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BULK SHIELDING FACILITY QUARTERLY REPORT
APRIL, MAY, AND JUNE OF 1967

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SUMMARY

The BSR was operated for 662.0 hr and produced 1,277,795 kwhr of energy. The major portion of this operation was for basic research. Remote operation of the BSR was begun on May 31, 1967; with the exception of one short shutdown due to the loss of the picture on the TV monitor, remote operation has been very satisfactory. All startups and balancing of shim rods have been performed at the local console.

The PCA was operated during April and May for graduate and undergraduate students of the Department of Nuclear Engineering of the University of Tennessee.

BULK SHIELDING REACTOR

Operations

The reactor operating time consisted of 578.7 hr for research, 7.1 hr for the training of UT students, 36.0 hr for sample irradiations (35.8 hr of the runs for samples were concurrent with the research runs), 8.2 hr for visitors on tours, and 67.8 hr to gain experience in remote operation.

Table 1. Research Usage of Reactor

Time (hr)	Location	Division or Other Sponsor
341.8[a]	Liquid nitrogen cryostat (at the north face)	Solid State
58.5[b]	Liquid helium cryostat (in the southwest corner of the pool)	Solid State
310.0[c]	Core position No. 15 facility tube	Solid State
176.5[d]	Core position No. 11 facility tube	Solid State
119.3	East D_2O tank (center hole)	Isotope
3.0	North front face facility tube	Solid State

[a]Of this time, 23.2 hr were concurrent with the east D_2O tank run.

[b]Of this time, 41.0 hr were concurrent with the east D_2O tank run.

[c]Of this time, 109.6 hr were concurrent with the east D_2O tank run and 160.1 hr were concurrent with the liquid nitrogen cryostat run.

[d]All of this time was concurrent with the east D_2O run.

A total of 16 samples was irradiated in or near the reactor. Details of these irradiations are presented in Table 2.

Table 2. Samples Irradiated

Material	Number of Samples	Location	Division or Other Sponsor
297.1-mg Ti wire; 34.2-mg SC_2O_3; 197.6-mg Au-Al (0.1% Au); 335.9-mg Co-Al (0.151% Co).	1	East D_2O tank (east hole)	Analytical Chemistry
~0.5-gm Pr; ~0.5-gm Na^{24}	10	North face of the core	Neutron Physics
~0.5-gm Na^{24}	5	North face of the core	Neutron Physics

Core Loadings

The BSR core loading, No. 8 (Fig. 1), remained unchanged during this quarter. Due to fuel burnup the operating mass was 3720.50 gm at the end of the quarter.

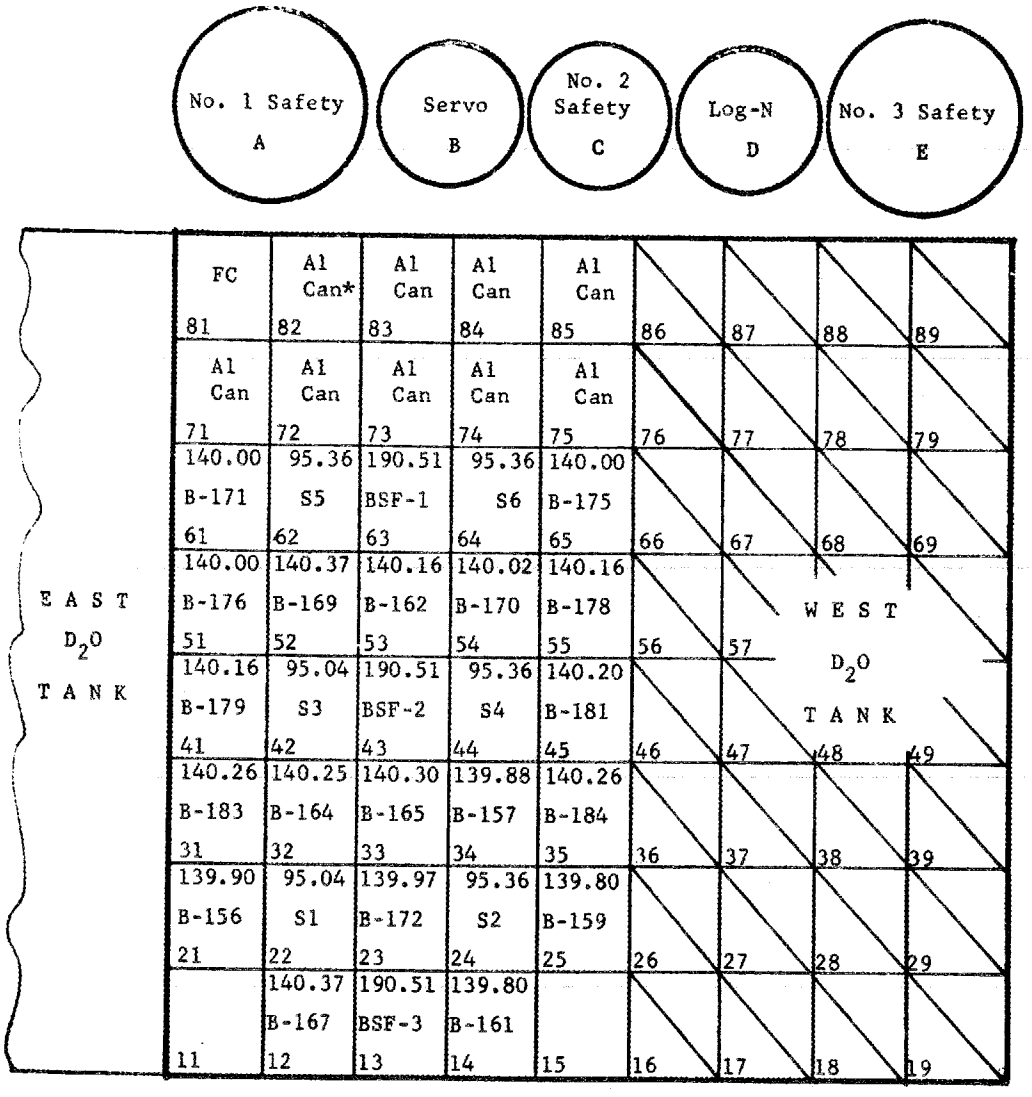
Unscheduled Shutdowns

There were five unscheduled shutdowns resulting in a total of 1.333 hr. Details are presented in Table 3.

Table 3. Unscheduled Shutdowns

Date	Downtime (hr)	Cause
4-11-67	0.217	The No. 4 shim rod dropped. A check was made for abnormalities and all components seemed to be working normally.
4-17-67	0.233	The No. 4 shim rod dropped. Reactor Controls Department personnel observed the two Composite Amplifier meters and it appeared that the magnet current was changing when the period changed. (This could possibly be due to the period section changing the load on the voltage regulator tubes which also supply regulated voltage to the magnet amplifier section of the Composite. Other possibilities are poor alignment between the magnet and keeper and/or collection of foreign matter on the keeper.)
6-10-67	0.167	The picture on the TV monitor at the remote console was lost temporarily. An adjustment was made in the TV monitor and reception was normal for the duration of this reporting period.
6-12-67	0.383	The No. 4 shim rod dropped; no action was taken.

ORNL DWG. 67-6076R



*The Al cans are filled with light water

Date: 2-1-67

Critical Mass: 2953.4 g; rods at 20.9 in.

Operating Mass: 3804.91 g

Core Number: 8

Type of Rods: _____

Rod Positions at Critical
(With Operating Mass)

Rod No.	In. Withdrawn
1	10.87
2	10.87
3	10.87
4	10.87
5	10.87
6	10.87

Fig. 1. Core Loading No. 8 - BSR

Table 3. (Continued)

Date	Downtime (hr)	Cause
6-12-67	0.333	The No. 4 shim rod dropped. Reactor Controls Department personnel checked the No. 4 Composite Amplifier and found one of the two voltage regulating (OA-2) tubes bad. Both of the tubes were replaced. The drop current for the No. 4 rod increased to 59 ma and remained at this setting on several drop checks. With proper approval, the system was reset for a drop current of 59 ma. (This resulted in an N_L current of 81 ma and an N_F current of 30 ma.) This allowed the run for an experiment in progress to be completed. On June 16, 1967 the No. 4 rod drive was removed for an inspection of the magnet, which was found to be very dirty. The magnet and armature were cleaned. The drive was reinstalled and proper electrical connections were made. (A complete rod-performance check was made on the No. 4 rod and the recorded readings were as follows: drop current, 50 ma; N_L current, 77 ma; and N_F current, 74 ma. Plans were made to clean the magnets and armatures on the other five shim rods.)

Reactor Maintenance

The mechanical and instrument maintenance which was performed on the BSR during the quarter are listed in Tables 4 and 5.

Table 4. Bulk Shielding Reactor Maintenance - Mechanical

Date	Component	Trouble or Condition	Action Taken
4-4-67	Primary-water valve pit and concrete plug	Rust from dampness	The bottom of the plug and the valve-pit surfaces were painted with one coat of white paint of a type similar to epoxy.
4-4-67	Radiation detector RIM-5 (for monitoring the radiation from the pool-water outlet line)	Unreliable readout at the BSR console	A new cable was run from the radiation-detector probe of the exit-water line in the valve pit to the readout meter at the BSR console.
4-11-67	Nuclear and process annunciator auxiliary circuits	Installation error	A missing wire was installed to allow the remote nuclear-annunciator indicator light to work properly. Jumper wires were installed around the missing (unused) positions in the process-annunciator auxiliary circuit to allow the remote process-indicator light to work properly.
4-13-67	Fuel storage racks in the BSR vault	Cadmium plates were not secured in the storage rack	A cadmium plate was permanently fastened in each storage rack position.
4-18-67	Degasser tank	For removing dissolved air from the primary water system	See section entitled "Modifications to Cooling System".
5-4-67	Air-conditioning unit No. 7	Broken belt	This unit was repaired and the filters were replaced.
5-10-67	Overhead pool light transformer	Relocation	This unit was removed from Room 103 and installed under the metal stairway in the north bay area. Room 103 is now being used by Reactor Controls Department personnel.
5-26-67	Stops on BSR bridge rail	New stops installed	This was necessary to keep the BSR core from being positioned too close to the PCA core. (These stops extend six inches further south than the old stops; this change was necessary since the new BSR grid extends six inches further north than did the old grid.)
5-30-67	North cooling-tower fan	Time-delay relays	The north cooling fan was placed in service after adjustments were made to the relays.

Table 4. (Continued)

Date	Component	Trouble or Condition	Action Taken
6-15-67	"E" panel switch No. 1	New installation	The "E" panel switch, No. 1, for the liquid helium cryostat was placed in service.
6-28-67	No. 3 shim rod drive	Electrical tape next to magnet came loose due to radiation damage	This tape is used to hold a section of the clutch-switch leads to the lift tube. The No. 3 rod drive was removed and this section of tape was removed. The magnet and armature were cleaned. (After the rod drive was reinstalled and all connections were completed, a performance check on the No. 3 shim rod was made and the results were as follows: Release time, 3.0 msec; Time of flight, 429 msec; Drop point, 145% N_F; Drop current, 50 ma; N_L current, 72 ma, and N_F current, 71 ma.)
6-16-67	No. 4 shim rod drive	Tendency to drop	Investigation indicated that the difficulty was not due to the instrumentation but was due to the magnet and armature combination. The rod drive was removed for inspection. The magnet was very dirty. Both the magnet and the armature were cleaned and returned to service following performance checks.

Table 5. Bulk Shielding Reactor Maintenance - Instrumentation

Date	Component	Trouble or Condition	Action Taken
4-3-67	Instrumentation checkout	Quarterly checkout	Typical shim-rod performance data are listed in Table 6.
4-3-67	Count-rate amplifier (serial No. 4)	Modification of amplifier	The amplifier was removed from service to install a period test connection. The amplifier was returned to service on April 4, 1967.
4-4-67	Building ventilation system	Malfunctioning flow control unit	Measurements were taken on air flow in the containment ducts. It was found that the damper in the west duct remained closed all the time. (It should remain opened all the time to allow ~1600 cfm of air to be exhausted from the bay area.) An adjustment was made in the control circuit to the damper.
4-10-67	12 r/hr radiation detector	New installation	The detector was connected to a meter located in panel A of the BSR vertical panel. (The information from the readout meter is also displayed by a meter at the BSR remote console in the ORR control room.) On April 28, 1967, the 12 r/hr radiation-detector channel was connected to the annunciator, "Monitron high level".
4-13-67	Count rate channel	Modification of audible count-rate amplifier	The circuit which drives the audible count-rate amplifier (popper) was modified and reinstalled with a new "popper". This was necessary so the count-rate would be audible in the bay area while the overhead exhaust fan was running.
4-14-67	Count rate channel	Shift in the posted noise curve	A new noise curve was determined, plotted, and approved.
4-20-67	Count rate recorder	Faulty reference power supply	Proper repairs were made.
4-23-67	Servo channel	Temporary withdraw error which cause the power to rise to 110% and initiate a setback	Tests were conducted to locate the trouble but these tests did not reproduce the cause of the failure.
5-3-67	Cell-ventilation-radiation monitoring probe	Faulty high readings and alarms on readout meter at the BSR console	The cell-ventilation-duct radiation probe was replaced with a new probe. In addition, holes were drilled underneath the connection box so that any rain water will drain out.

Table 5. (Continued)

Date	Component	Trouble or Condition	Action Taken
5-12-67	12 r/hr building monitor	Faulty readout	The monitor was removed to the shop and proper repairs were made. It was reinstalled, calibrated, and placed in operation. A meter reading of 10.6 (alarm setting) is equivalent to 12 r/hr.
5-31-67	Count-rate channel	Noise	The count-rate meter was replaced with a spare unit on June 1, 1967.
6-5-67	Count-rate channel	Noise	The preamplifier was replaced with a spare unit. New curves were determined, posted, and approved.
6-16-67	No. 2 Composite Amplifier	Magnet current was erratic	The power-supply tube was bad. Proper repairs were made.
6-16-67	Servo recorder	Installation error	Changes were completed according to reactor controls change memo BSR-2Mw No. 4 which results in tying the servo recorder to the power failure annunciator, "recorder off".
6-22-67	No. 1 safety channel	Adjustment needed on the sensitivity switch	The switch setting was reset from position No. 5 to position No. 2. (The readout on the No. 1 safety recorder was 104% before the change and 101% after the change.)

Table 6. BSR Shim-Rod Performance Data

Parameter	Rod No. 1	Rod No. 2	Rod No. 3	Rod No. 4	Rod No. 5	Rod No. 6
Release time (msec)	3.5	3.0	3.5	3.5	4.0	3.5
Drop time (msec)	440	435	435	445	439	441
Drop point (%)	146	140	145	144	140	143
Drop current (ma)	50	46	45	46	44	49
N_L current (ma)	77	71	71	67	75	75
N_F current (ma)	72	65	67	66	69	71

Special Tests

University of Tennessee undergraduate students performed a shielding experiment using the BSR. A fission chamber and a gamma chamber were placed in a dry tube, which was attached to the instrument bridge. The vertical centerline of this tube was initially about 38 cm north of the center of the north face of the reactor. The reactor was brought up to low power and measurements of neutron flux and gamma-ray dose were made. The instrument bridge was moved farther north from the reactor in 10 cm increments; the measurements were repeated following each movement of the instrument bridge. As the signals from the chambers decreased to very low levels, the reactor power was increased to obtain higher signal levels; appropriate normalizing factors were calculated to compensate for the changes in reactor power. All movements of the instrument bridge were made by Operations Division personnel. This experiment was performed by each of three groups of students and required about three hours per group.

Water System

Primary System

A routine radioactive analysis was made on a sample of BSR pool water. Table 7 presents the radioactivities which were present in the reactor.

Table 7. Radioactive Analysis of BSR Pool Water (June 15, 1967)

Constituent	dis min^{-1} ml^{-1}
^{131}I	<0.6
^{133}I	4.8
^{91}Sr	<3
^{89}Sr	<1
^{103}Ru	<0.3
^{106}Ru	<0.2
^{137}Cs	~0.4
^{239}Np	5.1
^{140}Ba	1
^{143}Ce	<1
^{141}Ce	<0.5
^{24}Na	2.62×10^{3}

The reactor had operated ~9 days and accumulated 366 Mwhr prior to the time the sample was taken.

Demineralizers

Table 8 presents performance data on the primary flow demineralizer.

Table 8. Demineralizer Performance Data

Run No.	Initiation Date	Termination Date	Throughput Gallons	Gross Gamma Counts min^{-1} ml^{-1} In	Gross Gamma Counts min^{-1} ml^{-1} Out	pH In	pH Out	Specific Resistance (ohm-cm) In	Specific Resistance (ohm-cm) Out
1	2-17-67	6-2-67	3,704,900	829	43	6.2	6.4	950,555	1,621,665
2	6-2-67	In Service	856,540	2,230	167	6.1	6.6	760,665	1,895,715

Modifications to Cooling System

During the latter half of May and the first half of June, preparations were made for installing a degasser tank in the primary cooling system. On June 15, 1967, the system was drained and the tie-in of the tank was begun. (The tank is part of the return line from the heat exchanger to the pool.) The tie-in was completed and the primary flow was started on June 19, 1967. All parts of the system were vented, and the top of the degasser tank was connected to the building ventilation system. There appeared to be more air bubbles in the pool than before tha degasser tank was installed. The trouble appeared to be caused by insufficient suction on the top of the tank. On June 21, 1967, the top of the tank was connected to the normal off-gas system by way of the surge tank. Since that time, the bubbles that have been released have been very few in number and very small in size. However, to keep the activity in the reactor bay at a low level, the overhead exhaust fan must still be operated.

Secondary System

On May 4, 1967, a sample of the secondary water was taken from the tower basin and sent to the microbiological laboratory of Nalco Chemical Co., Chicago, Illinois, for an anlaysis on the microbiological growth. The results on the condition of the water at the time of this sample showed very satisfactory bacteria, algae, and fungi control.

On June 26, 1967, a check on the cooling tower revealed that slime had started accumulating on the wood. To correct this, the Nalco No. 207 balls were added in greater numbers than usual at the suggestion of the Nalco representative. At the end of this report period, the slime had disappeared.

Cooling Tower Fans.--The cooling-tower-fan gear boxes are connected to their respective motors by Dodge Flexidyne Couplings. These couplings limit the starting torque on the motors. The transmission medium, or flow charge, consists of small metal particles. The amount of flow charge in each coupling was adjusted on May 19, 1967. Then, tests were conducted to determine the motor in-rush current as a function of time after initiating both low-speed and high-speed fan operation. The results of these tests indicated that the motor in-rush current was greater than ideal for long term operation. At the same time it was determined that the flow-charge material should be changed; therefore, stainless steel flow charge was ordered. When this material is obtained, further adjustment and tests will be performed.

Stainless Steel Fuel Elements

All stainless steel fuel elements and stainless steel fuel plates were transferred to the SS Accountability vault. (These were the BSR-II fuel elements.) The fuel was shipped in 11 steel drums. After the free volume in each drum was filled with vermiculite, the top was installed and fastened in place.

POOL CRITICAL ASSEMBLY

Operations

During the first week of April, R. Trinko, of the University of Tennessee, completed an experiment begun on March 31, 1967. The purpose of this experiment was to study the behavior of instrumentation designed for measuring reactor noise. The reactor configuration used was loading No. 43-B, Revision 1 (ref. 1).

During the last three weeks in April and the first week of May, undergraduate students of the Nuclear Engineering Department of the University of Tennessee performed a series of experiments using the PCA. (An additional experiment using the BSR is described elsewhere in this report. The use of the PCA and BSR for those experiments was arranged by the University Relations Department of ORNL.) A brief description of each experiment follows.

1. Critical Loading

A basic 3 x 4 fuel array was assembled prior to the experiment by Operations personnel and a standard approach-to-criticality was performed by the students. They determined the amount of fuel to be added and where it was to be placed in the core. The object was to bring the reactor just critical with all rods completely withdrawn from the core. No move was made without first obtaining the approval of Operations supervision. This experiment took approximately eight hours to perform and was done by each of three groups of students. (The three loadings assembled are shown in Figures 2, 3, and 4.)

2. Rod Calibration

This experiment consisted of two parts. First, the PCA regulating rod was calibrated using the period method; then, both the differential and integral rod worth were calculated. The second portion of the

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[1] W. H. Tabor, Bulk Shielding Facility Quarterly Report - January February, and March 19, 1967, ORNL CF-67-5-67, p 42 (May 23, 1967); (internal use only).

TX-2130

ORNL DWG. 67-10463

POOL CRITICAL ASSEMBLY

BLDG. 3010

LOADING NO. 74

DATE: 4-11-67

	1	2	3	4	5	6	7	8	9
A									
B		Aux FC							
C			S-28	B-186	B-180	B-168	A-76		
D			S-17	SR #1 / B-114	I-115	RR / B-197	A-64	A-81	
E			B-185	I-116	I-113	A-80	A-59	A-19	
F		FC	B-177	SR #2 / B-147	A-77	SR #3 / B-127	B-182	n Source	
G			A-78	A-61	A-67	A-60	A-79		

CRITICAL MASS: _____

FINAL MASS: 3380.14 g

EXCESS: +0.064% (130.8 sec period)

ROD POSITIONS:

NO. 1 SAFETY: Upper limit

NO. 2 SAFETY: Upper limit

NO. 3 SAFETY: Upper limit

REGULATING ROD: 18.085 inches

ROD MATERIALS:

SAFETIES: B_4C

REGULATING ROD: SS

POWER LEVEL: _____

REFLECTOR: H_2O

REMARKS: ___

University of Tennessee
critical experiment

CHAMBER POSITIONS:

NO. 1 SAFETY: Fully inserted

LOG N: Fully inserted

NO. 2 SAFETY: Fully inserted

SERVO: Fully inserted

FISSION CHAMBER: Both fully inserted

NO. 3 SAFETY: Fully inserted

SIGNED: [signature]

Figure 2

TX-2130

ORNL DWG. 67-10464

POOL CRITICAL ASSEMBLY

BLDG. 3010

LOADING NO. 75

DATE: 4-12-67

	1	2	3	4	5	6	7	8	9
A									
B		Aux FC			B-180				
C			A-70	A-76	I-121	I-117	B-168		
D			S-17	SR #1 / B-114	I-115	RR / B-197c	A-69		
E		A-40	A-78	I-116	I-113	A-80	A-81		
F		FC	I-114	SR #2 / B-147	A-77	SR #3 / B-127	A-79		
G			S-28	A-61	A-67	A-60	B-177		

CRITICAL MASS:

FINAL MASS: 3428.86 g

EXCESS: +0.031% (~305 sec period)

ROD POSITIONS:

NO. 1 SAFETY: Upper limit

NO. 2 SAFETY: Upper limit

NO. 3 SAFETY: Upper limit

REGULATING ROD: 19.30 inches

ROD MATERIALS:

SAFETIES: B_4C

REGULATING ROD: SS

POWER LEVEL:

REFLECTOR: H_2O

REMARKS:

University of Tennessee critical experiment

CHAMBER POSITIONS:

NO. 1 SAFETY: Fully inserted

LOG N: Fully inserted

NO. 2 SAFETY: Fully inserted

SERVO: Fully inserted

FISSION CHAMBER: Both fully inserted

NO. 3 SAFETY: Fully inserted

SIGNED:

Figure 3

TX-2150

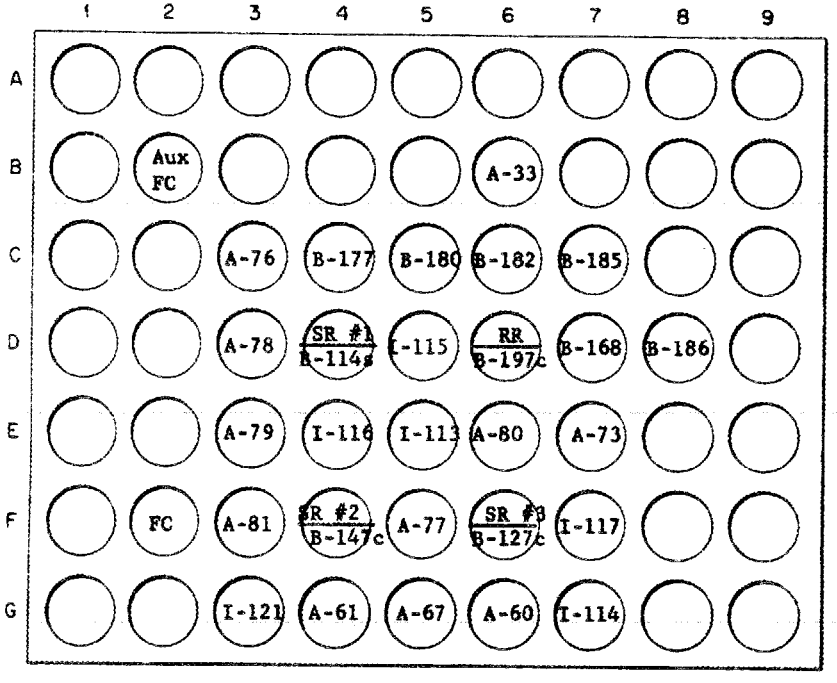
ORNL DWG. 67-10465

POOL CRITICAL ASSEMBLY

BLDG. 3010

LOADING NO. 76

DATE: 4-13-67



CRITICAL MASS: _____

FINAL MASS: 3415.88 g

EXCESS: +0.031% (~297 sec period)

ROD POSITIONS:

NO. 1 SAFETY: Upper limit

NO. 2 SAFETY: Upper limit

NO. 3 SAFETY: Upper limit

REGULATING ROD: 19.755 inches

ROD MATERIALS:

SAFETIES: B_4C

REGULATING ROD: SS

POWER LEVEL: _____

REFLECTOR: H_2O

REMARKS:

University of Tennessee
critical experiment

CHAMBER POSITIONS:

NO. 1 SAFETY: Fully inserted

LOG N: Fully inserted

NO. 2 SAFETY: Fully inserted

SERVO: Fully inserted

FISSION CHAMBER: Both fully inserted

NO. 3 SAFETY: Fully inserted

SIGNED: _____

Figure 4

experiment consisted of the measurement of the worth of the shim rod "bank" using the rod-drop method. For this part of the experiment, a 400-channel analyzer was connected to the output of the auxiliary counting channel and the printed results were analyzed by the students. Again, all moves were supervised by Operations supervision. This experiment took approximately four hours to perform and was done by each of three groups of students. (Operations personnel loaded the core prior to this experiment as shown in Figure 5; this loading was used in Experiment 3, also.)

3. Importance Function

In this experiment a special element with one vacant plate position was used. Various plates, containing silver discs located at different distances along the length, were placed in this position. The change in reactivity due to the change in location of the silver disc was determined by the change in regulating-rod position required to make the reactor just critical and by using the regulating-rod calibration, as determined by experiment No. 2. All moves were supervised by Operations supervision. This experiment took approximately four hours to perform and was done by each of three groups of students.

Reactor Maintenance

The mechanical and instrument maintenance which was performed on the PCA during the quarter is listed in Tables 9 and 10. Shim-rod performance data obtained during the test which followed the relocation of shim-rod drives on April 10, 1967, is listed in Table 11.

TX-2135

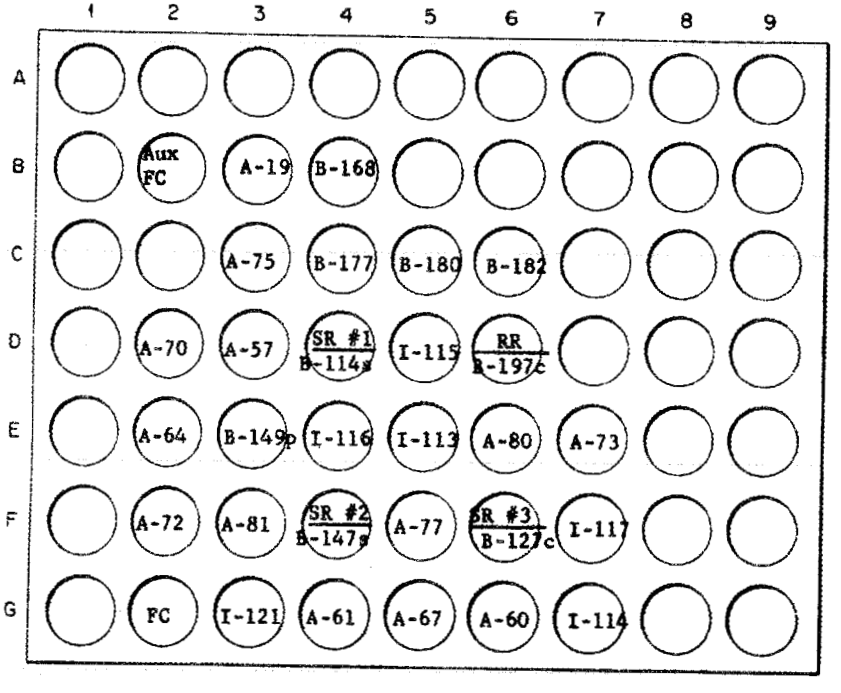
POOL CRITICAL ASSEMBLY

BLDG. 3010

ORNL DWG. 67-10466

LOADING NO. 77

DATE: 4-21-67



CRITICAL MASS: _____

FINAL MASS: 3479.13 g

EXCESS: _____

ROD POSITIONS:

NO. 1 SAFETY:	Upper limit	Upper limit
NO. 2 SAFETY:	Upper limit	22.67 in.
NO. 3 SAFETY:	Upper limit	Upper limit
REGULATING ROD:	5 in.	Lower limit
F. C.C.	1 in.	10 in.

ROD MATERIALS: (Source Removed)

SAFETIES: B_4C

REGULATING ROD: SS

POWER LEVEL: _____

REFLECTOR: H_2O

REMARKS: ___

University of Tennessee
Rod calibration experiment
and Importance function
experiment

CHAMBER POSITIONS:

NO. 1 SAFETY: Fully inserted

LOG N: Fully inserted

NO. 2 SAFETY: Fully inserted

SERVO: Fully inserted

FISSION CHAMBER: Aux FC at 8 in. withdrawn

NO. 3 SAFETY: Fully inserted

SIGNED: _____

Figure 5

Table 9. Pool Critical Assembly Maintenance - Mechanical

Date	Component	Trouble or Condition	Action Taken
4-7-67	No. 1 shim rod drive assembly	Clutch switch activated before sufficient insertion of drive (during automatic rundown)	The drive assembly was removed from the reactor. The clutch switch position was adjusted. In addition, the armature was found to be cocked; the armature was made level.
4-7-67	Instrument-start circuit	Instrument-start could not be obtained due to a missing wire	A wire, which had been removed during the summer of 1966, was replaced. (Since that time, the reactor had not been operated with the regulating rod installed; therefore, instrument-start had not been required.)
4-11-67	Permanent fission chamber drive unit	Unit not available for use	The drive unit was removed from the reactor. Adjustments were made and a drive gear replaced. This unit was reinstalled in the reactor and connected to the permanent count-rate channel. (The auxillary drive unit had been connected to the permanent channel since the difficulty reported on March 31, 1967).
4-11-67	Auxillary fission chamber drive unit	Unit previously used in permanent channel	The auxillary drive unit was reconnected to the auxillary channel.
4-20-67	No. 2 shim rod coarse position indicator	Rod motion not indicated continuously	The position indicator gears were meshing too tightly; the degree of tightness was reduced.
4-26-67	Permanent fission-chamber drive unit	Chamber could not be withdrawn more than 20 in.	The chamber drive was freed manually.

Table 10. Pool Critical Assembly Maintenance - Instrumentation

Date	Component	Trouble or Condition	Action Taken
4-3-67	Permanent count-rate channel preamplifier	Excessive electronic noise in channel	Investigation indicated that the preamplifier had become electronically unstable and had begun to oscillate. The preamplifier was disconnected from the channel and the auxiliary count-rate channel.
4-10-67	Shim rods	Recheck of performance required due to relocation of shim rod drives	A performance check was completed (see Table 10 for results).
4-10-67	Auxiliary count-rate	Channel not available for use	Installed a count-rate meter and reconnected the preamplifier. (The count-rate meter previously in service was removed from the auxiliary channel on March 31, 1967, for use in the permanent channel. The preamplifier had also been used in the permanent channel since April 3, 1967).
4-10-67	Permanent count-rate channel preamplifier	Preamplifier in use since April 3, 1967, was reconnected to the auxiliary channel	A repaired preamplifier was installed.
4-24-67	Log-N amplifier	Period varied with amplifier in calibrate	The logarithmic diode was replaced.
5-2-67	Micromicroammeter	Improper readout with calibrated current source as input	The two sychronus converter tubes were replaced with tubes from a spare unit.
5-3-67	Micromicroammeter	Readout of 10% of lowest range existed with reactor shut down	The two sychronus converter tubes were replaced with new tubes. (After this replacement, the channel was zeroed properly and the readout was 5.1×10^{-10}a with an input current of 5×10^{-10}a.)

Table 10. (Continued)

Date	Component	Trouble or Condition	Action Taken
5-11-67	Regulating-rod cable interlock for instrument start circuit	To prevent inadvertent startup in this instrument start mode with the regulating disconnected or out of the core	This change was made according to reactor controls change memo PCA No. 16.
6-27-67	Auxiliary count-rate channel	Channel not available for use subsequent to this date	The log count-rate meter was removed for use at the ESR.

Table 11. PCA Shim-Rod Performance Data

Parameter	Rods		
	No. 1	No. 2*	No. 3
Drop Current, ma	45	24	37
Drop Point, % scale reading	72	74	70
N_L Current, ma	63	44	59
N_F Current, ma	61	42	56
Release Time, msec	4.5	7.5	3.0
Time-of-flight, msec	480	477	475

*This drive unit contains the old BSR-type magnet.

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