERATIONAL DATA OF PHYSICS INTEREST
FOR THE MONTH OF OCTOBER, 1963

<table>
<thead>
<tr>
<th>Reactor</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>DR</th>
<th>F</th>
<th>H</th>
<th>KE</th>
<th>KW</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECT in October (1)</td>
<td>1495</td>
<td>1660</td>
<td>1505</td>
<td>1545</td>
<td>1545</td>
<td>1550</td>
<td>2450</td>
<td>2465</td>
</tr>
<tr>
<td>12-Month Average ECT</td>
<td>1500</td>
<td>1550</td>
<td>1500</td>
<td>1520</td>
<td>1515</td>
<td>1505</td>
<td>2485</td>
<td>2505</td>
</tr>
<tr>
<td>Recording Time:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*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 in minutes which may elapse between scram and first indication while still permitting a successful scram recovery.
B Reactor - C. E. Hughey

Reactor operating continuity was fair during this report period; operation was interrupted on 9/20 and 10/8 by rupture outages, and by two Panellit scrams due to faulty spline seal performance, with a successful recovery after each. Both pile flattening efficiency and prediction errors have shown improvements during the past month, although nonequilibrium losses for this period were relatively high.

C Reactor - P. D. Gross

Operation during the month was generally good and startup losses were exceptionally low. The H-hole subcritical monitor was returned to operation after four months of sporadic service. Installation work progressed during and after the extended outage on the new analog-to-digital converter (delta T automatic typewriter system).

D Reactor - G. D. Baston

Up until 10-18-63, D Reactor process cooling had been selectively controlled to provide near-side cooling with neutral acidity (pH = 7.0) and far-side cooling at pH = 6.6; the reactor now has a uniform distribution of pH = 6.6, in common with the other production reactors. Concurrently with this change, the bulk outlet temperature limit was raised from 93.5 to 95°C. High summer inlet temperatures had resulted in reduced stress on flattening, and consequently ECT was lower than average; enrichment has been added to help compensate the reactivity dip from a large discharge and to improve flattening efficiency. Extension of the top fringe poison pattern was also scheduled in order to accommodate operation with the anticipated higher CO₂ values.

DR Reactor - S. M. Skidmore

Nonequilibrium losses continued to be very low, and flattening efficiency high; occurrence of a rupture on 10/1 required only that plans for a scheduled outage be initiated slightly earlier than expected. During the outage odd rows were discharged, along with 40 per cent of the fringe. During the outage, four new model "V" Beckmans were installed; some slight operational problems have resulted as the operating crews are becoming accustomed to the sensitivity of the new instruments.

F Reactor - D. W. Constable

Continuity of operation was reduced during the report period by several unscheduled outages. F Reactor adopted the high graphite temperature PT late in September, and was operating at 47 per cent helium at report time. Flattening efficiency has been satisfactorily high under the PT.

H Reactor - E. L. Conner, Jr.

At the beginning of the report period, a 1207-tube discharge was taken and 73 process tubes were replaced; considerable nonequilibrium operation resulted from several unscheduled outages during subsequent runs. Two scrams, the
Spline traverses during the report period indicate a further degree of longitudinal flattening to be achieved in the 102-tube E-N trial block; this block utilizes five-inch N pieces in only two charge types rather than four-inch pieces in five patterns.

**KE Reactor - D. G. Albertson**

Flattening efficiency was lower than usual (partially associated with the zirconium tube replacement transition) but nonequilibrium losses were lowest in over a year. On 9-27-63, a control problem involving considerable spline movement followed by drastic power cuts resulted in an unwieldy reactivity transient, which was voluntarily terminated by a shutdown on 9-28-63. The reactor was shutdown from 10/8 through the rest of the report period for the third quarter of zirconium tube installation.

**KW Reactor - A. W. Medcalf**

KW Reactor operating efficiency has been generally lower than normal, as an expected consequence of high residual exposure complicated by various equipment problems affecting spline charging flexibility. Startup losses were high due to a number of reasons, including enforced low level operation during adjustment of the reactor atmosphere, a scram after startup, and an unusually high reactivity status.

**PROCESS PHYSICS STUDIES**

**Reactivity and Safety Control Studies**

Recent HL experimental runs on the KV lattice showed good agreement with initial computer runs which indicated approximately 9 mk reactivity gain in going from the KIV aluminum tube lattice to the KV zirconium tube lattice. An investigation of the reactivity effects due to splines, controls, enrichment and exposures within the two half-converted K Reactors appears to confirm the experimental results. Although the wet reactivity is higher in the KV lattice than in the KIV, a smaller void coefficient is expected in the zirconium case. The water-loss difference is sufficiently large to essentially compensate for the increased reactivity allowance in the dry case for controlling to uranium melting temperatures rather than to aluminum melting.

For operational purposes plutonium buildup in the E-N loading has been predicted on the basis of standard E-metal observations in HW-50300 B, Revised. Past data have indicated that the conversion ratio in E-metal irradiated in the blacker E-N lattice is somewhat higher than that in E-metal surrounded by natural uranium. A study is currently underway to adjust values within the tables.

A memorandum on the Zone Temperature Monitor reliability to trip on demand was issued as HW-78707 ADD1. Conclusions of the study were that reliability...
would be reasonably high provided that system maintenance were adequately high for precluding excessive fail-safe trips also. An investigation of H Reactor trip requirements indicates that the higher ramp potential at that reactor is counterbalanced by the greater safety system capacity such that ZTM trip limits would be approximately the same as at the 9-rod reactors.

The possibility of using octant holes for chambers in the Log-N period system appears feasible provided the period readout to the operator can be made to show only the fastest period, and provided that the octant holes can be reasonably spared from use for other functions.

Control Efficiency Studies

Separation of the H-core E-N load discharged in May is expected to be completed within the next few weeks. The H-loading separation will follow a cleanout of the Redox facility; however, it will be followed by a considerable amount of E-metal from other reactors before the next cleanout. Approximately 35 dissolver samples are to be taken during the separation, verified for specific gravity, and composited for analytical determinations.

The production test of the automatic distribution control concept, PT IP-578-C (Part II – Phase II), has been approved following minor changes in the procedures.

Biological Shield Protection

Information has been supplied the plants regarding protective measures for precluding excessive biological shield temperatures with high-CO₂ operation. It has been suggested that all top row (row 46) columns be charged with fringe poison and that every other column on the far-side (96 column) also contain fringe poison. The possible need for far-side fringe poison at C Reactor with high-CO₂ operation is under study. H Reactor already has a solid poison blanket on all four sides in conjunction with the E-N load.

Assistance on shielding problems was also provided for other components for the power conversion study and for the Log-N hole-drilling prototype.
**IRRADIATION TESTING**

Irradiations - Sample and experiment irradiations were handled as follows:

<table>
<thead>
<tr>
<th>Reactor</th>
<th>Test Hole</th>
<th>Facility</th>
<th>Request No.</th>
<th>No. of Samples</th>
<th>Material-Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>KW</td>
<td>2A</td>
<td>Quickie</td>
<td>HAPO 184</td>
<td>30</td>
<td>Washington Designated Program</td>
</tr>
<tr>
<td>KE</td>
<td>2D</td>
<td>Quickie</td>
<td>HAPO 254</td>
<td>3</td>
<td>Effluent water (reduction of radioisotopes in river water study)</td>
</tr>
<tr>
<td>DR</td>
<td></td>
<td>PCCF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KW</td>
<td>4C</td>
<td>Snout</td>
<td>HAPO 243</td>
<td>8</td>
<td>Iron (fast neutron damage study)</td>
</tr>
<tr>
<td>C</td>
<td>A-E</td>
<td>Bare Channel</td>
<td>HAPO 259</td>
<td>6</td>
<td>Hastelloy-Inconel (high temperature-radiation damage study)</td>
</tr>
<tr>
<td>KE</td>
<td>2B</td>
<td>Magazine</td>
<td>HAPO 263</td>
<td>1</td>
<td>Plutonium-uranium (neutron detector study)</td>
</tr>
<tr>
<td>KW</td>
<td>2A</td>
<td>Quickie</td>
<td>HAPO 252</td>
<td>9</td>
<td>Arsenic (tracer isotope production)</td>
</tr>
<tr>
<td>F</td>
<td>E</td>
<td>Quickie</td>
<td>HAPO 292</td>
<td>5</td>
<td>Lithium (tritium evolution study)</td>
</tr>
<tr>
<td>KE</td>
<td>2A</td>
<td>General Purpose</td>
<td>HAPO 278</td>
<td>1</td>
<td>Corn starch, sugar (activation analysis of rod channel filler material)</td>
</tr>
<tr>
<td>F</td>
<td>E</td>
<td>Quickie</td>
<td>HAPO 292</td>
<td>5</td>
<td>Mercury (production of Hg-204)</td>
</tr>
<tr>
<td>KE</td>
<td>2B</td>
<td>Magazine</td>
<td>ORNL 204</td>
<td>1</td>
<td>Thallium (production of Tl-204)</td>
</tr>
<tr>
<td>C</td>
<td>B</td>
<td>Process Tubes</td>
<td>NAA 116</td>
<td>2</td>
<td>Uranium-zirconium hydride (irradiation of SNAP 8 fuel elements)</td>
</tr>
<tr>
<td>DR-B</td>
<td></td>
<td>Process Channels</td>
<td>HAPO 098</td>
<td>38</td>
<td>Graphite (burnout rate determination)</td>
</tr>
<tr>
<td>KW</td>
<td>2A</td>
<td>Quickie</td>
<td>HAPO 172</td>
<td>2</td>
<td>Phosphorous (tracer isotope production)</td>
</tr>
<tr>
<td>KE</td>
<td>3C</td>
<td>Bare Channel</td>
<td>HAPO 177</td>
<td>1</td>
<td>Graphite (neutron irradiation damage study)</td>
</tr>
<tr>
<td>F</td>
<td>E</td>
<td>Quickie</td>
<td>HAPO 219</td>
<td>10</td>
<td>Strontium (tracer isotope production)</td>
</tr>
<tr>
<td>KW</td>
<td>2D</td>
<td>General Purpose</td>
<td>HAPO 236</td>
<td>2</td>
<td>Zirconium (creep rate study)</td>
</tr>
<tr>
<td>F</td>
<td>E</td>
<td>Quickie</td>
<td>HAPO 223</td>
<td>3</td>
<td>Chamber connectors (induced radioactivity treatment)</td>
</tr>
<tr>
<td>KW</td>
<td>4B</td>
<td>Snout</td>
<td>HAPO 249</td>
<td>3</td>
<td>Boron-graphite (heat generation and transfer study)</td>
</tr>
<tr>
<td>C</td>
<td>B</td>
<td>Bare Channel</td>
<td>HAPO 250</td>
<td>1</td>
<td>Ceramics (radiation damage to candidate rod liner materials)</td>
</tr>
</tbody>
</table>
Reactor Test Facility

<table>
<thead>
<tr>
<th>Reactor</th>
<th>Hole</th>
<th>Facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gamma*</td>
<td>HAPO 171</td>
<td>2 Plastics and rubber (radiation damage study)</td>
</tr>
<tr>
<td>Gamma</td>
<td>4</td>
<td>Insulation (radiation damage study)</td>
</tr>
<tr>
<td>Gamma</td>
<td>2</td>
<td>Thermocouple lead insulator (radiation damage study)</td>
</tr>
</tbody>
</table>

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

Borescoping Activities - In-reactor channels and tubes were examined with a borescope as follows:

<table>
<thead>
<tr>
<th>Reactor</th>
<th>Channel or Tube</th>
<th>Motion-Picture Record</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>KE</td>
<td>VSR-55</td>
<td>Yes</td>
<td>1)</td>
</tr>
<tr>
<td>C</td>
<td>VSR-41</td>
<td>Yes</td>
<td>1)</td>
</tr>
<tr>
<td>D</td>
<td>2674</td>
<td>No</td>
<td>2)</td>
</tr>
<tr>
<td>D</td>
<td>2570</td>
<td>No</td>
<td>2)</td>
</tr>
</tbody>
</table>

1) Horizontal rod, vertical rod channel problems
2) Maintenance support

Vertical Bowing - Vertical displacement measurements were taken as follows:

<table>
<thead>
<tr>
<th>Reactor</th>
<th>Channel #4, KW Reactor</th>
<th>No previous data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Tube 4674, C Reactor</td>
<td>Down .05&quot; at 8' since March, 1963</td>
<td></td>
</tr>
<tr>
<td>Process Tube 4676, F Reactor</td>
<td>Down .27 at 21' since March, 1963</td>
<td></td>
</tr>
<tr>
<td>Process Tube 4675, DR Reactor</td>
<td>Down .06 at 9'4&quot; since June, 1963</td>
<td></td>
</tr>
<tr>
<td>Process Tube 4574, B Reactor</td>
<td>Down .09 at 21' since June, 1963</td>
<td></td>
</tr>
</tbody>
</table>

Spline Traverses - Front-to-rear flux distribution data were obtained from the following reactors:

<table>
<thead>
<tr>
<th>Reactor</th>
<th>No. of Tubes</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>7</td>
</tr>
<tr>
<td>KW</td>
<td>7</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
</tr>
<tr>
<td>KE</td>
<td>2</td>
</tr>
<tr>
<td>F</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
</tr>
</tbody>
</table>
C-1 Loop Installation - A low flow condition during the September 30 reactor startup apparently caused dummy fuel corrosion and partial plugging of the in-reactor test section. The equipment needed to restore the test section to its original condition at the next outage has been fabricated.

COMPONENT TESTING

Irradiated IPD Fuel Examination, 105-C Facility - Examinations were completed on fuel elements from 96 tubes requiring 260.2 fuel examination units. Individual examinations completed were 8338.

<table>
<thead>
<tr>
<th>No. of Tube Charges</th>
<th>Production Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>IP-216-A, Evaluation of Normal I&amp;E Fuel Element Performance</td>
</tr>
<tr>
<td>5</td>
<td>IP-546-A, Irradiation of Hot-Die-Size Diffusion Bonded Fuel Elements</td>
</tr>
<tr>
<td>20</td>
<td>IP-549-A, Half-Plant Low Alum Feed Water Treatment at F Reactor</td>
</tr>
<tr>
<td>21</td>
<td>IP-560-A, Half-Plant Low Dichromate Low pH Water Treatment at C Reactor</td>
</tr>
<tr>
<td>20</td>
<td>IP-581-A, Half-Plant High Flocculation pH Test at B Reactor</td>
</tr>
<tr>
<td>9</td>
<td>IP-586-AIE, Extended Goal Exposure for Selected KVNS Fuel Columns</td>
</tr>
<tr>
<td>1</td>
<td>None - Examination of Normal I&amp;E Fuel Suspected of Being Rupture Prone</td>
</tr>
<tr>
<td>13</td>
<td>None - Examination of Enriched I&amp;E Fuel Discharged with High Forces at KW Reactor</td>
</tr>
</tbody>
</table>

Photographs were taken of two D-Reactor ruptured fuel elements.

Irradiated NRD Fuel Examination, 105-KE Facility - Upon completion of extensive MERCY IBM 7090 data analyses to evaluate dimensional measurement equipment biases, profile measurements of 13 outer elements were obtained. The elements were irradiated under PT IP-477-A, Irradiation of N-Reactor Fuel Elements in KER-3 and KER-4. They were discharged from KER 4, May 13, 1963.

Irradiated Process Tube Measurement

Wall Thickness Gauge (eddy-current type) - WTG

<table>
<thead>
<tr>
<th>Reactor</th>
<th>No. of Tubes Measured</th>
<th>Report No.</th>
<th>HW. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>87</td>
<td>56</td>
<td>79065</td>
</tr>
<tr>
<td>D</td>
<td>21</td>
<td>57</td>
<td>79064</td>
</tr>
<tr>
<td>C</td>
<td>77</td>
<td>58</td>
<td>79072</td>
</tr>
<tr>
<td>DR</td>
<td>322</td>
<td>59</td>
<td>79218</td>
</tr>
<tr>
<td>F</td>
<td>48</td>
<td>60</td>
<td>79304</td>
</tr>
<tr>
<td>D</td>
<td>64</td>
<td>61</td>
<td>79360</td>
</tr>
<tr>
<td>Total</td>
<td>619</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D-22
Sector Annulus Gauge (eddy-current type) - SAG

<table>
<thead>
<tr>
<th>Reactor</th>
<th>No. of Tubes Measured</th>
<th>Reactor No. of Tubes Samples Measured</th>
<th>Reason Examined</th>
<th>HW No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ex-Reactor Visual, Weight and Micrometer Measurement

<table>
<thead>
<tr>
<th>Reactor</th>
<th>No. of Tubes</th>
<th>Measured</th>
<th>Reason Examined</th>
<th>HW No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>2</td>
<td>84</td>
<td>Evaluation of corrosion under PT-IP-560-A, Half-Plant Low Dichromate Low pH Water Treatment at C Reactor</td>
<td>79361</td>
</tr>
<tr>
<td>H</td>
<td>5</td>
<td>224</td>
<td>2-leaking 2-SAG measurement precision check 1-WTG probe stuck during in-reactor measurement, examined to determine abnormality</td>
<td>79362</td>
</tr>
</tbody>
</table>

Total 476

Panellit System Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauges repaired, calibrated by Maintenance</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Gauges meeting calibration criteria</td>
<td>5</td>
<td>(63%)</td>
</tr>
<tr>
<td>- previous month</td>
<td></td>
<td>(85%)</td>
</tr>
<tr>
<td>In-board gauge reliability examination</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>Gauges meeting examination criteria</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>- previous month</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- average for past year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response time determination</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>Gauges meeting response criteria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- previous month</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- average for past year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-board Bourdon coil examination</td>
<td>4100</td>
<td></td>
</tr>
<tr>
<td>Non-leaking coils</td>
<td>4094</td>
<td>(99.9%)</td>
</tr>
<tr>
<td>- average rate past two years</td>
<td></td>
<td>(99.5%)</td>
</tr>
</tbody>
</table>
Gauges receiving failure analysis - 25

2B-X1 switch examination - 655
- acceptance rate - 576 (88%)
- previous month - (85%)

Gauges received from vendor and examined - 644
- acceptance rate - 541 (84%)
- previous month - (78%)

Gauges received from Central Maintenance and examined after pivot bushing replacement - 363
- acceptance rate - 298 (82%)
- previous month - (84%)

Five hundred seven gauges were removed from panels for new gauge installation and prepared for shipment to the vendor as exchange gauges.

COOLANT TESTING

KER Loop Operation

KER-1 - Testing of four stainless steel clad crud detectors and four 17-inch NIE1 fuel elements as authorized by PT IP-601-D continued. The objective of this test is to further evaluate the effects of ammonium hydroxide for coolant pH control, particularly the crud forming and decomposition characteristics of ammonium hydroxide at conditions approximating those expected at N Reactor.

KER-2 - Testing of eight 9-inch lithium-aluminum target elements with six NIE1 fuel elements as authorized by PT IP-584-D was continued. The purpose of the test is to evaluate target element swelling characteristics and lithium and tritium migration at conditions approximating those expected at N Reactor.

KER-3 - Testing of thirteen 23-inch NAE1 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 at N Reactor.

KER-4 - Testing of fourteen NAE1 fuel elements as authorized by PT IP-477-A continued.

Single-Pass Tube Operation - 1706-KE

<table>
<thead>
<tr>
<th>Tube</th>
<th>Production Test</th>
<th>Water Supplied</th>
<th>Corrosion Inhibitors and Chemical Additions</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP-1 (2952)</td>
<td>IP-476-AL</td>
<td>Process</td>
<td>1.8 ppm dichromate</td>
<td>6.6</td>
</tr>
<tr>
<td>SP-2 (3050)</td>
<td>IP-555-A</td>
<td>Service</td>
<td>10 ppm silicate</td>
<td>6.6</td>
</tr>
<tr>
<td>SP-3 (4355)</td>
<td>IP-520-A</td>
<td>Pilot Plant</td>
<td>1.8 ppm dichromate</td>
<td>6.6</td>
</tr>
</tbody>
</table>
**Corrosion Inhibitors and Chemical Additions**

<table>
<thead>
<tr>
<th>Tube</th>
<th>Production Test</th>
<th>Water Supplied</th>
<th>Corrosion Inhibitors and Chemical Additions</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP-4 (4456)</td>
<td>IP-520-A</td>
<td>Pilot Plant</td>
<td>1.8 ppm dichromate</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>Supp. A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP-5 (4557)</td>
<td>IP-524-AL</td>
<td>Service</td>
<td>0.2 ppm quachrom</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>glucosate</td>
<td></td>
</tr>
<tr>
<td>SP-6 (4863)</td>
<td>IP-524-AL</td>
<td>Service</td>
<td>0.2 ppm quachrom</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>glucosate</td>
<td></td>
</tr>
<tr>
<td>SP-7 (4963)</td>
<td>IP-449-A</td>
<td>Deionized</td>
<td>0.2 ppm sulfate</td>
<td>6.6</td>
</tr>
<tr>
<td>SP-8 (5063)</td>
<td>IP-449-A</td>
<td>Deionized</td>
<td>0.2 ppm sulfate</td>
<td>6.6</td>
</tr>
</tbody>
</table>

**KE Reactor Outage Time Requirements**

No unscheduled outages were charged to production testing. A total of 2.0 outage hours was charged to production tests as listed below:

<table>
<thead>
<tr>
<th>Production Test</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP-476-AL</td>
<td>Charge-discharge of single-pass and control tubes, remove coupon holders</td>
<td>2.0</td>
</tr>
<tr>
<td>IP-524-AL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP-555-A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TF-2 - Testing**

- Testing was started to determine the leak rate and the corrosion effects of leakage of NPR steam generator tubing with pin-hole failures.
- Operating conditions are 288 °C, 1600 psi and pH 10.0 adjusted with ammonium hydroxide.

**TF-3 - Testing**

- Testing to evaluate crevice corrosion beneath Zircaloy-2 fuel element supports with ammonium hydroxide used for pH control was continued.
- Operating conditions are 314 °C, 1985 psi and pH 10.0.

**TF-4 - Testing**

- Testing was continued for determining the effects of the presence of oxygen on the corrosion rates of coupled and uncoupled carbon steel when using the Sulfam-6 decontamination process. Prefilming operating conditions are 1600 psi, 300 °C and pH 10.0.

**TF-7 - Fretting corrosion testing**

- Tests were continued for various materials. Also, facsimiles of NPR steam generator tube ends are being thermally cycled to obtain development data. Testing of nine facsimiles was completed during the report period. Operating conditions are 277 °C, 1125 psi and pH 10.0.

The test sections contain the following materials:

1. A PRTR fuel element with an end bracket design employing a full 360° contact area with the process tube for fretting corrosion studies
2. Two dummy Zircaloy-2 clad elements for uniform corrosion testing of supports
3. Two NIN1 fuel elements for uniform corrosion testing
4. One KSE3 fuel element for uniform corrosion testing
5. Two 23-inch NAE1 fuel elements for support fatigue and fretting corrosion testing
6. Six coupon holders containing type 304 stainless steel and 70-30 copper-nickel alloy coupons for stress corrosion testing
7. A section of NPR steam generator tubing for determining the leak rate and the size propagation of a pin-hole leak formed by intergranular corrosion

TF-20 - Testing to determine the effects of heat transfer on aluminum corrosion in process water and the cause of resistance temperature detector corrosion and the effectiveness of various coatings continued. Operating conditions are 120 C and 5.5 gpm flow.

LEGEND

NIE1 - N Reactor, inner tube, enriched, first model
NAE1 - N Reactor, assembly - tube and tube, enriched, first model
NIN1 - N Reactor, inner tube, natural, first model
KSE3 - KER Loops, single tube, enriched, third model

[Signature]
Manager, Research and Engineering
Vertical Safety Rods

Testing of the new air and gas seals required for installation of the Universal VSRs at KE and KW Reactors has been completed. The tests indicate that initial designs were satisfactory for the intended service. Detail drawings of the new seals have been issued for procurement action.

Tests on the revised holding method for the C VSR gas seals demonstrated the adequacy of the proposed design. The drawings required for this particular modification had previously been approved and the necessary parts are on order.

Testing of candidate materials for application for liners in the VSR channels has been completed. Based on the results of this test program further effort in this field will be concentrated on polycrystalline or high strength impregnated graphite. No large amount of additional work on ceramics or pyrolictic graphite is planned. Reports summarizing the results of the materials development progress and the graphite stack distortion force analysis are being prepared.

Samples of proposed caulking materials for filling voids in the graphite stacks have undergone preliminary tests at high temperatures out of reactor. In-reactor test samples have been prepared and will be installed in sample test holes at 105-K Reactor at the first opportunity. The caulking materials are mixtures of graphite dust plus polyoxyethylene with some polysaccharide materials. A conceptual study of alternate methods providing reactor control has been completed.

Horizontal Control Rods

An order has been placed with NTH Products for two prototype HCR test assemblies for the K Reactors. These prototype rods have an Inconel sheath and cooling tubes. A sintered compact of boron carbide aluminum is used as the poison material. One of the rod tips will be used for out-of-reactor testing and the other will be used for in-reactor testing. Delivery is scheduled in late March, 1964.

There has been an increasing frequency of horizontal rod tip failures at the five smaller reactors. Work has been initiated on evaluation of the problem and design of a replacement tip.

Discharged Fuel Handling - K Reactors

Drawings and material specifications have been completed for the installation of the discharge port water jet test installation at KW Reactor. The purpose of this installation is to check the feasibility of using water jets to work discharged SSFE fuel elements into the pickup area.
Process Piping System Studies

The program to assure the integrity of process piping has continued. Test specimens have been prepared from some of the process piping samples, and 78 specimens have been shipped off-plant for Charpy tests. The procurement of program Charpy tested repair material for the pipe sampling continues to delay the over-all program.

Power Recovery

Work on the AEC authorized study to determine the power production potential of the five smaller reactors is under way. Enough preliminary physics calculations have been made to permit starting formation of the system heat balance and flow sheets. A detailed listing of the parameters of the over-all study program has been transmitted to RLO-AEC, Document HW-79244.
EQUIPMENT DEVELOPMENT

105-K Reactor Zirconium Tube Program - Development

Modifications of the slip tube assembly on the four K Reactor process channel boring rigs have been completed and tested. The on-reactor performance of the equipment at KW Reactor has been satisfactory, with an average cycle time of 12 minutes per channel.

Self-supported Fuel Element (SSFE) Charging

The two prototype self-supported fuel charging machines were used on-reactor for displacement charge discharging operation on October 1, for 165 columns, on October 16 for 27 columns, and on October 29 for 305 columns. In addition on October 30, 613 empty channels were charged following the retubing operation at KW Reactor. Several high exposure, enriched self-supported fuel columns could not be discharged due to machine force limitations. Consequently, modifications to the hydraulic system of each prototype were completed to permit application of larger thrust forces.

Delivery of the 400 all-magnesium magazines ordered from Dow Metals Company is delayed by a strike at the factory. Delivery of finished magazines can not be rescheduled until termination of the strike.

Preliminary investigation on the feasibility of all-plastic magazines has been completed. Discussions are under way with several vendors to determine interest and cost of furnishing prototype plastic magazines.

Prototype High Speed Scanner

The high speed scanner prototype was not operated continuously due to shutdown for a complete system check. Marginal operation, where detected, has been corrected. No unexpected degradation or failure was noted. A total of 23,970 operating hours has been recorded.

K Reactor Resistance Temperature Detector (RTD) Corrosion

Testing of RTDs coated with copper and silver in the corrosion test loop has been completed and the samples removed. Examination reveals the platings blistered and flaked off. The monel base underlying the flake areas in the silver plated specimen revealed pitting. The monel base showing through the copper coating was not corroded. Control monel RTDs showed no corrosion. Sample RTDs coated with Hina, nickel and cadmium titanium coatings, were installed in the loop and are undergoing test. No firm conclusions have been reached for cause of low resistance to ground of silicone varnish coated RTDs. Ceramic coated RTDs were received on October 28, 1963.

Linear Rate-of-Rise Instrumentation

The prototype Mark II power rate meter has completed 6,520 hours with no failure. The dual indicating meters supplied by Hickok Electrical Instrument Company are scheduled for return by the vendor in early November.
Intermediate Range Neutron Monitoring

Preparations have been initiated to drill the side shields at F Reactor for installation of prototypic chambers for the intermediate range neutron monitoring system. The test drilling is planned for an early December outage if outage time is available. Test drilling will be performed by J. A. Jones Construction Company under the direction of Equipment Development. Specification preparation on both the monitoring chamber and the instrument system is continuing.

Design Test Service

The N-Reactor program utilized 611 hours of engineering effort for design test service.
PROJECT ENGINEERING

CGI-103, Fuel Element Charging and Handling System, KE and KW Reactors

Vitro Engineering Company is working on all phases of the design work with special emphasis on the magazine loading and flow plan drawing, which has been issued for comment.

One drawing on the charging platform electrical system has been issued for comment. Draft of the specification of the lift trucks has been reviewed. Purchase specification for the charge seaters is being prepared. Two prototype magazine clips have been received from the fabricator and will be tested during the next charge-discharge outage at the K Reactor. The present procurement schedule requires that all major purchase requisitions be issued by the end of November.

The order for the charging machine was placed with Union Machine Company.

CAI-105, Modification for Use of Bauxite, KE and KW Water Plants

Detailed design has been initiated by the on-site Architect-Engineer and is scheduled to be completed by April 30, 1964.

CAI-108, Emergency Storage Basin Coolant

Detailed design has been initiated by the on-site Architect-Engineer.

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

Six check prints have been received from Vitro. Their work is 27% complete, and they have requested an increase in design funds to $17,300 for this part of the project.

A meeting was held on October 7, 1963, with representatives from RLOO-AEC, GE-APED, and GE-HAPO in attendance. GE-APED presented the justification for the claim for additional money on the contract for the Safety Circuit System. Their presentation has subsequently been submitted in writing, together with an itemized breakdown of their claim. A review of their presentation is being made at the request of RLOO-AEC.

A secondary impeller failed in one of the 275 HP pumps in the KER Loops. Since this is the third impeller to crack in these pumps a letter has been sent to RLOO-AEC requesting that they review this problem with the vendor.

The Purchase Order for the Neutron Detection System has been placed with General Nuclear Corporation.
CGI-960, "C" and "D" Work Platform Safety Improvements, All Reactors

Design is 98% complete.

A number of electrical drawings have been returned to the Architect-Engineer for correction. With the approval of these drawings, design effort will be completed.

Permission to negotiate with the brake bidder has been requested since it is believed a smaller brake than the one bid is adequate at possibly a substantially lower price. The order for differential platform level controls was placed on October 24.

Brake air compressor and supply line installation was started October 25 in KE.

CGI-966, Safety Circuit Trip Identification System, 105-B, C, D, DR, F, H

The Commission placed the order for the static switching assemblies with Montek, Salt Lake City, Utah, on September 30.

HUPO Estimating has been given a work order and instructions to complete a cost-to-complete estimate for this job.

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

A second Astrodata-HAPO meeting was held October 16, 1963 to resolve questions regarding interpretations of Astrodata's proposal.

A revised design schedule is being prepared.

CGI-976, Automatic Filter Backwash System, 183-DR Building

Control Panels Nos. 7, 8, and 9 are now operating with revised stems in the Beckett-Harcum solenoid valves. Clearance has been increased from a nominal 0.0005" on a radius to a nominal of 0.0025" on a radius. There have been no problems to this date on the revised panels.

CGI-998, Improvement to Gamma Monitor Systems, 105-KE and KW

All drawings, purchase requisitions, specifications, and ATPs have been approved and issued, completing design on October 5.
MJA-42, Interior Painting, Process Water Storage Tanks, B, F, H, DR and C

Specifications have been written around Bureau of Reclamation VR-3 Specification for a vinyl-resin paint. Bids received on October 25, 1963 increase the estimated cost of the job by approximately $135,000.

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

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<th>To Date</th>
<th>% Complete</th>
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<td>105-B</td>
<td>177</td>
<td>1303</td>
<td>65</td>
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<td>105-D</td>
<td>137</td>
<td>1073</td>
<td>54</td>
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<tr>
<td>105-DR</td>
<td>102</td>
<td>1412</td>
<td>70</td>
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<tr>
<td>105-F</td>
<td>246</td>
<td>966</td>
<td>48</td>
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</table>

Gage delivery is still much too slow. A report is being prepared which will show the number of gages received since the vendor moved his facility to Skokie, Illinois.

MJA-55, Zone Temp. Monitor Terminal Board Relocation & Controller Revision, B, C, D, DR, F and H

Shop fabrication of the terminal board and enclosing cabinets has been started. (Three have been completed.)

Controller rework has been halted temporarily at the request of the Manufacturing Section.

AR-P-25041, Portable Closed Circuit Television Systems, All 105 Buildings

Equipment received on September 25, 1963. Operability tests and visual inspection of components completed and results forwarded to AEC Purchasing. These tests revealed that the cameras do not meet our specifications and other components of the systems malfunction for various reasons. AEC Purchasing has been requested to return all components to the vendor for rework.

100-K Zirconium Retubing Program

To date 4,545 tubes have been received from the Wolverine Tube Company. Approximately 3,700 tubes have been accepted from the vendor after plant site inspection.

The outage at 105-KE was completed with 611 zirconium tubes and 28 aluminum tubes installed. This brings the total zirconium tubes installed to date to 1,154 at 105-KW and 1,776 at 105-KE. Tools and materials are being delivered to 105-KW for their next outage for installation of 580 zirconium and 38 aluminum tubes.
Project Proposals Submitted to AEC

CGI-112, Storage Basin Overflow, 105-KE/KW

Directives Received

AEC-225, Emergency Storage Basin Coolant
(Interim authorization for design)

AEC-200, Mod. No. 2, Installation of Oil Burning Facilities in Lead Boiler

CPFF Construction Service Contractor-Liaison

Issued four new work orders and supplemented four old jobs for a total of $63,826 to J. A. Jones Construction Company.

Plant Forces Work Review

The Labor Standards Board approved four jobs for assignment to plant forces, estimated to cost $28,423.

RT Jessen:dgm

Manager, Facilities Engineering
ACCOUNTING

Overtime control levels for the second quarter of FY 1964 were established and approved by the General Manager.

A special procedure has been established for the control of overtime worked by Manufacturing Section for other components and accounts. Servicing controls have been set and routine reports are being issued against these controls.

Annual physical inventory of IPD precious metal was observed and records of count submitted to Inventory Accounting, Contract and Accounting Operation.

AUDITING

Two IPD and four HAPO OPGs were revised and issued.

Eighteen revisions to AEC manual chapters were reviewed for their effect on the Department's operation.

BUSINESS AND INFORMATION SYSTEMS

B-C Maintenance Operation has started to develop a mechanized Preventative Maintenance Program. Special forms have been developed which will be the basis for establishing the master file for each piece of equipment.

Manager-Finance

HW McMichael:WKH:slb

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<td>HW-78849</td>
<td>Unclass.</td>
<td>CP Cabell</td>
<td>9-9-63</td>
<td>Effect of Backwash Procedures on 183-F Rapid Gravity Filter Throughput and Waste Water Costs</td>
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<td>HW-78849</td>
<td>Conf.</td>
<td>BH Herrman</td>
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<td>Preliminary Engineering Study Linear Power Rate-of-Rise Instrumentation B, C, D, DR, F, H, KE, and KW</td>
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<td>Design Criteria, &quot;C&quot; &amp; &quot;D&quot; Work Platform Safety Improvements - All Reactors, Project CGI-960</td>
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<td></td>
<td>Rev. 1</td>
<td>WR Thorson</td>
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<td>HW-77927</td>
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<td>Authorization Request for Non-Compliance with the American Standard Safety Code for Elevators, Dumbwaiters, and Escalators</td>
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<td>JE Boyd</td>
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<td>HW-79057</td>
<td>Official</td>
<td>RW Bown</td>
<td>9-30-63</td>
<td>Trip Report - Mound Laboratory, Miamisburg, Ohio; Savannah River Plant, Aiken, S. Carolina; Advanced Technology Laboratory and Packaging Laboratory, Schenectady</td>
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<td>Conf.</td>
<td>JW Ballowe</td>
<td>10-15-63</td>
<td>Meeting Minutes - Power Recovery Study - Meeting No. 2, 10-11-63</td>
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<td>HW-79337</td>
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<td>10-22-63</td>
<td>Meeting Minutes - Power Recovery Study - Meeting No. 3, 10-18-63</td>
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<td>RK Smith</td>
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<td>An Evaluation of Wrought 430 Boron Stainless Steel</td>
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<td>Life Tests on 105-N Rod Position Transducers</td>
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<td>Reliability to Trip on Demand of the Zone Temperature Monitor</td>
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<td>Report to the Working Committee of the Fuel Element Development Committee</td>
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<td>HW-78056 Rev. 1</td>
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<td>GL Hammons, FW Knight, LH Rice</td>
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<td>Unusual Incident Report, Shipment of Improperly Aged Metal to Purex</td>
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<td>WV Thompson</td>
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<td>Date</td>
<td>Purpose</td>
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<td>PH Hutton</td>
<td>MTH Products, El Cajon, Calif.</td>
<td>10/20-24/63</td>
<td>Discussion of requirements for fabrication of prototype HCR tips for K Reactors.</td>
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<td>CA Munro</td>
<td>AD Little, Inc., Cambridge, Mass.</td>
<td>10/1-6/63</td>
<td>Discuss Contract CA-379.</td>
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<td>PB McCarthy</td>
<td>Hydraulic Hoist Corp., Auburn, Wash.</td>
<td>10-11-63</td>
<td>Inspection of hydrahoist motor and witness torque tests.</td>
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<td>HF Jensen</td>
<td>Turco Products, Inc., Pacific Molded</td>
<td>10/15-18/63</td>
<td>Visit vendor plants to discuss chemicals and rubber seals and visit plastics show for up-to-date information and discuss feasibility of plastic fuel magazines.</td>
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<td></td>
<td>Products, Western Plastics Show, Los Angeles, Calif.</td>
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<tr>
<td>JM Fox, Jr.</td>
<td>MTH Products, Inc., El Cajon, Calif.</td>
<td>10/21-22/63</td>
<td>Discuss fabrication procedures, materials procurement for prototype horizontal control rods.</td>
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<tr>
<td>RT Jaske</td>
<td>Aero Space Nuclear Safety Meeting</td>
<td>9/30-10/2/63</td>
<td>Develop background information supporting Hanford diversification studies.</td>
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<td></td>
<td>Albuquerque, New Mexico</td>
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<tr>
<td>FAR Stainken</td>
<td>Concordia College, Portland, Oregon</td>
<td>10-31-63</td>
<td>Present speech, &quot;The Challenge of Atomic Energy&quot;.</td>
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<td>WK Alexander</td>
<td>Aluminum Co. of America, Pittsburg, Pa.</td>
<td>10-1-63</td>
<td>Consult on control rod fabrication.</td>
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<td>Nuclear Metals, Inc., Concord, Mass.</td>
<td>10-2-63</td>
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<td>Arthur D Little Co. Cambridge, Mass.</td>
<td>10-3-63</td>
<td>Discuss graphite study.</td>
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<td>R Nilson</td>
<td>University of Texas Austin, Texas</td>
<td>10/14-15/63</td>
<td>PhD Recruiting</td>
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<td>OH Greager</td>
<td>GE - APED San Jose, Calif.</td>
<td>10-17-63</td>
<td>Discuss GETHC matters.</td>
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<td>GE - VAL Pleasanton, Calif.</td>
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<td>Review Mixed Spectrum Critical Assembly.</td>
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<td>JR Fredsall</td>
<td>Ottawa, Canada</td>
<td>10/21-23/63</td>
<td>Attend ANS Topical Mtg.</td>
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<td>Argonne National Lab. Lemont, Ill.</td>
<td>10-25-63</td>
<td>Consult on reactor physics analysis methods.</td>
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<td>JD Schaffer</td>
<td>Diversey Corp., Chicago, Ill.</td>
<td>10-31-63</td>
<td>To discuss proposed processes and testing methods.</td>
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<td>JD Schaffer</td>
<td>Oakite Products Inc. Chicago, Ill.</td>
<td>11-1-63</td>
<td>Discuss fuel fabrication as related to wetting problems with components.</td>
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<td>JD Schaffer</td>
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<td>To discuss component preparation (cleaning and de-oxidizing).</td>
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<td>Chicago, Ill.</td>
<td>10-30-63</td>
<td>National Association of Manufacturers Conference.</td>
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<td>Name</td>
<td>Firm &amp; Location</td>
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<td>Purpose</td>
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<tr>
<td>DF Spellman</td>
<td>Management Development &amp; Employee</td>
<td>10-31-63</td>
<td>To review Relations Programs.</td>
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<tr>
<td></td>
<td>Relations - GE Co.</td>
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<tr>
<td></td>
<td>New York, N.Y.</td>
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<tr>
<td>LL Samford</td>
<td>Harvey Aluminum, Inc.</td>
<td>10-28-63</td>
<td>Aluminum caps and cans.</td>
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<tr>
<td>HC Money</td>
<td>Western Filter Gardens, Calif.</td>
<td>10-29-63</td>
<td>Water mix spools.</td>
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<td></td>
<td>Alan Mold &amp; Engineering</td>
<td>10-29-63</td>
<td>Steel sleeves.</td>
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<td></td>
<td>N. Hollywood, Calif.</td>
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<td></td>
<td>R &amp; R Tool &amp; Die Co.</td>
<td>10-29-63</td>
<td>Aluminum supports.</td>
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<td></td>
<td>N. Hollywood, Calif.</td>
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<td></td>
<td>Bridgeport Brass</td>
<td>10/30-31/63</td>
<td>Aluminum caps and cans.</td>
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<td></td>
<td>Riverside, Calif.</td>
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<td></td>
<td>General Atomics</td>
<td>11-1-63</td>
<td>Magneform equipment.</td>
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<td></td>
<td>San Diego, Calif.</td>
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<tr>
<td>A McDonald</td>
<td>Reed Electric Co.</td>
<td>10/27-30/63</td>
<td>To inspect and evaluate the coil insulation on the 3,500 hp motor which failed in service in 190-C.</td>
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<tr>
<td></td>
<td>Portland, Oregon</td>
<td></td>
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<tr>
<td>WD Hamilton</td>
<td>ERA-ISA Electronic Exposition</td>
<td>10/9-10/63</td>
<td>Attend professional society meeting.</td>
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<tr>
<td></td>
<td>Seattle, Wash.</td>
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<tr>
<td>JW Green</td>
<td>L. Frank Markel &amp; Sons</td>
<td>10-21-63</td>
<td>Discuss RTD cable wire.</td>
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<tr>
<td></td>
<td>Norristown, Pa.</td>
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<td>Oak Ridge, Tenn.</td>
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<tr>
<td>WV Thompson</td>
<td></td>
<td></td>
<td>Discuss reactor confinement.</td>
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<tr>
<td>WV Thompson</td>
<td>American Foundry &amp; Furnace</td>
<td>10-21-63</td>
<td>Discuss confinement damper characteristics.</td>
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<tr>
<td></td>
<td>Bloomington, Ill.</td>
<td></td>
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<tr>
<td>ER Astley</td>
<td>Mfg. Services</td>
<td>10/12-15/63</td>
<td>Conferred with Mfg. Services on tool development.</td>
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<tr>
<td></td>
<td>New York</td>
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<table>
<thead>
<tr>
<th>Name</th>
<th>Firm &amp; Location</th>
<th>Date</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Patton</td>
<td>Huntington Alloy Div.</td>
<td>10-1-63</td>
<td>Nickel alloy development.</td>
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<td></td>
<td>International Nickel</td>
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<td></td>
<td>Huntington, West Va.</td>
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<tr>
<td>WH McGuire</td>
<td>Parker Aircraft Co.</td>
<td>10-8-63</td>
<td>Demonstrate use of Parker &quot;H&quot; Fitting.</td>
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<td></td>
<td>Los Angeles, Calif.</td>
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<tr>
<td>Y Hickey</td>
<td>Parker Aircraft Co.</td>
<td>10-8-63</td>
<td>Same as above.</td>
</tr>
<tr>
<td>RJ Schwieso</td>
<td>Seattle, Wash.</td>
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<tr>
<td>OJ Harper</td>
<td>OJ Harper Sales Co.</td>
<td>10-8-63</td>
<td>Same as above.</td>
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<tr>
<td></td>
<td>Seattle, Wash.</td>
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<tr>
<td>JR Churchill</td>
<td>Atomics International</td>
<td>10-3-63</td>
<td>Review testing programs being performed.</td>
</tr>
<tr>
<td></td>
<td>Canoga Park, Calif.</td>
<td></td>
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<tr>
<td>RS Quick</td>
<td>Self (Consultant)</td>
<td>10/7-15/63</td>
<td>Consult on Export System.</td>
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<td></td>
<td>Havertown, Pa.</td>
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<tr>
<td>FA Eidsness</td>
<td>Black, Crow, &amp; Eidsness, Inc.</td>
<td>10-8-63</td>
<td>Inspect water treatment plant.</td>
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<td></td>
<td>Gainesville, Fla.</td>
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<tr>
<td>AG Dunbar</td>
<td>GE - APED</td>
<td>10-15-63</td>
<td>Discuss potential for instrument irradiation</td>
</tr>
<tr>
<td>L Stanley</td>
<td>San Jose, Calif.</td>
<td></td>
<td>tests at HAPO.</td>
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<tr>
<td>G Shore</td>
<td>Abbey Automations Systems, Inc. N.Y.</td>
<td>10/8-9/63</td>
<td>Discuss design concepts for Nickel Plate</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>machine.</td>
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<tr>
<td>EA LeDuc</td>
<td>Dearborn Chemical Co.</td>
<td>10-16-63</td>
<td>Service contract on boilers.</td>
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<td></td>
<td>Portland, Oregon</td>
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<td>Seattle, Wash.</td>
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<td>D Tuel</td>
<td>Wyandotte Corp.</td>
<td>10-23-63</td>
<td>Cleaning Compounds.</td>
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<td></td>
<td>Wyandotte, Mich.</td>
<td></td>
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<tr>
<td>DM Guy</td>
<td>ALCOA, Seattle, Wash.</td>
<td>10-24-63</td>
<td>Aluminum caps and cans.</td>
</tr>
<tr>
<td>LE Null</td>
<td>Sandia Corp.</td>
<td>10/8-9/63</td>
<td>To discuss ultrasonic welding.</td>
</tr>
<tr>
<td>MJ Daves</td>
<td>Albuquerque, N. Mex.</td>
<td></td>
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<tr>
<td>Mr. Hall</td>
<td>National Lead Co.</td>
<td>10/16-17/63</td>
<td>To discuss stress analysis in fuel cores.</td>
</tr>
<tr>
<td></td>
<td>Cincinnati, Ohio</td>
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<tr>
<td>Name</td>
<td>Firm &amp; Location</td>
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<td>Purpose</td>
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</table>
| CE Polson       | National Lead Co.  
S. Cincinnati, Ohio | 10/21-22/63    | To discuss the uranium specifications.           |
| CE Bussert      | "                               | "             | "                                                |
| PN McCreery     | "                               | "             | "                                                |
| NF Neumann      | Mallinckrodt Chemical Works St. Charles, Mo. | 10-31-63 | To discuss thorium oxide feed.                   |
| RF Hartmann     | MOW, St. Charles, Mo.           | 10/1-3/63     | Fuel Element Development Working Committee Meeting. |
| NF Neumann      | MOW, St. Charles, Mo.           | "             | "                                                |
| CE Bussert      | NLO, S. Cincinnati, Ohio        | "             | "                                                |
| CE Polson       | "                               | "             | "                                                |
| RL Huntoon      | duPont-SRL, Aiken, S.C.         | "             | "                                                |
| TC Evans        | "                               | "             | "                                                |
| FR Dowling      | "                               | "             | "                                                |
| FH Belcher      | AEC, S. Louis Area Office       | "             | "                                                |
| IA Hobbs        | AEC, Savannah River Operation   | "             | "                                                |
| JW Ruch         | AEC, Oak Ridge Operations Office | "          | "                                                |
| PH Permar       | SRL, Aiken, S. C.               | "             | "                                                |
| JA Fellows      | MOW, St. Charles, Mo.           | "             | "                                                |
| S Marshall      | NLO, S. Cincinnati, Ohio        | "             | "                                                |
| JH Noyes        | "                               | "             | "                                                |
| JH Yeager       | MOW, St. Charles, Mo.           | "             | "                                                |
| RK Welty        | GE - APED  
San Jose, Calif. | 10-18-63      | Discuss industrial wastes.                       |