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AUG 19 1959

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Office Memorandum • UNITED STATES GOVERNMENT

TO : PE&M Files

DATE: August 10, 1959

FROM : R. L. Plum, Chief
Reactors Branch

HAN-71329
Rpt. #7

SUBJECT: MONTHLY REPORT FOR MONTH OF JULY, 1959

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SYMBOL: OR:MRS:GTO:HAH

PRODUCTION

Reactor input production was 7.9% above forecast; 16.7% above at the six old reactors and 4.5% below at the K's. July was the second best production month ever experienced and was only 0.7% below the February 1959 record.

Over-all TOE was 84.8% (79% forecast); 86.2% at the six old reactors and 80.6% at the K's. Forecast was exceeded due largely to improved rupture, water leak, and scram experience. H area TOE was 100%. Monthly production records were achieved at B and C reactors.

OPERATING EXPERIENCE

Power Levels

A new maximum power level of 1605 megawatts was established at H reactor; an increase of 5 mw over the previous record.

Ruptures

Six ruptures, all I&E regular, were removed from the reactors. Two were at B and one each at C, D, DR and F. A ruptured NPR prototype fuel element and 2 "C" metal ruptures were also discharged from KER loops 1 and 3, respectively, at KE reactor.

Reactor Outages

Reactor outages are listed below:

[redacted]

[redacted]

B REACTOR

Date Down	Date Up	Outage Hours	Remarks
6/29	7/1	39.6	Charge-discharge and miscellaneous maintenance following rupture removal.
7/2	7/3	26.7	Repair of a raw water export line break.
7/13	7/15	45.9	Removal of I&E regular metal ruptures from tubes 3255 and 3189. Charge-discharge and miscellaneous maintenance.
7/15	7/15	0.5	Beckman trip due to a flux concentration in the lower region.

C REACTOR

6/30	7/3	65.6	Charge-discharge and miscellaneous maintenance following a trip caused by a 151 Substation power failure.
7/3	7/3	3.5	Poison discharge.
7/20	7/22	50.6	Removal of a stuck I&E regular metal rupture in tube 2477 and charge-discharge.
7/22	7/22	6.8	Poison discharge.

D REACTOR

7/6	7/6	.03	Panellit trip due to a broken rear pigtail on tube 3768.
7/6	7/8	38.3	Leak testing and miscellaneous maintenance during a period of insufficient reactivity resulting from a broken rear pigtail. Four additional cracked rear pigtails were replaced and all other rear pigtails were inspected.
7/12	7/12	0.3	High pressure Panellit trip on tube 3091.

D REACTOR (cont.)

7/12	7/13	30.9	Removal of an I&E regular metal rupture from tube 3091 and charge-discharge.
7/19	7/19	0.2	Panellit trip due to a leaking Bourdon tube.

DR REACTOR

7/2	7/6	95.8	Charge-discharge following leak testing; completed the installation of rear face fog spray equipment.
7/6	7/6	0.9	Unexplained Panellit trip.
7/10	7/11	36.1	Charge-discharge following a Panellit trip.
7/20	7/21	35.5	Removal of an I&E regular metal rupture from tube 3459. Leak testing and replaced 40 leaking Panellit gauges.
7/28	7/30	41.2	Charge-discharge following leak testing.

F REACTOR

7/20	7/26	142.7	Removal of an I&E regular metal rupture from tube 3273. Completed the installation of 57 process tubes and charge-discharge.

H REACTOR

Not down

KE REACTOR

7/11	7/14	82.1	Charge-discharge and miscellaneous maintenance following the removal of 2 production test C metal fuel element failures from KER.
7/15	7/15	4.5	Poison discharge.

KE REACTOR (cont.)

7/19	7/20	30.8	Trip caused by a defective temperature relay on #1 low-lift pump. Charge-discharge and miscellaneous maintenance.
7/21	7/21	1.0	Forced turn-around.
7/26	7/27	30.1	Charge-discharge following a high pressure crossheader trip.
7/30	Still Down		Removal of an NPR prototype production test fuel element failure from KER Loop #1.

KW REACTOR

7/8	7/10	66.0	Scheduled charge-discharge.
7/11	7/11	5.1	Poison discharge.
7/26	7/27	35.5	Charge-discharge following a Panellit trip.
7/28	7/28	3.1	Poison discharge.

EQUIPMENT EXPERIENCE

4500HP Motor Failure - D

Eight-pump operation was interrupted for two days at 190-D when the stator of #4 pump shorted out on the July 13 startup. This is the fourth such coil failure in these 4500 HP CG-558 units, three having occurred in the last two months. HOO and HAPO are cooperating with the vendor of these units, the GE Apparatus Department, in an investigation of these failures.

Rear Cross-Header Joint Failures

During the July 11 outage at KE, six failed rear cross-header expansion joints had to be replaced. A total of 20 failures have occurred at KE, compared to only one at KW.

Storage Basin Murkiness - K Reactors

Slug pickup has been severely hampered by murky water in the storage basins at both K reactors. The problem is of a seasonal nature and coincides with high river turbidity during spring run-off. This year, however, the condition has lasted for 3 or 4 months, and it has undoubtedly been aggravated by increased reactor flow rates and the inadequacy of the filters.

Export Line Replacement

This emergency maintenance job being handled by Facilities Engineering and Minor Construction was progressing very satisfactorily up to the time of the work stoppage by Construction Craftsmen because of the Estep picket line. The final work of tie-in of the new line to existing piping at four points and blanking of one existing line was completed August 4-7.

RESEARCH AND DEVELOPMENT

Reactor Fuels

Projection Fuel Element Testing

To date, nine solid and 18 I&E self-supported fuel charges have been irradiated to exposures up to 870 MWD/T without the appearance of any hot spot flow patterns. Statistically, a factor of 10 reduction in hot spots is indicated, with 95% confidence. This result is based on comparison with a sample of normal production fuel elements from D reactor irradiated over the same period. All 13 ribless tubes in B reactor have been recharged with I&E self-supported fuel elements.

KER Fuel Element Testing

Two rod-and-tube elements irradiated to about 1800 MWD/T in KER loop 4 were discharged July 11. The Loop 4 Zr-2 process tube was replaced with an improved tube capable of operation at higher pressures. Preliminary examination of the discharged elements indicated no significant non-uniformity in dimensional behavior and relatively small diametrical increases.

Radiological Engineering

The following table summarizes the first 28 weeks of 1959 radiation exposure experience for the critical IPD classification:

Classification.	No. of Employees	Avg. Dose/Employee	Extrapolated year end avg.	No. of Employees over 3 r extrapolated exposure
Radiation Monitors	86	1146 mr	2127 mr	2
Processing Operators	256	920 mr	1708 mr	0
Pipefitters	94	1172 mr	2176 mr	12
Millwrights	78	959 mr	1780 mr	3

This table indicates a considerably more successful effort than last year to keep personnel exposures below the plant limit of 3 rads per year.

Reactor Power Level Limitations

The limits to all reactor power levels at the end of the month except D reactor were based on fuel element control at the goal exposure currently in effect. At D reactor the bulk outlet temperature limit was the most restricting limit.

Pipe Physics

Reasonably unrestricted equilibrium spline usage was resumed at D and KW reactors with the arrival of solid splines. Improved flattening efficiency resulted immediately.

Initial charging of spike enrichment (within the flattened zone) was being initiated at nearly all the older reactors. Central enrichment is becoming necessary to maintain high flattening efficiency and adequate reactivity control during intervals of low central residual exposure, especially with planned charging of water mixer slugs in all reactors.

The flattening efficiency as measured by average equilibrium ECT's approached nearly 76% of all reactor tubes in July compared to 75.0% in June and 74.5% in May. Higher residual exposures and increased spline usage at D and KW have been the principal contributors.

Pile Reactivity Studies

Multi-region calculations of reactivity and flux distribution effects of water mixing slugs have been carried out for C pile. These calculations indicate reactivity losses ranging from 40 to 80 inhours. These calculations should be applicable to the older reactors also.

Shielding Studies

The solid fring layer of depleted uranium in column 96 at B pile has been discharged and replaced with alternate mint columns. The latter alternate tube configuration has approximately the same reactivity and flux depressing effects as the solid depleted layer.

DR Gas Loop

The General Atomic fuel test described by the HIR MGCR-1 has been found to be not compatible with the existing facilities due to the radiological hazard which could result from a break in the fuel cladding.

Graphite Channel Overboring

Initial tests of Graphite channel overboring within moderate ranges, not including shield work, have indicated that it can be accomplished in approximately 3 minutes per channel.

FISSIONABLE MATERIALS - 2000 PROGRAM

Metallurgy Program

Reactor Decontamination Studies

The possible use of Turco 4501, a proprietary decontaminating agent, in NPR and PRTR, has produced an interest in learning the ingredients. Analyses of this mixture show the following contents:

> Potasium, 24.2%; sulfur, 0.06%; chlorine, bromine, and iodine as chloride, 0.003%; fluorine, none detected; nitrogen, 1.46%; water, 29.9%. A compound analysis indicated the presence of potassium hydroxide, tri-ethanol amine, and potassium salts of phenol, a steam volatile acid, and a non-volatile acid.

Examination of Reactor Pigtails

Samples of pigtails from B, D, DR, and H reactors have been dye checked to reveal cracks. The results to date are summarized below:

Examination of Reactor Pigtails

Reactor	No. Examined	No. Showing Cracks in Dye(a)		Evaluation of Sections Typical(b)	Other(c)
H	46	7	6	4	2
D	15	3	2	1	1
DR	43	3	2	1	1
B	23	1	0	1	1

(a) Only those showing the diagonal or circumferential crack were counted. Many pigtails from all reactors showed pits and longitudinal imperfections.

(b) A typical crack starts on the outside of the pigtail, frequently at a pit. It proceeds transgranularly with bunching to form a root-like-pattern. This type of crack is usually associated with stress corrosion in 304 stainless steel.

(c) These are all other cracks, pits, or tears that are not clearly the typical type described above.

Since the samples were taken, most of the rear face pigtails have been replaced at H reactor.

Reactor Program

Coolant Systems Development

Decontamination Studies

Tests have been completed in ELMO-10 loop to determine if the APACE decontamination process will attack graphitar bearings in the recirculating pumps. It was concluded that APACE can be used.

Aluminum Corrosion Studies

In preparation for one long-term test on aluminum at heat flux and water temperatures expected in advanced reactors, two short-term conditioning tests were run. Pieces from the first test were discharged after exposure at surface temperature up to 265°C for 23 days and were in very good condition. The second test consisted of Doe slugs clad in al (C-810) and X-8001). After ten days in the region of highest power and highest local water temperature (275°C) a high neutron activity from this test caused the reactor to scram. Examination revealed two X-8001 clad slugs ruptured in several spot welding areas. The exact reason for the failures is not known.

Component Testing

An NPR cap sealed with a Flexitallic gasket successfully completed 1369 thermal cycles between 200 and 550 F.

A Canadian rolled nozzle tube seal was removed from the ELMO-7 test loop after completing 4188 thermal cycles from 300 to 525°F at 1430 psi and 3993 cycles from 300 - 550°F at 1850 psi with no leakage. A flared nozzle tube joint with 800 ft. lb. torgue instead of the usual 1200 ft. lb. torgue began leaking on the first thermal cycle. A screwed nozzle tube joint with bell-ring seals has 700 thermal cycles from 250 - 550°F with no leakage.

Structural Materials Development

Zircaloy Retubing BDF

Fabrication of ribbed process tubes has commenced at each of the four contractor plants. Allegheny has produced extrusions for processing at Tube Reducing Corporation. After the first pass in the tube reducing machine, progress will cease because of the steel strike unless other arrangements can be made for vacuum annealing.

Nonmetallic Materials Development

MTR Graphite Irradiations

The GEH-19-2 modified shim rod containing four samples of GL-10, graphite (Great Lakes) and four samples of CSF as reference standards was charged June 29. Difficulty in holding the rod to the magnet was cause for discharge. An attempt for repairs will be tried for insertion again.

ETR Graphite Irradiations

The first two GEH-13 graphite irradiation experiments continue to operate satisfactorily. Temperatures vary from 800°C to 900°C along the capsule length in GEH-13-1, and vary from 625°C to 800°C in GEH-13-2,

GETR Graphite Irradiations

The first two of the HAPO graphite irradiation experiments in the GETR were built during the month. H-1, the experiment going into the E-5 center loop position of the GETR contains 12 sets of four samples. Six of the sets contain GL-10, GL-11 and VC referred to GSF as a standard and the other six sets contain RX-1, RX-2, and RX-3 referred in RC-1 as a standard.

H-2, which will be located in the E-7 side loop position of the GETR, contain eight sets of four samples. Four sets contain GL-10, GL-11, and VC and the other four contain SP-9, SP-10, and SV, all eight sets having a CSF sample as a reference standard.

Graphite Radiation Damage

A possible mechanism for high-temperature, radiation-included contraction of graphite is the relief of stresses developed upon cooling from graphitization temperatures. Small angle boundaries between crystallites joined at the edges of the 'a_o' planes, appear to be one of the sources for these stresses.

Hot Water Resistance of Elastomers

Additional work has been undertaken to determine the resistance of elastomers to long time immersion in boiling water and water at 175°C. Results on immersions for 5000 hours in boiling water indicate that there are several classes of materials and materials within a class

that will perform satisfactorily. The best of these are the silicone rubber Silastic S2096 and the nitrile rubber Hycar 1002. Immersions for 2000 hours at 175°C show that the material least affected in Silastic S2096. Hycar 1002 gained considerable weight and was substantially swelled.

Nuclear Physics Research Operation

A series of graphite exponential pile measurements has been completed using 1.92" diameter solid natural uranium rods. Similar measurements continued on a fuel element consisting of two concentric tubes. Measurements started on a rod-in-tube element.

A comparison of measured values of k_{oo} with predicted values for an enriched uranium cluster-type fuel element showed a 19 millik difference. This discrepancy must be resolved if the predicting code is to be used for NPR cluster-type fuel loadings.

A study of the possible consequences of a nuclear incident in a Redox dissolver was completed. The maximum credible incident was found to be one in which a final charge takes the dissolver to a near prompt critical situation. Most of the fission heat is retained in the fuel elements and severe exothermic chemical reactions are postulated as resulting. The available energy release in such an incident appears to be sufficient to rupture the dissolver, cause severe damage to process lines and possibly to the dissolver cell.

A re-evaluation of previous work on k_{oo} for UO_3-H_2O mixtures has confirmed earlier results, namely, k_{oo} is less than unity for U-235 enrichments less than one percent.

The second mass spectrometer, intended for heavy element analyses, has been put into operation for the first time. Alignment and general shakedown are in progress.

A final tabulation of the fission cross section of Pu-241 from 0.1 ev to 20 ev has been prepared and revised values of resonance parameters have been obtained.

The fission cross section of Pu-240 in the 1 ev resonance has been reconfirmed with a fission foil containing 99.75% Pu-240.

The experimental phases of the Gas-Cooled Reactor core experiemnts in the PCTR have been completed for the first fuel enrichment. This includes measurements of k_{oo}, p, f, c, control rod strength and fuel temperature coefficient.

4000 Program - Reactor Development (Gas-Cooled Power Reactor Program)

Graphite Studies

Microwaves can be used to generate oxygen atoms and ions in CO_2 and simulate the effect of radiation in making CO_2 more reactive towards graphite. A trial graphite oxidation run with CO_2 in the microwave apparatus has been made at room temperature; however, air leaks in the gas purification train showed up in the color of the glow discharge. These leaks are being eliminated.

In order to determine the oxygen atom concentration in the CO_2 the gas is titrated with NO_2. The fast reaction of $O + NO_2 \longrightarrow NO + O_2$ is succeeded by the slow reaction $O + NO \longrightarrow NO_2 + h\nu$, and the intensity of the emited light is used to follow the progress of the reaction. It is necessary to measure flow rates of the NO_2 and CO_2 accurately. A simple device has been constructed which measures low flow rates by observing the volumes swept out during measured time intervals in a calibrated tube by soap films. This device is being used to calibrate rotameters for low flows.

Gamma Irradiation Facility

The 15,000 curie Co60 source was received and placed in the gamma irradiation facility. The stainless steel encased cobalt rods were arranged in an underwater source holder to enclose a volume five inches in diameter and eighteen inches high. Irradiation damage to plastic samples irradiated in the dry tube indicated a dose rate of 10^6 r/hr. The source is being more accurately calibrated with ferrous sulfate and ferrie sulfate chemical dosimeters.

July OUTAGES (Year) (1959) [redacted] DECLASSIFIED

Reason	B	C	D	DR	F	H	KE	KW	Total
Charge-Discharge	12.8	31.7	24.6(2)	73.3(3)	41.9(4)		44.9	81.8(5)	311.0
Maintenance	27.4	38.4	25.4	74.6	18.4		52.6	18.0	254.8
Rupture Removal	10.0	-	8.6	9.5	3.2		-	-	31.3
Leak Testing	14.3	-	7.8	32.0	-		-	-	54.1
Tube Replacement	-	-	3.0	8.5	73.7		-	-	85.2
Project Work	12.8	11.5	-	5.0	-		-	-	29.3
Production Tests	3.5	28.3(1)	.2	2.1	5.5		81.2(6)	1.1	121.9
Instrument & Circuitry	.5	-	.2	4.5	-		-	8.8	14.0
Rupture Suspects	-	-	-	-	-		-	-	-
Miscellaneous	-	3.2	-	-	-		-	-	3.2
Total	81.3	113.1	69.8	209.5	142.7		178.7	109.7	904.8
Scheduled Outages	49.3	65.9	45.3	144.9	136.4		104.1	97.0	642.9
Unscheduled Outages	32.0	47.2	24.5	64.6	6.3		74.6	12.7	261.9

(1) Incl. 19.9 hrs. for removal at PT-IP-143-A Rupture
(2) Incl. 2.2 hrs. unplanned outage time for stuck charges.
(3) Incl. 18.6 hrs. unplanned outage time for stuck charges.
(4) Incl. 1.2 hrs. unplanned outage time for stuck charges.
(5) Incl. 1.4 hrs. unplanned outage time for stuck charges.
(6) Incl. 25.1 hrs. for trips caused by KER and 30.2 hrs. for Loop #1 rupture.

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RUPTURED SLUG TABULATION FOR JULY, 1959

Tube No.	Date Charged	Date Ruptured	Tube Power (KW)	Concentration MWD/Ton	Assigned Production Loss		Observations
					MWD	Days	
3091-D	2-1-59	7-12-59	833	817	819	.57	I&E Regular - Hole Failure
3255-B	1-28-59	7-13-59	677	670	298	.20	I&E regular. Hole Failure
3189-B	3-31-59	7-13-59	1003	590	298	.20	I&E Regular. Hole Failure
2477-C	5-12-59	7-20-59	1037	462	1995	1.16	I&E Regular - Hot Spot PT-IP-143-A
3459-DR	4-1-59	7-20-59	961	635	755	.54	I&E Regular - Hot Spot
3273-F	3-16-59	7-20-59	927	728	357	.24	I&E Regular - Hole Failure
3565-KER	6-28-59	7-12-59	553	663	2053	.74	Loop 3. 2 Doe Metal Pieces in the same tube. PT-IP-190-A Supp. B
2160-KER	6-28-59	7-30-59	600	159	6517	2.37	Loop 1. NPR Prototype - PT-IP-250-A
					[redacted]		