

OAK RIDGE NATIONAL LABORATORY LIBRARIES



3 4456 0550189 1

cy.48

ISOTOPE PROGRAM (5000) PROGRESS REPORT FOR QUARTER ENDING JUNE 30, 1973

J. H. Gillette



OAK RIDGE NATIONAL LABORATORY
CENTRAL RESEARCH LIBRARY
DOCUMENT COLLECTION

LIBRARY LOAN COPY

DO NOT TRANSFER TO ANOTHER PERSON

If you wish someone else to see this
document, send in name with document
and the library will arrange a loan.

UCN-7969
(3 3-67)



OAK RIDGE NATIONAL LABORATORY

OPERATED BY UNION CARBIDE CORPORATION • FOR THE U.S. ATOMIC ENERGY COMMISSION

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Atomic Energy Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

ORNL-TM-4338

Contract No. W-7405-eng-26

ISOTOPES DEVELOPMENT CENTER

ISOTOPE PROGRAM (5000) PROGRESS REPORT
FOR QUARTER ENDING JUNE 30, 1973

J. H. Gillette

Isotopes Division

NOTICE This document contains information of a preliminary nature and was prepared primarily for internal use at the Oak Ridge National Laboratory. It is subject to revision or correction and therefore does not represent a final report.

AUGUST 1973

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
operated by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION

OAK RIDGE NATIONAL LABORATORY LIBRARIES

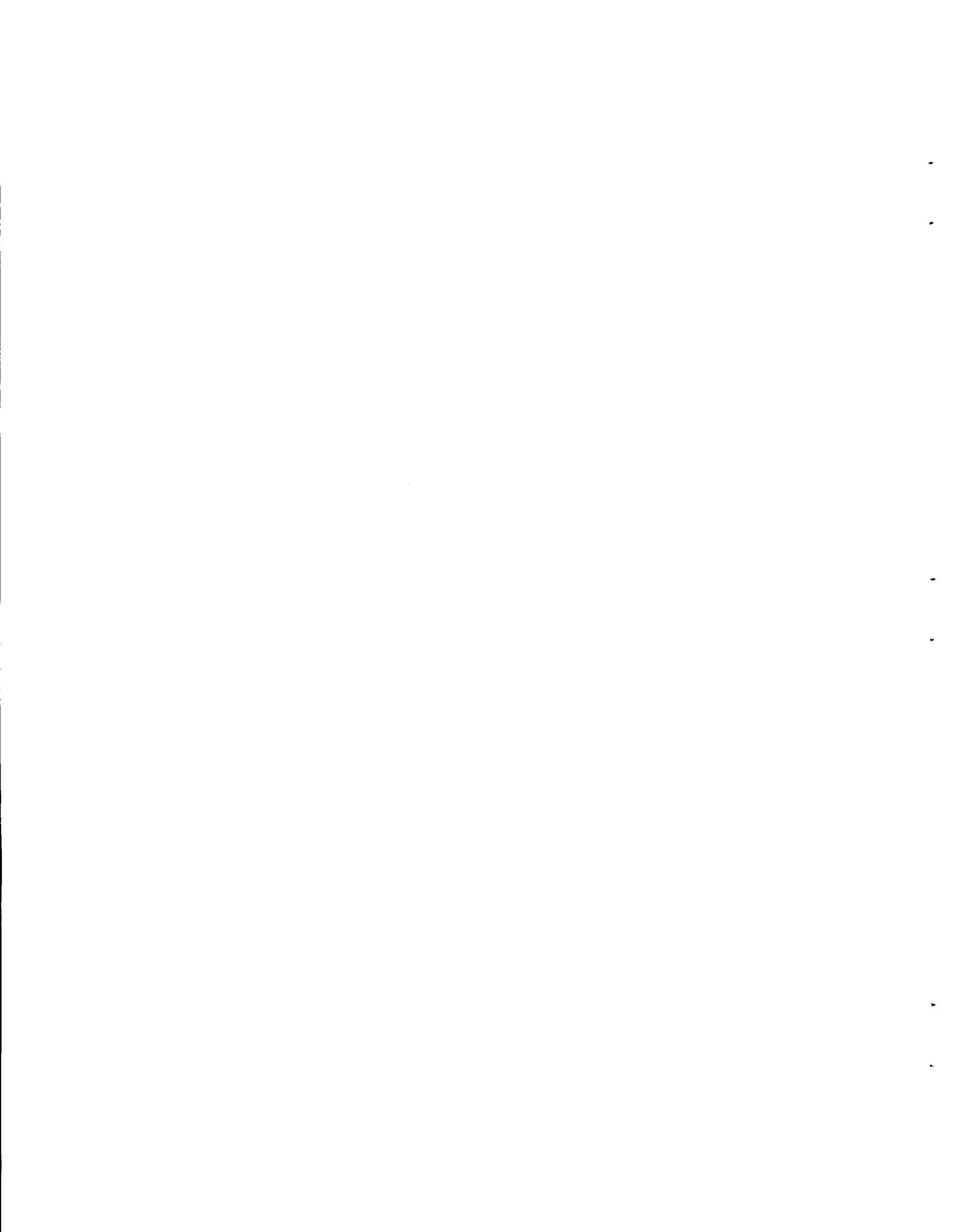


3 4456 0550189 1



CONTENTS

	<u>Page</u>
TARGET FABRICATION AND DEVELOPMENT	1
$^{239}\text{PuO}_2$ Fission Chamber Plates	1
ISOTOPIC SEPARATIONS	4
Stable Isotopes	4
Platinum Separation	5
Source Development for Silicon Isotopes	5
SPECIAL SEPARATIONS	6
Plutonium-244 Separation	6
Beryllium-10 Enrichment Program	7
Promethium-147	8
180° OAK RIDGE SECTOR ISOTOPE SEPARATOR	8
CHEMICAL PROCESSING	9
Material in Process	9
Material Added to Inventory	9
ISOTOPES PREPARATIONS AND SALES	9
ADMINISTRATIVE	14
TALKS PRESENTED	14



ISOTOPE PROGRAM (5000) PROGRESS REPORT
FOR QUARTER ENDING JUNE 30, 1973

J. H. Gillette

TARGET FABRICATION AND DEVELOPMENT

$^{239}\text{PuO}_2$ Fission Chamber Plates

Fission chamber plates of high-purity $^{239}\text{PuO}_2$ have been produced and accurately characterized. The fissile oxide was deposited on 0.013-mm-thick pure aluminum substrates by vapor deposition at a pressure of 10^{-6} torr. Electron-beam heating was employed to vaporize the oxide ($\sim 2300^\circ\text{C}$). The entire vapor deposition vacuum system and glove box are shown in Fig. 1, and a schematic drawing of the Temescal evaporation source is shown in Fig. 2.

Plutonium oxide (PuO_2) vapors were deposited over areas of 5.1- and 7.6-cm diameter. To achieve the desired deposit uniformity, the substrates were positioned 30.5 cm above the vapor source and rotated at ~ 100 rpm. Because of the value of the high isotopic purity of the $^{239}\text{PuO}_2$, the entire

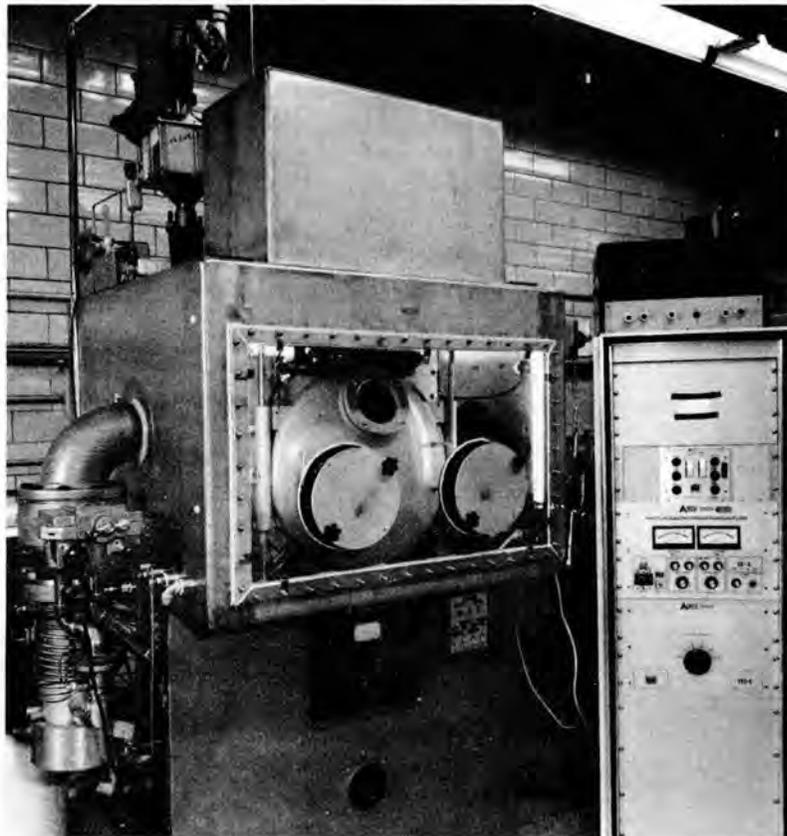


Fig. 1. Plutonium Vapor Deposition System and Power Supply.

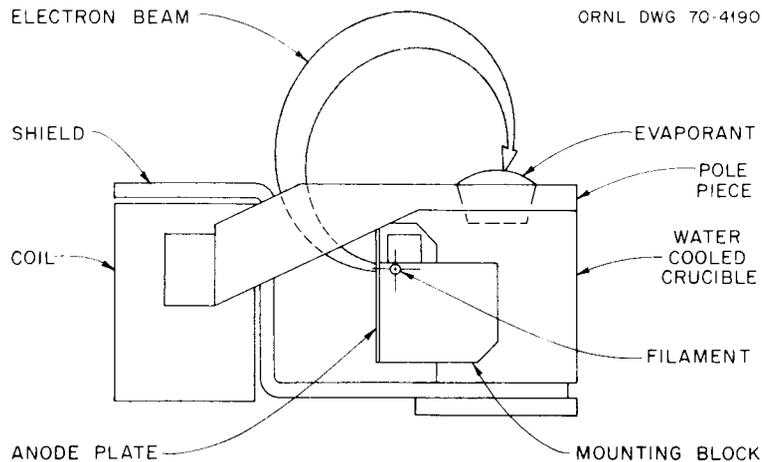


Fig. 2. 270° 10-kW Evaporation Source.

vaporization zone (between the source and the substrate) was surrounded with stainless steel shim stock to collect spurious vapors for future chemical recovery. By this technique 36 plates for several fission chambers were prepared having several prescribed ^{239}Pu thicknesses between 70 and 150 $\mu\text{g}/\text{cm}^2$ (see Table 1).

The amount of ^{239}Pu deposited on each substrate was determined by low-geometry alpha counting; the counter geometry factor was accurately determined by destructive analysis of one of the fission foils using a coulometric technique. From this calibration, the ^{239}Pu concentration on any one target could be determined with an accuracy of $\pm 1\%$ at the 95% confidence level. Results of counting analyses for 30 fission chamber plates are shown in Table 1. Mass analysis of the PuO_2 starting material is shown in Table 2. Using a $60\text{-}\mu\text{g}/\text{cm}^2$ ^{239}Pu deposit, a typical alpha spectrum is shown in Fig. 3.

Table 1. ^{239}Pu Content of Fission Foils Determined by Low-Geometry Alpha Counting

Target No.	Deposit Diameter (cm)	Thickness ($\mu\text{g}/\text{cm}^2$)	Target No.	Deposit Diameter (cm)	Thickness ($\mu\text{g}/\text{cm}^2$)
2	5.1	151.9	17	7.6	73.0
3	5.1	106.7	18	7.6	70.6
4	5.1	81.1	20	7.6	95.1
5	5.1	103.0	21	7.6	103.7
6	5.1	111.9	23	7.6	88.2
7	5.1	75.3	24	7.6	60.4
8	5.1	57.5	26	7.6	89.7
9	7.6	118.6	27	7.6	87.2
10	7.6	143.6	28	7.6	101.1
11	7.6	96.7	29	7.6	84.4
12	7.6	79.6	30	7.6	126.6
13	7.6	87.9	33	7.6	77.8
14	7.6	144.1	34	7.6	75.3
15	7.6	69.3	35	7.6	117.7
16	7.6	77.6	36	7.6	89.9

Table 2. Mass Analysis for $^{239}\text{PuO}_2$
Batch 277A

Mass	Atom Percent
238	<0.0002
239	99.978
240	0.021
241	0.0005
242	0.0005

To determine the uniformity of the oxide deposit, a counting chamber (Fig. 4) was used in which the alpha particles from many small areas of the target could be counted. By indexing these areas, the variation in ^{239}Pu content could be determined as shown in Fig. 5. The numbers recorded in Fig. 5 represent the number of alpha counts

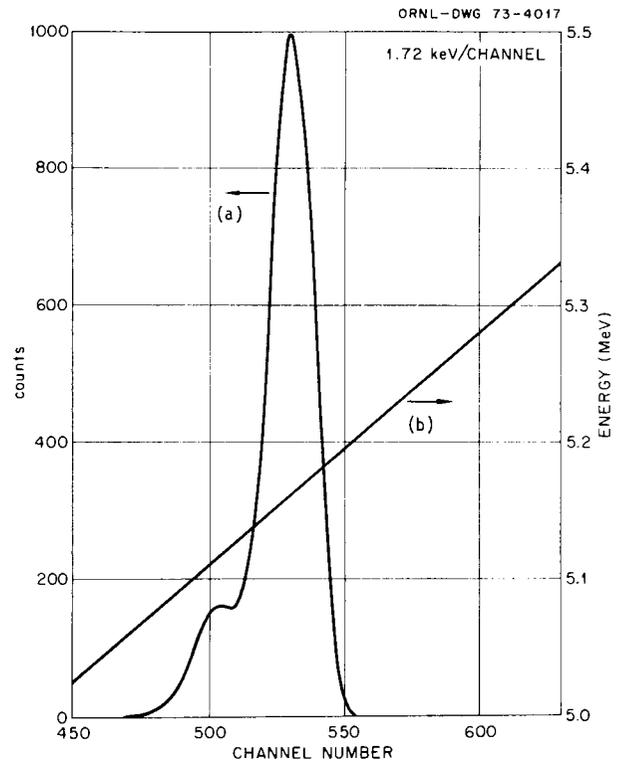


Fig. 3. ^{239}Pu Alpha-Energy Spectrum (a) and Energy-Channel Calibration (b) Curves.

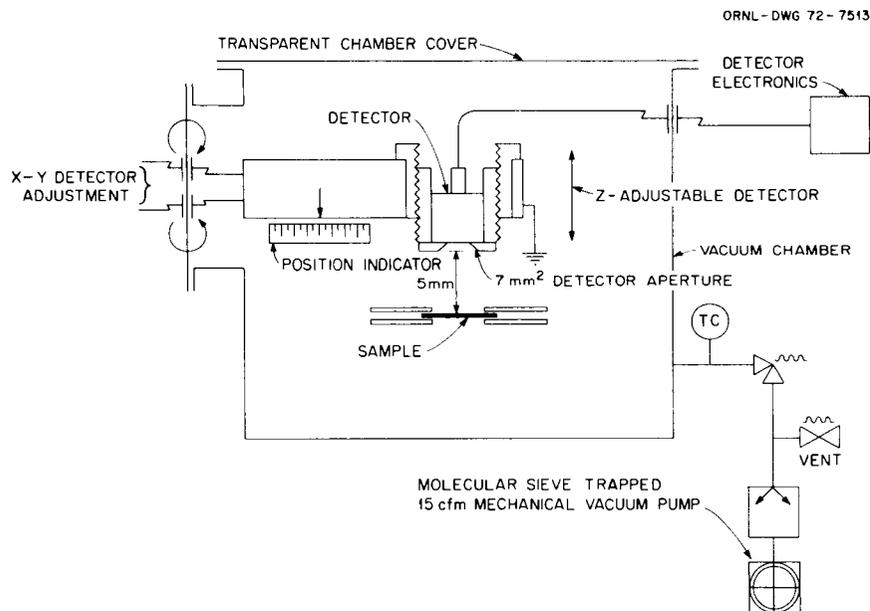


Fig. 4. Counting Chamber Used to Determine Deposit Uniformity.

per 100 sec $\times 10^{-3}$ at 0.6-cm increments from the center of the circular deposit. The counting data at the most distant radial positions were obtained at positions of 0.3 cm from the outer edge of the deposit. As can be seen, the variation in uniformity of ^{239}Pu over a 5.1-cm-diam section of the fission chamber plate was $\pm 2.5\%$ from the mean value, but at the most distant radial positions far more deviation was observed. These non-uniformities were apparently caused by aberrations induced by the scattering and shadowing by the circular mask used to define the deposit area during vapor condensation.

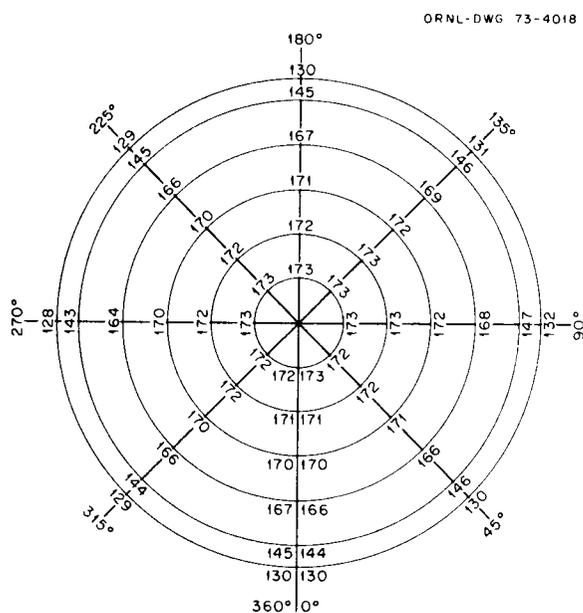


Fig. 5. Uniformity Measurement of ^{239}Pu Target Number 29.

ISOTOPIC SEPARATIONS

Stable Isotopes

Isotopic separations of iridium, osmium, rubidium, and zirconium are currently underway in 18 electromagnetic isotope separators. Iridium isotopes are being separated and collected in two beta-type separators; osmium in two alpha-type separators; rubidium in a segment of eight beta-type separators; and zirconium in six separators modified with 255° equipment. Iridium and osmium separations are being conducted on an 8-hr, 5-day-week basis, while rubidium and zirconium separations are being made on a 24-hr, 5-day-week basis. The rubidium and zirconium separations were both initiated April 30, 1973, following terminations of mercury and zinc, in order to fill Sales and RMC requirements. Rubidium is tentatively scheduled for ~ 3 months in order to recover ~ 100 g of $>99\%$ ^{87}Rb , while zirconium is scheduled for ~ 18 months with the objective of recovering ≥ 62 g of ^{96}Zr and appropriate quantities of other isotopes. The osmium isotope separation was started in one alpha tank May 10, 1973, adjacent to platinum already in progress, and the second alpha tank was added for osmium when the platinum series was terminated, May 16, 1973.

A special second-pass ^{115}Sn separation, which was in progress at the end of last quarter¹ to fulfill Division of Physical Research requirements, was successfully completed with the recovery of ~ 100 mg of $\sim 95\%$ ^{115}Sn .

¹J. H. Gillette, *Isotope Program (5000) Progress Report for Quarter Ending March 31, 1973*, ORNL-TM-4251, Oak Ridge National Laboratory.

The charge material for this separation consisted of 6.673 g of tin from both active and RMC inventories and was enriched to 32.72% in ^{115}Sn from a prior calutron separation. The highly enriched second-pass sample is to be used in proposed coulomb excitation studies at ORNL. At the present time nothing is known about charge losses or isotopic dilution, since charge-recovery operations are just starting.

Development activities in the stable isotopes program this quarter were concerned with (1) continuing to develop techniques for separating and recovering silicon isotopes with isotopic purities of 99.99+% ^{28}Si , 99% ^{29}Si , and 99% ^{30}Si in a single pass; (2) evaluating different zirconium charge-material combinations in an effort to obtain higher isotopic enrichments, especially ^{96}Zr , to meet RMC requirements of $\geq 95\%$; (3) developing an ion source for gas charges which will permit the withdrawal and reinsertion of the filament assembly without letting the vacuum tank down to air; and (4) further improving the decel-receiver optics in the 180° sector, as related to target preparations.

Platinum Separation

The platinum isotope separation (Series PI), which was terminated the middle of May 1973, made use of the newly developed technique of producing a volatile charge compound directly in the arc chamber by reacting platinum metal with chlorine trifluoride gas. This was an excellent separation, averaging 10.3 mA of total ion current, and yielding 30-50 g each of the three most abundant isotopes in 4400 tank hours of operation. Prior platinum separations in 1953 and 1956 made use of electron-bombardment-heated wedges to vaporize platinum metal into the arc chamber, and these averaged 3.74 and 3.79 mA of total output, respectively. In addition to improving the total output, the ion reception time was increased, and the purity of the isotopes significantly improved. As an example, the purity of ^{194}Pt was increased from a previous high of 65% to an average purity of $\sim 95\%$, a change that may ultimately affect the possible use of ^{194}Pt as a starting material in preparing medically useful $^{195\text{m}}\text{Pt}$.

Overall, it is estimated that the new charge system saved $\geq 10,000$ tank hours of operating time in obtaining RMC requirements of at least three of the more abundant isotopes, assuming that the same separation had been made using the electron-bombardment method.

Similar, if not greater, improvements are being seen in current separations of iridium and osmium isotopes using the ClF_3 fluorination technique of charge preparation.

Source Development for Silicon Isotopes

Ion sources being developed to obtain 99% ^{29}Si and ^{30}Si are now achieving outputs of 35 mA, a factor of two better than those used in initial earlier efforts in February of this year. The increase in output has not reduced the isotopic purity attained, this being 98.5-99.0% in all

runs completed. Primary efforts are aimed at reducing the energy spread of accelerated ions (measured roughly by the peak-to-valley current ratio) and reducing the pressure existing in the accelerating electrode region. A progression of arc-chamber and electrode changes has resulted in the improved ion output noted. In essence, the arc chamber is now shallower than that normally used, the collimating slot admitting electrons into the chamber is moved forward and is lengthened to better trap gas, and the electrode spacing and apertures are both reduced. Present efforts involve evaluation of electrodes reduced markedly in overall size to provide a less restricted path for gas escape from the region.

During this source-improvement project, >100 mg each of the ^{29}Si and ^{30}Si have been collected along with >2 g of 99.95% ^{28}Si . These materials are the best ever provided from the calutron; they should also be fairly representative of what can be achieved in future special-effort separations.

SPECIAL SEPARATIONS

The special separations program this quarter was characterized by three very different, fairly short, specialized separations in order to obtain unique materials for Division of Physical Research needs. Two of these separations, ^{244}Pu and ^{10}Be , were made to enrich specific isotopes, while the third was made to deplete unwanted gamma-active ^{146}Pm in fission product ^{147}Pm . The ~ 2 g sample of 98% ^{244}Pu will be used initially at Argonne National Laboratory for heat capacity measurements; the enriched sample of ^{10}Be , some 24.5 mg of BeO containing 9.2 mg of beryllium enriched to 57% in ^{10}Be , will be used at Los Alamos Scientific Laboratory primarily for charged-particle experiments; and the ^{147}Pm sample, estimated to be ≥ 1 g of promethium and depleted in ^{146}Pm from the initial concentration of 0.6 ppm, is to be transferred to the Astronautics Division of McDonnell Douglas Laboratories for fabricating test devices for dosimetry measurements. Promethium-147 is one of the radionuclides currently being considered in fabricating implantable cardiac pacemakers.

Plutonium-244 Separation

A ^{244}Pu separation, which was started near the end of last quarter in one of the alpha-contained separators, was continued, with the collection and recovery of ~ 2 g of >98% ^{244}Pu . Another run, making use of recycle-recovery feed material, is scheduled before the series is completed. The charge material for this separation consisted of ~ 37 g of plutonium, in two separate batches, which ranged from 22.38% to 24.80% in ^{244}Pu content. This material was produced at Savannah River Laboratory by neutron irradiation of ^{242}Pu tubes ("Outer Housings") during ^{252}Cf campaigns. The ^{244}Pu values were reclaimed and purified by the ORNL Chemical Technology Division.

To date, three individual runs have been made; the first two used the separate batches of charge material mentioned above, while the third run was made with recycle-recovery material. Two separate lots of enriched ^{244}Pu have been recovered with the following descriptions:

Sample No.	Weight (g)		Mass Assay (%)
	Estimated	Recovered	
ay 297A	1.404	1.237	98.78
ay 297B	1.04		98.27

Beryllium-10 Enrichment Program

A special ^{10}Be enrichment program was carried out in four of the alpha-contained calutrons in order to obtain a few milligrams of highly enhanced ^{10}Be for research use. The charge material for this separation consisted of 96.6 g of beryllium in the form of "low-fired" ($\sim 400^\circ\text{C}$) beryllium oxide containing 700 ppm of ^{10}Be . The beryllium was originally obtained from Idaho Nuclear Corporation as a lattice piece that had been exposed to a long neutron irradiation in the Materials Testing Reactor. Some 126 g of beryllium was transferred to the Los Alamos Scientific Laboratory where it was chemically processed to remove the major radioactive contaminants, especially ^{60}Co . As received at ORNL, the activity had been reduced from the prior level of 100 R/hr to 280 mR/hr on contact, and the BeO was in the form of a fluffy fine powder. In order to reduce the volume of the powder so that the total sample could be loaded into only four calutron charge bottles, the oxide was treated with water to a slurry and when dried occupied $\sim 25\%$ of the original volume.

The calutron separation was begun April 16, 1973, and was terminated May 11, 1973, using 763 innage hours at an average total ion output of 26.9 mA. The beryllium was vaporized into the arc chamber by passing carbon tetrachloride over the oxide positioned in the graphite charge bottle within the ion source. Beryllium-10 was collected in a specially designed receiver that consisted of a small water-cooled copper pocket shielded by a larger graphite pocket to protect the enriched sample from isotopic contamination.

Beryllium-10 was recovered from the four collector pockets by leaching with $\sim 6\text{ M H}_2\text{SO}_4$ and $\sim 6\text{ M HNO}_3$. After the removal of copper by electrolysis between platinum electrodes, EDTA and mannitol were added to the solution to complex impurities, especially boron which is isobaric, and beryllium was precipitated with NH_4OH at pH 8.5-9. Following a filtration on paper, the beryllium hydroxide was dissolved in HCl , reprecipitated with NH_4OH , and redissolved in HCl . After adding EDTA, the beryllium was again precipitated with NH_4OH , the hydroxide was collected on paper, and the paper and precipitate were ignited to 900°C in porcelain.

The separation actually yielded 24.5 mg of BeO enriched in ^{10}Be to 57 atom %. The separation, therefore, resulted in an enrichment factor of ~ 1900 and a process efficiency of 7%.

Promethium-147

A short promethium isotope separation was made, for the first time, in one of the alpha-contained electromagnetic isotope separators to evaluate the feasibility of using a calutron for reducing the ^{146}Pm content of fission-produced ^{147}Pm . Promethium-146 is an unwanted gamma-active nuclide which reduces the usefulness of ^{147}Pm in cardiac pacemakers.

The charge material for this separation was provided by the Astronautics Division of McDonnell Douglas Laboratories, Hanford, and consisted of 10.4 g Pm_2O_3 , equivalent to 8.6 g promethium. The oxide was repelletized at ORNL and was subsequently transferred to a graphite charge bottle where a volatile promethium compound was produced directly by passing carbon tetrachloride from an external source over the heated oxide.

The separation yielded an estimated 1.3 g of promethium in the 147 pocket in 53 innage hours at a process efficiency of 15%. The ^{147}Pm receiver, when removed from the collector assembly, read over 100 R/hr (unshielded) at 2 in.

The evaluation of the run has not yet been completed and will be reported at a later date.

180° OAK RIDGE SECTOR ISOTOPE SEPARATOR

Research and development work has continued toward the design of methods and equipment for the 180° ORSIS computer control system to enable the system to function properly in the presence of the intense noise spectrum which an isotope separator generates. The sector was adjusted so as to generate the maximum amount of electrical noise to simulate conditions which exist during separator startup and during sparking flurries with some elements. At this noise level, the system signal scanner, which selects signals for measurement by the system digital voltmeter, did not perform properly. Isotopes Division and Instrumentation and Controls Division personnel concluded that the design of the scanner needed modification. However, since costs for such a modification could not be easily estimated, an alternative solution was implemented which involved substituting the computer UDC-8 controller for the scanner controller. This change has been accomplished within the capital funds allocated for random signal access in the ORSIS computer update and has simultaneously achieved random access and noise immunity. Testing of this solution will be carried out during the next quarter.

Purchase orders have been placed for equipment to be used in the ORSIS computer control system update. All bids should be received and acted upon and final orders placed during August. Hardware delivery should be complete during January 1974, with some items arriving during September 1973. Engineering-software changes will be completed before all hardware arrives so that system testing can commence upon completion of hardware delivery. The fully modified computer system should be available by February 1974 to begin calutron-control development.

Most of the ORSIS variables controlled during actual isotope collections have so far been concerned with quality control. The inclusion of variables concerned with the ion source and associated functions has been delayed by the electrical noise problem. Since this problem appears to have been solved, efforts will now be directed toward including more of these variables in the control program. Intermediate programming will be directed towards acquisition of fundamental information and towards keeping the separator running until the new computer update is finished, since most of the computer programs concerned with control will have to be redone then. Preliminary design and alterations to R&D calutron 668 are proceeding in anticipation of capital funds to proceed with control efforts on this production prototype unit.

The second draft of the proposal for computer-assisted operation of all production calutrons was completed during the past quarter, and the feasibility of this project still appears to be good.

CHEMICAL PROCESSING

Material in Process

Elements in chemical processing during the quarter ending June 30, 1973, are Ir, Hg, Mo, Os, Pt, Rb, Zn, and Zr.

Material Added to Inventory

Isotopic material released or made available to the Sales Department during the second quarter of calendar year 1973 is shown in Table 3, along with appropriate data.

In addition to the new lots of isotopes released to inventory, 42 loan-return samples were processed and returned to inventory.

ISOTOPES PREPARATIONS AND SALES

The stable isotope and radioisotope target and research material preparations for the quarter ending June 30, 1973, are given in Tables 4 and 5, respectively.

Table 3. Operations Status — April-June 1973

Element and Isotope	Series	Run Start	Run Finish	Innage Hours	Tank Hours	Charge Material	Estimated Recovery (g)	Estimated Purity (%)	Actual Recovery (g)	Actual Purity (%)	Requirements
TELLURIUM	PJ	9/11/72	12/29/72	8,973	10,944	Te					
¹²⁰ Te							0.67	20-35	0.475 0.108	38.13 22.06	0.4 g 50-60% 2.0 g >60%
¹²³ Te							5.15	75	6.062 1.176	73.98 51.65	10 g >85%
¹²⁴ Te							23.90	85	26.667 12.369	91.86 74.78	~50 g >95%
¹²⁵ Te							39.35	85	34.575 3.868	91.23 75.56	~17 g 90-97%
¹²⁶ Te							98.61	90			
¹²⁸ Te							170.20	95			>60 g 97-99+%
¹³⁰ Te							216.35	95			
MOLYBDENUM	PK	10/2/72	4/13/73	19,556	25,728	3MoO ₃ + Mo + CCl ₄			121.328 127.456 128.636 40.423	97.18 96.90 96.87 89.63	~600 g
⁹⁸ Mo											
⁹² Mo							335	>90			None
⁹⁴ Mo							230	>80			None
⁹⁵ Mo							390	>90			None
⁹⁶ Mo							435	>90			None
⁹⁷ Mo							240	>90			None
¹⁰⁰ Mo							225	~93			Unknown
MOLYBDENUM	R&D	12/1/70	12/2/70	28	—	3*MoO ₃ + *Mo + CCl ₄			1.316	99.96	~1 g
¹⁰⁰ Mo											
ZINC	PL	1/2/73	4/27/73	13,309	15,744	Zn metal**					
⁶⁴ Zn							375	>95			None
⁶⁶ Zn							315	>95			4 g
⁶⁷ Zn							45	>85			15 g 50-95% 30 g >95%
⁶⁸ Zn							145	>98			96 g
⁷⁰ Zn							7.5	>70			5 g

Table 3. Continued

Element and Isotope	Series	Run Start	Run Finish	Innage Hours	Tank Hours	Charge Material	Estimated Recovery (g)	Estimated Purity (%)	Actual Recovery (g)	Actual Purity (%)	Requirements
PLATINUM	PI	4/3/72	5/16/73	3,000	4,400	Pt + ClF ₃					
¹⁹⁰ Pt							0.180				50 g
¹⁹² Pt							1.280				50 g
¹⁹⁴ Pt							47.0				55 g
¹⁹⁵ Pt							51.0				51 g
¹⁹⁶ Pt							35.0				56 g
¹⁹⁸ Pt							10.5				50 g
SILICON											
²⁸ Si	R&D			110		SiS ₂			2.0	99.97	30 g
²⁹ Si	R&D					SiS ₂	0.15	99.0			1 g
³⁰ Si	R&D			233		SiS ₂			0.10	98.84	1 g
MERCURY	PG	3/13/72	6/1/73	26,816	32,736	Hg					
¹⁹⁶ Hg							1.0	~20			50 g
²⁰⁰ Hg							7	>90			50 g
²⁰¹ Hg							17	>80			50 g

*Enriched ¹⁰⁰Mo.

**ZnS used in two tanks ~1 month.

Table 4. Stable Isotope Preparations

Isotope	Number of Preparations	Isotope	Number of Preparations
Boron-10	8	Nickel-58	5
Boron-11	6	Nickel-60	1
		Nickel-61	1
Calcium-40	4		
Calcium-42	1	Palladium-104	4
Calcium-44	3	Palladium-106	2
Calcium-48	3	Palladium-108	2
		Palladium-110	2
Cerium-140	6		
		Samarium-144	1
Chromium-50	1	Samarium-148	2
Chromium-54	2	Samarium-150	2
		Samarium-152	4
Cobalt-59	1	Samarium-154	4
Copper-63	1	Scandium, normal	1
		Scandium-45	13
Dysprosium-162	2		
		Silicon, normal	3
Gadolinium-155	1	Silicon-28	1
Gadolinium-158	1		
		Silver-107	3
Hafnium-179	1		
		Strontium-88	1
Iron-54	2		
Iron-56	1	Sulfur-33	4
Iron-57	2		
Iron-58	1	Tin-112	2
YFe ₂	1	Tin-114	1
		Tin-122	1
Lead-204	1	Tin-124	2
Lead-208	3		
		Titanium-46	3
Lithium-6	4	Titanium-48	1
		Titanium-49	1
Magnesium-24	6		
Magnesium-26	1	Vanadium, normal	1
Molybdenum-92	1	Ytterbium-170	1
Molybdenum-98	1		
Molybdenum-100	1	Zirconium-90	3
		Zirconium-92	1
Neodymium-150	1		

Table 5. Radioisotope Preparations

Isotope	Number of Preparations	Isotope	Number of Preparations
$^{244}\text{Cm}^{13}\text{C}$	1	Tritium-Titanium	3
Neptunium-237	10	Uranium, normal	8
Plutonium-239	20	Uranium-234	1
		Uranium-235	22
		Uranium-236	2
Tritium	2	Uranium-238	26
Tritium-Erbium	1	$^{235}\text{U}/^{238}\text{U}$ Metal Foils	16

The isotope sales and services for the quarter ending June 30, 1973, are given in Table 6.

Table 6. Isotopes Sales and Services
April 1, 1973, Through June 30, 1973

	Shipments	Revenue
EM Isotopes Sales	918	\$324,584
Non-EM Isotopes Sales	103	\$ 29,307
Services		
Stable Isotope Target Preparations		\$ 46,312
Radioisotope Target Preparations		3,250
Special Services		15,313
Reprocessing Returned Loans		11,746
Work for Others		<u>8,700</u>
Total Services		<u>\$ 85,321</u>
TOTAL	1021	\$439,212

ADMINISTRATIVE

Visitors to the IDC are shown in Table 7.

Table 7. IDC Visitors

Visitor	Affiliation	Subject Discussed
Jean-Paul Longeron	CNRS, France	Purification of metals
Leon Majman	Materials Research Corporation	Levitation melting and radiofrequency heating
Milton Lewis	Astronautics Division of McDonnell Douglas	Promethium-147 purification

TALKS PRESENTED

L. O. Love, "Process Efficiencies in Calutron Separations," 8th International Electromagnetic Isotope Separator Conference, Billingeus, Sweden, June 13-15, 1973.

L. O. Love, "Developments in the ORNL Electromagnetic Separation Program," 8th International Electromagnetic Isotope Separator Conference, Billingeus, Sweden, June 13-15, 1973.

INTERNAL DISTRIBUTION

- | | |
|-----------------------|--------------------------------------|
| 1. M. A. Baker | 30. L. O. Love |
| 2. P. S. Baker | 31. W. S. Lyon |
| 3. E. E. Beauchamp | 32. F. C. Maienschein |
| 4. W. A. Bell | 33. H. H. Nichol |
| 5. D. S. Billington | 34. F. Perey |
| 6. G. E. Boyd | 35. J. J. Pinajian |
| 7. F. N. Case | 36. W. K. Prater |
| 8. J. W. Cleland | 37. M. E. Ramsey |
| 9. T. F. Connolly | 38. S. A. Reynolds |
| 10. F. L. Culler | 39. R. W. Schaich |
| 11. W. C. Davis | 40. M. R. Skidmore |
| 12. J. S. Drury | 41. M. J. Skinner |
| 13-19. J. H. Gillette | 42. P. H. Stelson |
| 20. W. M. Good | 43. H. F. Stringfield |
| 21. H. R. Gwinn | 44. A. M. Weinberg |
| 22. J. A. Harvey | 45. J. R. Weir |
| 23. C. E. Haynes | 46. J. C. White |
| 24. R. F. Hibbs | 47. A. Zucker |
| 25. J. E. Keeton | 48-49. Central Research Library |
| 26. O. L. Keller | 50. Document Reference Section |
| 27. E. H. Kobisk | 51-56. Laboratory Records Department |
| 28. E. Lamb | 57. Laboratory Records - RC |
| 29. R. E. Leuze | |

INTERNAL DISTRIBUTION

58. N. F. Barr, Office of General Manager, AEC
59. R. C. Block, Rensselaer Polytechnic Institute
60. R. M. Brugger, Aerojet Nuclear Corporation
61. K. E. Chellis, Florida State University
62. R. E. Chrien, Brookhaven National Laboratory
63. J. T. Christy, AEC-RLOO
64. G. Cowan, Los Alamos Scientific Laboratory
65. B. J. Dropesky, Los Alamos Scientific Laboratory
66. L. Friedman, Brookhaven National Laboratory
67. K. A. Gschneidner, Jr., Iowa State University
68. M. E. Harris, Lawrence Livermore Laboratory
69. I. A. Hobbs, Savannah River Operations, AEC
70. R. W. Hoff, Lawrence Livermore Laboratory
71. H. E. Jackson, Argonne National Laboratory
72. J. S. Kirby-Smith, Division of Biomedical & Environmental Research, AEC
73. J. H. Lawrence, Lawrence Berkeley Laboratory
74. J. L. Lerner, Argonne National Laboratory
75. J. N. Maddox, Division of Biomedical & Environmental Research, AEC
76. W. B. Mann, National Bureau of Standards
77. J. W. Meadows, Lawrence Livermore Laboratory
78. M. C. Michel, Lawrence Berkeley Laboratory
79. R. A. Neumann, Princeton University
80. H. W. Newson, Duke University
81. A. O. C. Nier, University of Minnesota

82. H. A. O'Brien, Los Alamos Scientific Laboratory
83. D. M. Richman, Division of Physical Research, AEC
84. G. L. Rogosa, Division of Physical Research, AEC
85. B. C. Rusche, Savannah River Laboratory
86. W. D. Sandberg, Savannah River Operations, AEC
87. L. G. Stang, Brookhaven National Laboratory
88. W. L. Talbert, Jr., Iowa State University
89. G. Taplin, University of California, Los Angeles
90. J. M. Teem, Division of Physical Research, AEC
- 91-95. D. H. Turno, Savannah River Laboratory
96. A. R. Van Dyken, Division of Physical Research, AEC
97. M. Williams, Lawrence Livermore Laboratory
98. Research and Technical Support Division, ORO
- 99-100. Technical Information Center