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NUCLEAR PHYSICS RESEARCH OPERATION

MONTHLY REPORT

SEPTEMBER 1958

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NUCLEAR PHYSICS RESEARCH OPERATION

MONTHLY REPORT

SEPTEMBER 1958

Compiled by Members of
Nuclear Physics Research
Physics and Instrument Research and Development
HANFORD LABORATORIES OPERATION

Submitted by: John E. Faulkner

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October 14, 1958

By Authority of DS Lewis
12-14-93 CG-PR-2
By J E Savely 1-4-94
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NUCLEAR PHYSICS RESEARCH OPERATION

MONTHLY REPORT

SEPTEMBER 1958

FISSIONABLE MATERIALS - 2000 PROGRAM

METALLURGY

Nuclear Safety Considerations - N. Ketzlach

A. Tube Type Shipping Containers

The prototype shipping container for 0.95 percent U^{235} enriched fuels in 1/8-inch-thick iron-encased pipes was inspected and a process work request for shipping this type fuel in the prototype container together with a full car shipment of natural uranium was approved. Approval has been given for making future containers of this type with 12 gauge (0.109 inches thick) iron tubing.

B. Fernald Shipping Containers

Drawings of a Fernald shipping container lined with boral were reviewed and a study of the nuclear safety of arrays of these containers was made. This study showed that an infinite array of these containers containing five percent U^{235} fuels could have an effective multiplication constant of 1.618 under optimum conditions for water flooding. In fact, even a one layer array of these boxes would not be safe for fuels of this enrichment.

A study was also made of the nuclear safety of these boxes for shipping 0.95 percent I and E fuel elements. This study indicated that a cubic array of these boxes could be made critical with about 14 tons of fuel. The dimensions of the cubic array are about 3.8 feet on each side. These calculations were also based on fuel elements of this type under conditions of optimum moderation.

C. Plutonium Shapes

Comments were received from Livermore on an empirical method of estimating critical masses for oralloy and plutonium shells of different diameters. There is one experimental point for a 7.10-inch O.D. shell of oralloy reflected in polyethylene. A fairly high multiplication was obtained for a 40 kg shell. This compares to a critical mass of 39.3 kg using the empirical formulation. A series of measurements on spherical shells are planned in the near future at Livermore. The applicability of this theory to water-reflected hemispherical shells remains in doubt as no experimental data are available for water-reflected systems in this geometry.

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REACTORSTUDIES RELATED TO PRESENT PRODUCTION REACTORSGraphite Temperature Coefficient with Synthetic Slugs - R. A. Bennett, R. I. Smith

The primary purpose of this series of experiments is to obtain the moderator temperature coefficient of k_{∞} using the synthetic high exposure uranium. Since this type of work has never been done in the PCTR, a secondary objective, but of obvious importance, is to determine how such measurements may be made. The following description is given here to summarize the work which has been done on this research project and the present state of our efforts.

The following major experiments have been completed in the PCTR:

1. Spectral matching experiments with the aluminum, vacuum oven in the core.
2. PCTR temperature and pressure coefficient measurements where the changes are those taking place outside the oven.
3. Data on the reactivity of the PCTR as a function of oven temperature between room temperature and 400°C; for core configurations of 0, 1000, and 2000 MWD/T fuel; and for cases where the central test cell is in the core, out of the core, and poisoned with copper sheets.
4. Pin traverses at low and high temperatures using copper, Pu-Al and U^{235} -Al detectors.
5. Measurements on the change in the oven temperature coefficient with some of the poisonous structural materials removed from the oven.
6. Measurements of the fuel temperature coefficient of k_{∞} for this test lattice.

The work has resulted thus far in a series of curves giving the rate of change of reactivity of the PCTR with temperature for those heating runs described in 3 above.

A plot of this corrected data is shown, somewhat roughly, on the accompanying graph. Activation traverses have been taken for both their basic interest and for their aid in determining the change in k_{∞} with temperature. A fuel temperature coefficient of k_{∞} of $-(2.65 \pm 0.10) \times 10^{-5}$ per C° was obtained, where the error is statistical only. Although this number is in good agreement with the K-pile startup measurements, the systematic errors in the PCTR experiment may be as large as 10 or 15 percent. It has been shown that the large positive oven-temperature coefficient of reactivity decreases substantially when some of the structural members of the vacuum oven are removed.

The present status of these experiments may be summarized as follows:

1. The uniform temperature, total temperature coefficient of k_{∞} can be measured, with the present oven and by using current techniques, to

to about 30 percent, as shown by the experiments with the natural uranium lattice. The apparently larger errors shown in the accompanying graph for the synthetic fuel experiments have not yet been explained. The techniques for making the measurements had been improved, so that the larger errors were unexpected. These data need to be re-examined for arithmetical or operational errors.

2. The techniques for the measurement of fuel temperature coefficients of k_{∞} are on firm experimental and theoretical grounds. The PCTR is uniquely suited to this type of measurement.
3. The limit of accuracy on the moderator temperature coefficient, with current techniques, is a factor of three or more too high to satisfy the need for basic data. This limit is imposed by several overlapping factors: the present oven is too poisonous (too heavy in structural materials from the nuclear point of view); the size of the PCTR cavity is too small; the temperature coefficient of the reactor is too large; and the size of the lattice sample removed is too small.

The significance of some of the above conclusions can be illustrated by reference to the accompanying data. The total temperature coefficient is given, in large part, with the present interpretations, by the difference between $\frac{dp}{dT}$ with the sample cell out of, and inserted into, the core. For the natural uranium case, this difference at any temperature is visible and negative. For either the 1000 or 2000 MWD/T cases, we would expect the difference to be close to zero or positive, as shown by the data - but the least squares errors shown are decidedly larger than those for the natural uranium case. However, it is readily observed that the differences in $\frac{dp}{dT}$ between the 0, 1000, and 2000 MWD/T cases are large and are therefore given accurately. The method of interpreting these differences in terms of the change in the total temperature coefficient remains to be discovered.

Lattice Neutron Temperature Study - W. P. Stinson

Lattice experiments in the TTR hot thermal column require an exact simulation of the lattice that is being studied (8 3/8 inches). Among other things, this requires that the process tubes in the cells adjacent to the test cell be filled with water.

If the process tubes in the cells adjacent to the test cell are filled with water, the graphite temperature in this region may be distorted to the extent that an accurate interpretation of the data from the experiment will be difficult. To determine if this difficulty can be avoided by leaving the adjacent tubes dry, the effects that will be caused by the absence of water in these tubes must be known and corrected for if necessary. This information is to be obtained from traverses (described below) in the form of the relaxation length for neutrons in equilibrium at one temperature to come to equilibrium at another temperature.

Traverses to determine the neutron temperature across a temperature discontinuity were made in the PCTR oven with Pu and U^{235} foils. Two traverses were taken, one at ambient temperature and one with a temperature discontinuity of approximately 150°C. The neutron temperature is to be determined by the ratio of the fission products activity of the Pu and U^{235} foils.

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GRAPHITE TEMPERATURE (°C)

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TTR thermal column irradiations were not made because the facility was used for Critical Mass Approach experiments. At month end, the reactor controls had been changed back for reactor operation. The Pu and U²³⁵ foil calibration and decay correction calculations were completed.

Neutron Thermalization Theory - D. A. Kottwitz, J. E. Schlosser, D. D. Matsumoto

A question has arisen as to the precision of the computed values of the second ten universal constants occurring in the analytical solution to this problem. To settle this question, an auxiliary calculation has been programmed for the IBM-702. This program is now being debugged.

Tests of the recursion scheme for computing values of Laguerre polynomials show that it is sufficiently precise for our purposes. This scheme has therefore been incorporated as a subroutine in the OMNICODE program for calculating the flux from the analytical solution. This latter program is now at the debugging stage. Hand calculations now being made at selected points will serve as checks on the machine computations. These hand calculations reveal a slow convergence of the series solution on the low temperature side near the discontinuity, particularly for a large relative temperature difference. As this convergence is oscillatory, a more precise value of the flux is obtained by an averaging of partial sums rather than by using the sum of the greatest number of terms available.

Neutron Thermalization Experiments - R. A. Bennett

An experimental investigation of the variation of the effective temperature of the thermal neutron distribution near a temperature discontinuity in a moderating medium and of the neutron transfer cross section for neutron exchange between the two equilibrium neutron distributions has been underway for the past quarter.

As previously reported (June and July Monthly Reports) thermal neutron $1/v$ activity transverses through a temperature discontinuity between moderator regions of two temperatures may be employed to investigate these quantities. Required thermal neutron $1/v$ traverses may be obtained from copper activity traverses which have been corrected for epithermal activation.

A series of irradiations designed to yield this information has been completed this month. The experiments were done in slab geometry in the core of the PCTR. Three slabs were centered on the core axis with their faces parallel to the core axis. The outer section temperatures were the same by symmetry and held reasonably constant near room temperature. The central slab temperature was varied in discrete steps from - 180°C to 400°C.

The ratio of the relative activities of $1/v$ detectors activated at two neutron temperatures is inversely proportional to the square root of the respective neutron temperatures; and in a region sufficiently removed from a temperature discontinuity one can expect that the neutrons will be in temperature equilibrium with the moderator. Under these conditions, the maximum thermal $1/v$ detector activity ratio one can expect in these experiments is that given by the physical

temperatures of the two region. The maximum is specified since a smaller transfer cross section than expected could result in a less than equilibrium status in either the hot or cold regions used.

Plutonium and U^{235} may be employed to investigate this problem, also, since the ratio of the thermal-flux weighted fission cross section is a reasonably well known function of temperature. Irradiations employing Pu-Al and U^{235} -Al detectors were made. A brief table of general information concerning these experiments is included.

The only unreported results to date concern the epithermal correction to the bare copper activity traverses.

Some analysis of these data has been completed. It has been shown that the epithermal portion of the copper activity varies monotonically from one percent at the center test region to four percent at the outer boundary. Further, irradiations at 200°C indicate that this distribution remains constant within 10 percent at elevated temperatures. This result is approximately what one would expect since neutron slowing down is not affected appreciably by "small" changes in the effective thermal energy. In view of this result, it will be possible to apply the room temperature epithermal correction to all traverses independent of temperature. Analysis of remaining data is continuing.

Neutron Thermalization Activation Traverses

Temperature		Moderator (Temperature) ^{1/2} Ratio	Purpose
Central Region (°K)	Outer Region (°K)		
491	340	1.20	Medium High Temperature*
666	350	1.38	High Temperature*
179	270	0.81	Medium Low Temperature*
108	285	0.615	Low Temperature*
300	300	1.00	7 Traverses** Room Temperature
575	321	1.34	High Temperature*** Cadmium Ratio Traverse
580	321	1.34	High Temperature Pu and U^{235} Fission Traverse

*Copper Pin Traverse

**These traverses were for normalization of the other traverses and to take account of neutron diffusion out of the central region, and epithermal activation of the copper pins.

***Copper and gold foil traverses.

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Relative Reactivities of Lattices Fueled with Solid and I and E Fuel Elements
G. W. R. Endres

The special measurements of the differences in material buckling of an 8 3/8-inch lattice with solid and with I and E fuel elements have been completed. The measurements are:

<u>Difference</u>	<u>$\Delta B^2 (10^{-6} \text{ cm}^{-2})$</u>
Dry (Solid) minus Wet (Solid)	+ 33.3 $\pm$ 2.2
Dry (I and E) minus Wet (I and E)	+ 40.0 $\pm$ 2.2
Dry (Solid) minus Dry (I and E)	+ 5.0 $\pm$ 2.5
Wet (Solid) minus Wet (I and E)	+ 11.7 $\pm$ 1.9

The second difference is

$$\sqrt{\text{Dry} - \text{Wet}} \text{ Solid} - \sqrt{\text{Dry} - \text{Wet}} \text{ I and E} = - 6.7 \pm 3.1$$

The solid fuel elements used for these measurements had a can outside diameter of 1.44 inches and a uranium diameter of 1.336 inches. The I and E fuel elements used had the following dimensions:

	$OD_u(\text{in})$	$ID_u(\text{in})$	$OD_{\text{can}}(\text{in})$	$ID_{\text{can}}(\text{in})$
"O" Size I and E	1.356	0.416	1.445	0.310

The process tube used had an outside diameter of 1.729 inches with a wall thickness of 0.0595 inches.

The errors quoted are those obtained from a statistical analysis of the data, assuming that the error on each buckling determination is independent. Therefore, the errors may be smaller if there are systematic errors in fitting the data.

As a comparison, some results from similar measurements made with "C" pile fuel elements and process tubes in an exponential pile are given:

<u>Difference</u>	<u>$\Delta B^2 (10^{-6} \text{ cm}^{-2})$</u>
Dry (Solid) minus Dry (I and E)	+ 11.4 $\pm$ 3.0
$\sqrt{\text{Dry} - \text{Wet}} \text{ Solid} - \sqrt{\text{Dry} - \text{Wet}} \text{ I and E}$	- 6.1 $\pm$ 2.7
Dry (Solid) minus Wet (Solid)	47.1 $\pm$ 1.8
Dry (I and E) minus Wet (I and E)	53.2 $\pm$ 2.0

STUDIES RELATED TO FUTURE PRODUCTION REACTORS

PCTR Measurements of k_{∞} and f for Selected Cluster Elements - E. Z. Block, R. I. Smith

Work is continuing in the fabrication of lattice components to be used in the PCTR measurement of clusters of 0.925-inch-diameter natural uranium in a 10 1/2-

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inch graphite lattice. Some of the special fuel elements for the test cell have been assembled.

Coordinated Theoretical - Experimental Reactor Physics Development - W. C. Finch

An investigation has begun to obtain better correlation of existing exponential pile data with lattice theory. At present, the natural uranium-graphite data for solid fuel rods are being re-examined with the aim of developing improved methods of analysis and presentation, while simultaneously acquiring background information.

Computational Programs and Services - D. D. Matsumoto

Programming services supplied to other components of Nuclear Physics Research include the following:

For Critical Mass Physics, a further revision was made in the program for solution of a 4×4 determinant. A program was written to evaluate an integral encountered in the solution of the neutron density equation in a reactor the reactivity of which increases linearly with time. Work on this program was complicated by the fact that the usual Simpson's rule for integration proved inapplicable. A reasonably accurate result has now been obtained using another integration procedure.

More than the usual amount of time was spent in routine services and in assisting others with problems encountered in running existing programs.

Fuel Temperature Coefficients - R. I. Smith

The minimum experimental program required for the investigation of the temperature coefficient of the S/M term in the resonance integral of natural uranium has been set at 9 measurements of k_{∞} and $\frac{1}{k_{\infty}} \frac{dk_{\infty}}{dT}$ using three different fuel rod sizes. The level of effort required is estimated at 6 shift-weeks plus 4 man-months of exempt time, after preliminary development work. Such preliminary laboratory work is being carried on now, but on a low priority basis since the exempt manpower has not yet been assigned.

Graphite Cross Section - E. Z. Block, G. W. R. Endres

In connection with the international exchange program, eight bars of GBF graphite have been tested in 305 pile for shipment to France sometime in October. The bars had purity indices varying from $0.874 \Delta h$ to $1.064 \Delta h$. The purpose of the exchange is to evaluate testing procedures of the various participants and, it is hoped, to shed more light on the graphite absorption cross section per carbon atom. Shipments of similar quantities of representative graphite have already been received from the French and the British.

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STUDIES RELATED TO SEPARATIONS PLANTSCriticality Studies in Support of Processing Power Reactor FuelsA. Experiments with Heterogeneous Systems - R. C. Lloyd, E. D. Clayton, R. B. Smith

Experimental work was continued for determining the minimum critical mass and maximum buckling of a heterogeneous system of three percent enriched uranium rods in light water. Multiplication measurements were made in the approach tank located in the 305-B Building with uranium rods of two different diameters; in one case the diameter was 0.925 inch, and in the second, 0.600 inch. For these measurements the uranium was encased in thin Lucite tubes; these tubes were then positioned in a hexagonal pattern to form the different lattices, which in all cases were fully water reflected.

The critical mass was determined with the 0.925-inch-diameter rods for a separation of 1.8 inches (H_2O/U volume ratio of 3.17) at each of two different cylinder heights, 16 inches, and 24 inches, and for a separation of 1.5 inches (H_2O/U volume ratio of 1.89) with the 16-inch cylinder height. In each case, the reactor was loaded to within about 96 percent of the critical mass as estimated from the multiplication curves. The results of these measurements are summarized below. The results of a previous measurement for the 1.5-inch lattice with the 24-inch column are included to facilitate comparisons.

<u>Lattice Spacing</u>	<u>H_2O/U (by Volume)</u>	<u>Length of Fuel Column</u>	<u>Critical No. of Rods (0.925" dia.)</u>	<u>Quantity of Uranium</u>
1.8 inches	3.17	16 inches	56.7 ± 0.2	416.3
1.8 inches	3.17	24 inches	46.9 ± 0.3	516.6
1.5 inches	1.89	16 inches	72.1 ± 0.3	529.1
1.5 inches	1.89	24 inches	60.0 ± 0.4	660.6

A single multiplication measurement was made with the 0.600-inch-diameter rods. The length of the fuel column was 16 inches; the lattice spacing was 1.2 inches which corresponds to an H_2O/U volume ratio of 3.41. The extrapolated number of rods for criticality was 106.3 ± 0.3 . The critical mass in this geometry is thus measured as 328.3 pounds for the three percent enriched uranium.

B. Experiments with Homogeneous Systems - J. A. Berberet and V. I. Neeley

With reference to the k_{∞} measurements of homogeneous systems of three percent enriched UO_3-H_2O mixtures, experiments were begun in the PCFR for determining k_{∞} at the H/U atom ratio of six. The H/U ratio of six is being obtained with water and also with polyethylene; for one case, small polyethylene pellets will be mixed with the UO_3 to determine the feasibility of using polyethylene as a replacement for water in these experiments. Previous measurements were taken at an H/U atom ratio of 3.4; however, a detailed analysis of the latter data has not been completed.

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Instrumentation for Neutron Flux Measurements - R. C. Lloyd

Recently some difficulties have been encountered with BF_3 counters exhibiting poor stability. The counting rate on some of the BF_3 counters was observed to increase with time when the BF_3 counter was placed in a constant neutron flux. In some instances the increase would amount to as much as six percent over a three-hour period after which the counter remained stable. By using glass-to-steel seals, as made by the Fusite Corporation, in the counter construction, the problem of drift seems to have been eliminated.

Instrumentation was assembled and tested for continuous automatic recording of neutron flux measurements utilizing a digital printout of the scaler and with provisions for a wide variety of accurate and adjustable controlled on-off periods.

Critical Mass Experiments for E-Metal Dissolver - E. D. Clayton

As reported previously, experiments are being conducted by the Oak Ridge Criticality Group to determine critical mass limits for 0.95 percent enriched I and E type fuel elements in a mockup of a Hanford dissolver. The 12 tons of uranium originally shipped to Oak Ridge were insufficient for obtaining criticality in a random array; the critical mass was estimated only to be in excess of 16 tons. On September 30, about five tons of enriched uranium were shipped to Oak Ridge in order that the experiments with the random arrays might be extended to provide improved estimates of the critical mass.

The work progress on these experiments has been hampered because of new construction projects currently underway in the Oak Ridge laboratory building.

Preliminary data on the first critical assembly with the 0.95 percent enriched uranium in a uniform array were reported. A critical mass of about six tons was given for the uranium in a cylindrical reactor, although the height and diameter of the reactor were not specified; thus far further details on the lattice spacing and water-to-uranium volume ratio of the reactor have not been received.

Nuclear Safety, Critical Mass Consultations - N. Ketzlach1. Finished Products Operation

Several meetings were held during the month with personnel of CPD to discuss methods of calculating criticality parameters for plutonium solution handling systems for the 234-5 Development Laboratory, pertaining to the nuclear safety of plutonium metal pickling tanks, and storage arrays of plutonium and powders.

2. Power Reactor Fuels

- (a) Calculations were made of the criticality parameters for five percent U^{235} enriched uranium metal-water systems, and also of the criticality parameters for 3.0 percent U^{235} enriched uranium oxide-water systems. The results of both of these studies will be reported in the Nuclear Physics Research Quarterly Report for July-September 1958.

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(b) Discussions were held with members of CPD and HLO regarding safety criteria for processing power reactor fuels having a maximum of 5.0 percent U^{235} enrichment. Several methods for dissolving these fuel elements have been suggested:

1. Dividing the annulus in an E-metal dissolver into compartments allowing metal in alternate compartments. These compartments are to be lined with boral or cadmium sheets encased in stainless steel. The nonmetal containing compartments are to be at least 18 inches long. The power fuels are to be placed in cartridges that are safe by geometry when immersed in uranium solutions. The safe cartridge size depends on the maximum allowable solution concentration. In no case is the UNH solution to have a concentration >250 grams uranium per liter. These cartridges are to be placed in the compartments in the annulus reserved for metal.
2. In a second proposal the metal is to be dissolved in a vessel safe by geometry; this dissolver is to be connected to a dissolver solution containing vessel with the solution being recirculated to the dissolver by pump.
3. In a third method, larger solution concentrations are allowed because of the addition of boron in solution as a neutron poison. Members of CPD are conducting experiments to establish the stability of boron in these solutions under all processing conditions as well as the completeness of boron removal, when required, in later processing steps.

Calculations are being made to establish nuclear safety criteria under each of the above conditions so that an optimum design can be made for processing power reactor fuels having a U^{235} enrichment of 5.0 percent or less.

Plutonium Critical Mass Laboratory - J. A. Berberet, and E. D. Clayton

Liaison was provided on a continuing basis for the design of the Plutonium Critical Mass Laboratory; the detailed design is currently about 25 percent completed. Considerable time was spent in the preparation of a preliminary hazards report for the laboratory which will be issued under document HW-57603.

Theoretical Critical Mass Studies - J. L. Carter, B. C. Clark

An empirical formula has been obtained which gives the volume ratio of water-to-uranium for a random array of identical cylindrical fuel elements immersed in water in terms of dimensions of the elements. The effect of cores and cladding is explicitly included. This formula is based on experimental volume ratios obtained by R. C. Lloyd of Critical Mass Physics and by A. D. Callihan of ORNL in connection with buckling measurements on such arrays. It is applicable in the range $2 \leq l/d_0 \leq 6$ where l and d_0 are the length and outside diameter of the element respectively.

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Neutron Age Measurements - D. G. Foster, Jr.

One run in the monoenergetic neutron age experiment was completed with the small diameter neutron source in kerosene moderator. No serious difficulties were encountered during this run.

A second run was designed and set up to measure the photoneutron background in both water and kerosene during the same run using a beryllium free source. This scheduled run was postponed because of reactor outage.

The IBM-650 program for data reduction for these measurements was revised to accept more input information. The revised program has been reassembled but not debugged.

Mass Spectrometer for Plutonium Analyses - C. R. Lagergren, W. J. Friesen

Difficulties were encountered in the operation of the source vacuum lock sample changer. The original difficulty was caused by oversized gaskets which did not allow metal-to-metal contact such that critical alignment could not be maintained. This difficulty was overcome but after several operations, the revised assembly would not operate smoothly. Work on this instrument has been suspended while efforts are concentrated toward the startup of the other mass spectrometer.

CROSS SECTION PROGRAMThree Crystal Spectrometer - B. R. Leonard, Jr., J. H. McCrary, S. J. Friesenhahn

The mechanical difficulties which were encountered with one of the milling machine dividing heads of the spectrometer have been cleared up. The excessive torque which was required to drive this head was caused by poor lubrication of sliding surfaces. A considerable time was required for lubricating oil to fill the trapped volumes inside the head.

The instrumentation for the spectrometer has been completely installed and is operating routinely.

Most of the operating time has been spent in studying monochromating crystals, resolution, and intensity. The best arrangement which will allow the successful study of isotropic incoherent scattering has not yet been determined. The neutron intensity through the first beam defining collimators has been determined to be only about one-third of that calculated from the assumed neutron density at the source. The assumed neutron density to be expected at the source has been verified by calculations performed by Irradiations Testing personnel using reactor operations data and measured flux traverses. The reason for this loss of intensity is not known at present.

Subthreshold Fission - Np^{237} and Am^{241} - B. R. Leonard, Jr., S. J. Friesenhahn

The high resolution run (0.5 $\mu\text{sec/m}$) was continued through the 0.58 ev fission resonance in Am^{241} and the 0.49 ev fission resonance in Np^{237} . The Np^{237} resonance could not be evaluated because of poor statistical precision. The Am^{241} resonance

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at 0.58 ev was observed with a peak height about five times that previously seen with poor resolution (3 μ sec/m) and a different sample. This is the same effect as was seen at the 1.25 ev resonance. The collimation system was changed to give a higher neutron intensity and a resolution of 1 μ sec/m. The results of this run for the Am^{241} resonance were in agreement with the high resolution run. It seems very doubtful that this is a resolution effect. The weight of the old Am^{241} foil has been verified by a new alpha count. The effect is still unexplained. The results of a 1 μ sec/m resolution run on the 0.49 ev resonance in Np^{237} were in good agreement with the previous poor resolution (3 μ sec/m) results.

Time-of-Flight - J. T. Russell

Operating time on the Van de Graaff was available at the end of the month after an extended outage for installation of the new beam facility. Several days were spent in realignment and servicing of the accelerator optical system and the associated beam chopping and time-of-flight instrumentation. The over-all alignment achieved seems to be satisfactory. A study was started of detector efficiency and thresholds using carbon d, n neutrons.

PLUTONIUM RECYCLE PROGRAM

Fuel Isotope Concentrations - J. R. Worden

The program for computing fuel isotope concentrations as a function of exposure on the Litton D.D.A. has been completed. As now programmed, the machine plots U^{235} , U^{238} , Pu^{239} , Pu^{240} , Pu^{242} concentrations up to a local exposure of 5000 MWD/T. The plot of each isotope requires approximately ten minutes. The effect of the various cross sections on the calculated density can now be determined very conveniently. Higher local exposure values can also be readily accommodated.

In the future, the program will be extended to include U^{236} . Also, a modification will be made to provide a similar analysis for a Pu-recycled reactor.

GAS COOLED REACTOR PROGRAM

Gas Cooled Reactor Studies - T. J. Oakes

Several exchanges of information with ACF have taken place during the month. The changes in the prototype reactor design caused by the change from CO_2 to He coolant have now become firm. Most importantly, delivery dates have now been established for the various components to be used in the PCIR experiments:

Item	Date of Delivery to Hanford	Delivery from
1. UO_2 pellets - 1st enrichment	Jan. 5, 1959	G. E., San Jose
2. MgO pellets	Oct. 27, 1958	American Lava
3. S. S. tubing	Dec. 1, 1958	Superior Tube via ORNL
4. Depleted U^{238} foil	Oct. 15, 1958	ORNL
5. Enriched U foil	Nov. 1, 1958	ORNL

An experimental schedule can be set up using these dates.

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There are a few questions which still need answering by ACF before detailed blueprints can be drawn for those components to be fabricated by HLO.

OFFSITE PROGRAM

Mass Spectrometer - C. R. Lagergren, W. J. Friesen

The vacuum system of the mass spectrometer for this program has been completed and is in satisfactory operation.

A positive ion beam was obtained from a uranium source. The observed mass resolution for UO_2 ions was about twice as poor as expected after only preliminary focusing.

Work is underway to align the ion optical system for optimum operation. The stability of the high voltage system is also being studied. The pulse counting equipment is installed and is being debugged.

PCTR Operations

Operation of the PCTR continued routinely during the month. There were three unscheduled shutdowns during the month with two being due to electronic failure and the other to mechanical failure. The magnet on the number two rod was making poor contact with the rod resulting in the rod falling off the magnet.

The neutron thermalization experiment was completed during the month. Work was started on the three percent UO_3 -water system.

The addition to the 305-B Building is progressing. The walls have been erected and the roof is nearly completed. Delays resulting primarily from the truck strike will prevent meeting the October 10 completion date.

Special graphite core blocks for the close-packed natural U lattice experiments were machined and delivered to the experimenter.

TTR Activities - W. P. Stinson

Critical mass experiments continued through the month. At the end of September, the controls were changed to normal to allow the lattice neutron temperature experiment to get underway.

Preliminary circuit diagrams have been drawn up for the scanner section of the automatic counter.

DECLASSIFIEDINFORMAL REPORTS PUBLISHED

- HW-57394   Nuclear Physics Research Monthly Report - August 1958, J. E. Faulkner
September 9, 1958 (Secret)
- HW-57603   Preliminary Hazards Study of the Hanford Plutonium Critical Mass
Laboratory, J. A. Berberet, J. W. Healy, and E. D. Clayton
September 30, 1958 (Unclassified)

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