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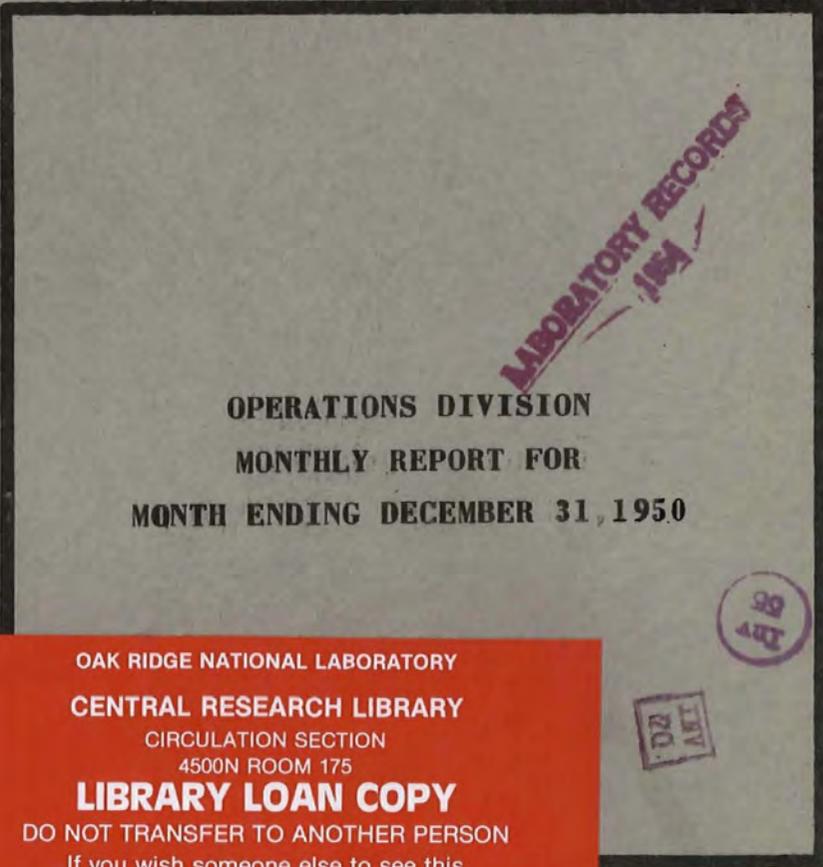
ORNL 938
Series A 6A
Progress Report

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AEC RESEARCH AND DEVELOPMENT REPORT

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OPERATIONS DIVISION
MONTHLY REPORT FOR
MONTH ENDING DECEMBER 31, 1950

OAK RIDGE NATIONAL LABORATORY

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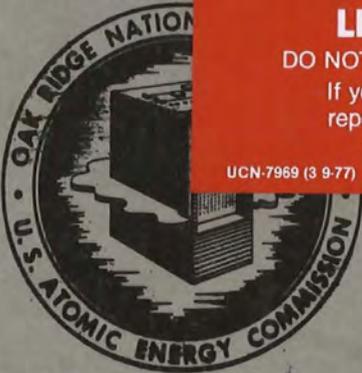
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Series A.

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OPERATIONS DIVISION

MONTHLY REPORT

for

Month Ending December 31, 1950

by

M. E. Ramsey

DATE ISSUED

FEB 5 1951

OAK RIDGE NATIONAL LABORATORY
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CARBIDE AND CARBON CHEMICALS DIVISION
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SUMMARY

1. Lost pile-operating time averaged 10.2%, compared to 11.1% for the year of 1950, and 9.4% for the year of 1949. (Page 5.)
2. One ruptured slug was located and discharged without difficulty. A total of thirteen jacket failures occurred in 1950, compared to fourteen in 1949, and fourteen in 1948. (Pages 5 and 6.)
3. The pile is to be recharged with aluminum silicon bonded slugs during the coming year. This will permit raising the maximum metal temperature from 245° C. to 350° C., resulting in a neutron flux and pile power increase of thirty to thirty-five percent. (Page 6.)
4. Essentially all experimental holes in the reactor are being used and additional facilities are badly needed for proposed experimental work. A priority system will no doubt be necessary during the coming year. (Pages 7 and 8.)
5. The excess pile reactivity was approximately one hundred and ten inhours at the end of the month. (Page 8.)
6. The new equipment, used since September, 1950, for P32 production, has been very satisfactory. (Pages 14, 15, 16, 17, and 18.)
7. The process for separation of C¹⁴ from Be₃N₂ has been developed and a small unit handling two Be₃N₂ slugs per batch has been operated. (Pages 19, 20, and 21.)
8. Multicurie quantities of Cs¹³⁷ and Sr⁹⁰ were separated from fission products during the year. Very sharp separations of fission products are being obtained by heated ion exchange columns made in the form of a spiral. (Pages 24, 25, 26, 27, and 28.)

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9. The disposal of radioactive off-gases is being satisfactorily handled by the system installed during the past year. (Pages 34 and 35.)
 10. The activity discharged to White Oak Creek was 18.8 curies, compared to 6.0 curies during November, 1950. The discharge from the evaporator was 0.13 curie, compared to 0.12 curie last month. Over fifteen curies of the activity was discharged during a six-day period in the first part of the month and it appears to have been caused by overflow of a waste tank. During 1950, 187 curies were discharged into White Oak Creek, compared to 1,050 curies during 1949. (Pages 36 and 38.)
 11. The alterations to the RaLa process are scheduled for completion by February 1, 1951, since Los Alamos indicated that they may want a shipment by February 5, 1951. (Page 41.)
 12. There were 616 radioisotope shipments during December, compared to 661 during November, 1950. There were 8,075 radioisotope shipments during 1950, compared to 5,597 shipments during 1949, which represents a forty-four percent increase during the year. (Page 45.)
- 

A. PILE DEPARTMENT

I. Operating Data:

	<u>DECEMBER</u>	<u>YEAR</u>	<u>YEAR</u>
	1950	1950	1949
Total Accumulated KWH-----	2,675,199	26,908,563	29,072,468
Average KW/Operating Hour-----	4002.9	3454.7	3663.4
Average KW/24-Hour Day-----	3595.7	3071.7	3318.8
Percent Lost Time-----	10.2	11.1	9.4
Excess Pile Reactivity-----	Approx. 110 inhours-----		
Slugs Discharged-----	124	2859	3339
Slugs Charged-----	124	2987	3377
Product Made (Grams)-----	97.64	982.06	1061.04
Product Discharged (Grams)-----	5.96	168.93	248.58

II. Pile Operations:

The pile-down time was 10.2%, compared with 11.1% for the year of 1950 and 9.4% for 1949. The 1.7% increase in pile-down time during 1950 was largely due to greater usage of the pile for research work resulting in more and slightly longer routine shutdowns.

One ruptured slug was found during the month. It was located in Channel No. 1773 on December 31, 1950, having been indicated by a high probe reading. Since the thermocouple in this channel had given a high temperature reading previously, the channel was checked and found to contain the rupture. The discharge was completed and operations resumed in less than two hours. Upon inspecting the discharged slugs, it was found that the jacket was almost completely off the slug to which the thermocouple was attached.

This rupture was the seventy-ninth detected to date. The slugs in Channel No. 1773 had been in the pile for 900 days at a maximum temperature of approximately 245° C.

II. Pile Operations: - (Continued)

The number of ruptured slugs detected and discharged in 1947, 1948, 1949, and 1950 remained relatively constant at thirteen, fourteen, fourteen, and thirteen, respectively. Seven of the thirteen ruptures during 1950 were indicated on the probe. An increase in the frequency of ruptures had been anticipated but did not occur even though much of the metal in the pile is now six years old. Since additional slugs must be procured during 1951, these will be aluminum silicon bonded since this type of slug can be operated at 350° C. instead of the current 245° C. maximum temperature, resulting in an approximately thirty to thirty-five percent increase in neutron flux and pile power.

Information has been received that the Al-Si alloy may corrode the aluminum wall appreciably during fabrication, making the present maximum wall thickness of 0.027 inch infeasible. It is proposed to make the wall 0.030 inch to 0.033 inch thick to obviate any trouble on this score. The procurement of 2-S aluminum may be difficult, the best delivery date obtained so far is April, 1951. Efforts are being made by Y-12 to improve this schedule.

The average pile power per operating hour for the month was 4,003 KWH, compared with 3,613 KWH in December, 1949. Part of the difference is undoubtedly due to the lower temperature experienced in December, 1950, but the new fans are responsible for a major part of the improvement.

For the past several months, the nominally 110 voltage service in the Pile Building has been high, especially at night when it sometimes rose to 130 volts. This condition has been partially corrected so that the maximum reached is now about 118 volts.

II. Pile Operations: - (Continued)

A stringer for irradiating materials inside the Low Intensity Training Reactor is being designed. It is hoped that an arrangement can be made which will permit samples to be removed fairly easily.

Since all of the $\text{Ca}(\text{NO}_3)_2$ cans have been discharged from the pile, there is no source of low specific activity Ca^{45} . This has proven to be a very popular radioisotope and, in order to provide a continuing supply, a number of cans of pure CaCO_3 will be prepared. These will be irradiated to provide a supply of this radioisotope. The use of CaCO_3 will also have the advantage of being free of any radioactive contaminant; whereas, $\text{Ca}(\text{NO}_3)_2$ (which was irradiated for production of Cl^{36}) required chemical purification.

A total of twenty-three experimental programs together with two general-usage pneumatic tubes and seven radioisotope production facilities are being provided for on the six balconies that give access to the 4" x 4" holes and on the top of the pile. All but one of the 4" x 4" holes are in active use or are blocked by the work at other holes. This one hole (No. 55) is in a very undesirable location and can only be used for work requiring little external equipment.

In addition to those programs using 4" x 4" holes, others are using sixteen fuel channels and five miscellaneous holes, making a total of fifty-one neutron facilities in use. This does not include peripheral fuel channels frequently in use in radioisotope work.

II. Pile Operations: - (Continued)

During the year, five vacant holes were put into use and six others were converted to new usages. Also, a second general-usage pneumatic tube was installed.

Additional facilities are needed for HRE solution studies, a cryostat, and creep test apparatus. If these are provided for, other work will have to be discontinued to provide space.

Except for the replacement pile control wiring, the permanentization of the Pile Building and Inlet Filter House was completed during the year. The replacement control wiring is being installed during the routine pile shutdown each week and will be completed early in 1951.

A special irradiation of approximately 400 pounds of tantalum in 282 slugs was irradiated to give about fifteen curies of Ta^{182} as of February, 1951. The slugs were opened and the tantalum loaded into special containers provided, and the material was shipped December 30, 1950.

The excess pile reactivity remained unchanged from last month at approximately 110 inhours. Except for the early summer months when a large amount of tantalum was being irradiated, there has been sufficient reactivity for good pile control and exposure of materials.

III. Fan House:

The fans have operated very satisfactorily since the installation of the new Sturtevant fans was completed in November, 1950.

III. Fan House: - (Continued)

A new, 900-horsepower motor is being purchased and is expected early in January, 1951. This will permit the present motors to be repaired. One, No. 3, is badly in need of this since one of its coils burned out during June, 1950.

IV. Filter House:

The following table compares the pressure drop across the exit air filters last month and this month with that a year ago and that experienced immediately after replacement of filters:

<u>Date</u>	<u>Glass Wool (In. w.g.)</u>	<u>CWS #6 (In. w.g.)</u>	<u>Total Across Filter House</u>
12-31-50	2.4	3.8	7.6
11-30-50	2.1	3.7	7.1
12-31-49	3.0	2.5	6.8
Clean Filters	1.1	1.0	3.3

V. Radioisotopes:

The following is a comparison of the radioisotope and research samples charged into the pile during the Year 1950 with those handled in 1949:

	<u>1950</u>		<u>1949</u>	
	<u>Research</u>	<u>Radioisotopes</u>	<u>Research</u>	<u>Radioisotopes</u>
Stringers 13, 14, and 16	331	1,988	338	1,279
Hole 22 (Pneumatic Tube)	751	88	506	52
All Other Holes	<u>105</u>	<u>291</u>	<u>180</u>	<u>215</u>
TOTAL BY GROUPS	<u>1,187</u>	<u>2,367</u>	<u>1,024</u>	<u>1,546</u>
TOTAL FOR YEAR		3,554		2,570

There were 341 cans of target material in the stringers at the end of 1950, compared with 372 at the end of 1949.



VI. Water Demineralization Building:

The operation of the building was normal throughout the month with 566,100 gallons of water being demineralized.

<u>Produced (Gallons):</u>	<u>December, 1950</u>	<u>November, 1950</u>	<u>Year-to-Date</u>
Demineralized	566,100	521,000	7,207,200
Deaerated	90,900	--	461,700

The responsibility for operation of the Water Demineralization Building was transferred to the Pile Department on January 1, 1950, and has been operated without appreciable difficulty during the past year.



B. CHEMICAL SEPARATIONS AND RADIOISOTOPE DEVELOPMENT DEPARTMENTS

I. Radioisotopes:

1. Iodine (I¹³¹ - 8d)

Fourteen ORNL slugs were processed and 30,402 millicuries were shipped. Shipments during the first two weeks of this month were made using product from the Hanford slug run made last month.

Some piping repairs and changes were made on the exterior cell equipment, and a leaking trap in Room #10 was repaired.

Summary of Operations During 1950

The following is a comparison of the uranium processed and the product shipped for the last two years:

<u>Year</u>	<u>Material Processed</u>		<u>Pounds of Uranium</u>	<u>Millicuries Shipped</u>	<u>mc Shipped/ Lb. of U Used</u>
	<u>ORNL Slugs</u>	<u>Hanford Slugs</u>			
1949	201	4	533	217,927	409
1950	396	12	1,066	310,698	291

The lower number of millicuries shipped per pound of uranium in 1950, as compared to 1949, is accounted for by the following:

- a. In October of 1950 an unusually large number (eighty) of ORNL slugs were processed which gave very low yields because of equipment failures.
- b. An attempt was made during 1950 to keep a larger supply of I¹³¹ on hand to meet emergency shipments. This practice resulted in higher decay losses between the time processing was completed and the time the product was shipped.

I. Radioisotopes: - (Continued)1. Iodine (I^{131} - 8d)

The equipment operated fairly well during most of the year. The most serious difficulties encountered were high air counts in the operating area during several runs during the first part of the year. This air contamination resulted from leaks in the dissolving cell and an inadequate off-gas system; no incidents of high air activity were noted after tying-in the off-gas lines in May and the hood exhaust ducts in November to the 900 Area exhaust system.

The cell was decontaminated twice during the year. The first time was during March to repair a broken valve, numerous leaks in welds, and several leaking stainless-steel-to-tantalum connectors on the dissolver. The second time was during the latter part of October for replacement of the leaking dissolver (the tantalum liner was collapsed in the dissolver) and a leaking still condenser. The tantalum instrument lines and draw-off lines were replaced with stainless steel and a number of leaking welds, a leaking valve, and the distillate receiver probes were repaired.

Because of a high radiation background, additional shielding was added to the hot off-gas line and the vacuum traps above the cell. A device was also installed in the final distillation room to shield the product while removing it from the processing equipment to a transporting pig. Although the background has been considerably lowered by these improvements, more work must be done to make the equipment acceptable for normal operation.

I. Radioisotopes: - (Continued)

1. Iodine Development Work

The Engineering Department submitted a preliminary construction sketch for the new I¹³¹ plant on December 7, 1950. This sketch has been evaluated and we are now awaiting additional drawings. Work on a chemical flowsheet was started.

Summary of Development Work During 1950

No further chemical development work was done on the I¹³¹ process this year. The 706-C plant operated successfully except for mechanical failures, such as the previously-mentioned leak which developed in the stainless steel dissolver causing the tantalum liner to fail. Some precipitate was encountered in the product during this period; it was determined to be chiefly organic matter, but the connection between the dissolver leaks and the chemical contamination was never clearly established. The trouble cleared up when a new dissolver was installed.

Preliminary design work was done and a CR for additional design work was filed for a new iodine and fission product unit of increased capacity in the Radioisotope Area. Equipment for iodine production will be made chiefly of stainless steel, and duplicate dissolving equipment will be installed. An additional small glass dissolver will be used to produce UNH solution for the fission product separation process (other than iodine). The new equipment is scheduled to be in operation by the end of 1951.

I. Radioisotopes: - (Continued)2. Phosphorus (P³² - 14.3)

Sixteen 2,000-gram cans of irradiated sulfur were processed and approximately 6,701 millicuries were shipped.

Some further difficulty was experienced with leaks developing due to loosening of flanges on the extractor; it is hoped that this can be corrected by addition of locknuts to all flange bolts as soon as down time and exposure time will allow their installation. Also, difficulty was experienced in processing of one four-can run in that the sulfur from one can solidified in the mouth of the extractor and spilled over onto the outside of the equipment; the remaining three cans were lost during extraction due to an operating error caused by lack of operating experience on the new equipment. No shipments were delayed, since enough P³² was on hand to meet all current orders.

Summary of Operation During 1950

The following is a comparison of the material processed and the product shipped for the last two years:

<u>Year</u>	<u>Kilograms of S Processed</u>	<u>Millicuries Shipped</u>	<u>Millicuries Shipped/ Kilogram of Sulfur</u>
1949	374	73,166	196
1950	452	95,954	212

The higher number of millicuries shipped per unit weight processed in 1950, as compared to 1949, can be accounted for by the better extraction yields and fewer equipment difficulties encountered during extraction.

I. Radioisotopes: - (Continued)

2. Phosphorus (P^{32} - 14.3d) - Summary of Operation During 1950

The temporary equipment installed in the Tank Farm and in Building 204 was operated until September, 1950, at which time full production was begun in the new permanent equipment in Building 906. The temporary extraction equipment in the Tank Farm operated satisfactorily except for the high exposure to personnel and the long period of time necessary to make extractions. However, difficulties were encountered in the glassware purification equipment during several runs because of poor visibility during some of the operations and the temporary nature of the equipment.

The new purification glassware in Building 906 has been proven very satisfactory; losses across this equipment have been very low. The extraction equipment has not been proven completely satisfactory, although it is hoped that the troubles can be corrected by changes to the equipment.

Phosphorus Development Work

A five-gallon, glass-lined, jacketed vessel with an agitator will be ordered from Glascote Products, Inc., to be used as extraction unit No. 2.

A new sulfur irradiation can was designed and approved by the Pile and Chemical Separations Departments.

Emergency P^{32} production equipment in the Tank Farm Area was dismantled. Reinstallation of this equipment in Building 906 was not begun, nor has fabrication of the hood been started.

I. Radioisotopes: - (Continued)

2. Phosphorus Development Work During 1950

Use of the new P³² equipment in the Radioisotope Area has permitted removal of the old P³² equipment from Cell 5 of Building 205. Also, the extraction unit from the temporary equipment in the Tank Farm will be transferred to the Radioisotope Area for stand-by service until a second extractor of the new type is built. The new extraction equipment is glass-lined and rocker agitated, heated to 135° C. by steam and electricity. Extractions of molten sulfur may be made by remote control and the aqueous extractant (0.2 N HNO₃) discharged at one end of the four-inch diameter horizontal extractor, while the molten waste sulfur is discharged at the other end. Two kilograms of irradiated sulfur are processed per batch. New purification glassware, incorporating many improvements, is located adjacent to the extractor, and can be operated completely by remote control. The operation of this equipment has been satisfactory except for flange leakage on the extractor. A great deal of useful information has been gained by the construction and operation of this equipment. Glass-lined equipment is shown to be satisfactory for this severe service: radioactive molten sulfur in contact with 0.2 HNO₃ at 135° C. and 25 psi. A second extraction unit consisting of a conventional glass-lined pressure kettle with a mechanically-rotated agitator will be built early in 1951. It is necessary to have stand-by equipment for P³² production because of the continuous high demand for this radioisotope, so that normal repairs may be made without interrupting production.

I. Radioisotopes: - (Continued)2. Phosphorus Development Work During 1950

Three significant chemical improvements were made. The high pH (NaOH) precipitation of iron, chromium, and nickel was replaced by straight ion exchange. The extracted P^{32} in 0.2 N HNO_3 is taken to near dryness and fumed with aqua regia; after suitable dilution, the gross cationic impurities are removed by Dowex-50 ion exchange resin in a Stang reactor. The use of a Stang reactor is an innovation which allows rapid remote control work with ion exchange resin. Regeneration of the resin may be accomplished quickly by air agitation of the resin with HCl instead of allowing it to flow through the resin bed. Very little loss of P^{32} is encountered on the resin bed.

Traces of organic matter from the original sulfur target material carry along with the P^{32} during processing and can come through to the final product where a slight white organic precipitate often formed at pH 7-9. A precipitation step at pH 7-9 was added before the final ion exchange column to remove any possible precipitable material. This method is not new, but it has not been included routinely in the operating procedure before. Very little difficulty is experienced now because of precipitation in alkaline P^{32} preparations.

Losses of P^{32} by adsorption on glass or quartz have been high when the final product was evaporated to dryness for removal of excess acid. A gold-lined evaporator heated by an electric mantle was installed for final evaporations. Losses of P^{32} by adsorption on the gold have been extremely low.

I. Radioisotopes: - (Continued)

2. Phosphorus Development Work During 1950

Several new sulfur irradiation cans were designed and tested. A final design of a round can made from standard aluminum pipe has been selected for use. The round can will withstand the considerable (50-200 psi) gas pressure developed within the can during irradiation without danger of rupture. The square cans now in use are easily deformed by internal pressure. Slugs were designed and filled with sulfur for irradiation at Hanford. Similar irradiations will be made at Brookhaven and in the ORNL Low Intensity Training Reactor to augment the supply of P^{32} .

Special chemical separations were made for Dr. Jensen of Iowa State College in trying to establish the existence of a very small amount of a metastable S^{32} in P^{32} preparations. This collaborative work will continue.

Equipment was transferred from the Biology Division for the measurement of surface beta radiation intensity of red phosphorus-bakelite molded discs which are irradiated in the pile. A method of fabrication is being sought for bakelite-phosphorus discs because the former source of supply of these discs no longer exists. Some work on fabricating new discs was done initially at the K-25 Plastics Shop; however, equipment has been borrowed from them and experimental work is now being done in the Radioisotope Area. All the plastic discs examined so far blister or warp upon irradiation in the pile. The problem appears to be one of trial of numerous plastics composition and molding conditions.

I. Radioisotopes: - (Continued)

3. Carbon (C^{14} - 5700y)

The C^{14} was recovered from the old $Ca(NO_3)_2$ equipment; about 315 millicuries with an isotopic ratio of 2.08% was obtained.

The following is a list of the C^{14} available in the unprocessed Be_3N_2 slugs:

No. of Be_3N_2 Slugs on Hand	897
Total C^{14} Content in Be_3N_2 (Estimated)	40,365 mc
C^{14} in Form of $BaCO_3$ on Hand at End of Month	<u>350</u> mc
TOTAL	40,715 mc

Summary of Operation During 1950

The following is a comparison of the material processed and the yields obtained for the last two years:

<u>Year</u>	<u>Slugs Processed</u>	<u>Yield (mc)</u>	<u>Average Isotopic Ratio</u>
1949	2,980	3,402	5.39%
1950	4,565	3,574	2.65%

The lower isotopic ratio and yield per slug in 1950 are due entirely to the shorter time these slugs were in the pile. All $Ca(NO_3)_2$ slugs have been removed from the pile and processed; no more $Ca(NO_3)_2$ slugs are to be inserted into the ORNL pile. All C^{14} production in the future will come from beryllium nitride irradiated in the Hanford reactors. The equipment used in the $Ca(NO_3)_2$ process is scheduled to be dismantled.

I. Radioisotopes: - (Continued)

3. Carbon Development Work

Several Be_2N slug-crushing tests were made. Except for a few minor improvements, the primary hood equipment is ready for use.

Installation of glassware and associated equipment continued as rapidly as the various units were received.

It is estimated that this project is about 75% complete. There were 255.1 millicuries of C^{14} produced during December from four beryllium nitride slugs.

Carbon Development Work During 1950

Equipment for separating C^{14} from Be_3N_2 was installed in the Radioisotope Area. One small unit which can handle two slugs per batch is in operation. The full-scale coating removal and pellet-crushing equipment is installed. A larger separations system (ten slugs/batch) is approximately 50% complete. The dry box for making final BaCO_3 precipitations and handling NaCO_3 is in operation. A vault for storage of approximately 900 Be_3N_2 slugs was installed.

High isotopic ratio C^{14} (21%) has been produced and this value can be increased still further by lengthening the irradiation time at Hanford.

Studies will be resumed on the pressure developed in Be_3N_2 slugs during irradiation. Only a few slugs have been found to have abnormal pressures (several atmospheres).

I. Radioisotopes: - (Continued)

3. Carbon Development Work

$\text{BaC}^{14}\text{O}_3$ produced in the old process ($\text{Ca}(\text{NO}_3)_2$) was found not to be homogeneous. Old stocks were reworked through the new equipment, the isotopic ratio increased by addition of material from the Be_3N_2 process, and reprecipitated from $\text{NaC}^{14}\text{O}_3$ solution to give a uniform product. It will be possible to offer C^{14} in solution as $\text{NaC}^{14}\text{O}_3$, should there be a demand for it.

Research work on C^{14} was concerned with an investigation of the organic gases which are obtained from Be_3N_2 during dissolution. Equipment was assembled for low-temperature ($-190^\circ \text{C}.$) fractionation of these gases (methane, CO, ethane, etc.). Indications are that it also may be possible to obtain HC^{14}N from the process which is almost isotopically pure.

A process was devised for the recovery of beryllium as pure beryllium carbonate. The beryllium carbonate will be converted to beryllium chloride, from which it may be possible to synthesize Be_3N_2 without going through the Be metal step. The recovered Be is practically non-radioactive, containing only a minute amount of Be^{10} .

C^{14} sources were made by incorporating $\text{BaC}^{14}\text{O}_3$ in Lucite discs.

4. Sulfur (S^{35} - 87.1d)

A batch of elemental sulfur was produced which contained a total of 4,900 millicuries at a specific activity of approximately one curie per gram.

I. Radioisotopes: - (Continued)4. Sulfur Development Work During 1950

In addition to production of adequate amounts of carrier-free $H_2S^{35}O_4$ and BaS^{35} for distribution, a process was developed for preparing high specific activity elemental sulfur. Large quantities of elemental S^{35} were prepared for a project at Y-12. The method is based upon the electrical glow discharge separation of H_2S into H_2 and S .

5. Calcium (Ca^{45} - 180d)

The "W"-irradiated material reported last month had the following analysis:

Total Ca^{45} -----	209 mc
Concentration-----	2.09 mc/ml
Specific Activity-----	69.7 mc/gm
HM-----	< 6 ppm
Acidity-----	0.048 N (HCl).

Carrier-free material produced from "W"-irradiated Sc had the following analysis:

Total Ca^{45} -----	0.26 mc-----	0.92 mc
Concentration-----	0.0106 mc-----	0.00368 mc
Total Solids-----	1.0 mg/ml-----	0.0 mg/ml
NVM-----	0.0 mg/ml-----	0.0 mg/ml
Radiochemical Purity-----	100%-----	100%
Acidity-----	0.365 N (HCl)-----	0.131 N (HCl)

Calcium Development Work During 1950

Calcium 45 is now offered in four grades: low specific activity (0.5 mc/gm); high specific activity (50 mc/gm); enriched (1500 mc/gm); carrier-free. Purifications of low specific activity material was improved by precipitation from fuming HNO_3 ; the starting material was from $Ca(NO_3)_2-C^{14}$ process waste. However, in the future this product will be made by irradiation of $CaCO_3$ in the low flux zones of the X-pile.

I. Radioisotopes: - (Continued)5. Calcium Development Work During 1950

A new technique was used in irradiating Sc for carrier-free Ca^{45} production. Sc_2O_3 was irradiated at "W" in receptacles, which are openings drilled into U slugs. The increased proportion of fast neutrons resulted in a thirty-fold increase in Ca^{45} production over that obtained in thermal neutron zones in the X-pile. Even so, the total production remained very low: 1.9 mc per gram of Sc.

6. Beryllium (Be^7 - 52.9d) (Cyclotron)

The product reported last month had the following analysis:

Total Be^7 -----	289 mc
Concentration-----	2.63 mc/ml
Total Solids-----	1.0 mg/ml
Acidity-----	1.9 N (HCl)
Radiochemical Purity---	100%

7. Tritium (H^3 - 12.1y)

Tritium was packaged for the following:

Electronic Products Co.-----	10 ampoules-----	10 mc/ea
Harvard University-----	2 ampoules-----	10 mc/ea
Bartol Research Foundation-----	4 ampoules-----	10 mc/ea
Brown University-----	1 ampoule-----	10 mc.

Tritium Development Work During 1950

Equipment was installed for purifying H^3 , separating it from the He^3 daughter, and packaging in almost any quantity down to one millicurie. A palladium valve (used for separating H^3 and He^3) was developed which can be heated by passage of a high current (at low voltage) through the palladium; valves have been heated before by use of a tungsten coil wound around them.

I. Radioisotopes: - (Continued)7. Tritium Development Work During 1950

Techniques were developed for preparing H^3 Zr metal targets (used as targets in various particle accelerators) by an absorption of H^3 in a molten film of Zr on a tungsten disc; the target is heated to 1850° C. by induction heating during this operation.

8. Argon (A^{37} - 34.1d)

Procedures were developed and equipment set up for the separation of A^{37} from $CaCO_3$, purification, and packaging. This radioisotope emits only weak X-rays; work is not finished on the calibration of a gas counting chamber to measure it accurately.

9. Tellurium (Te^{125} - 60d) - Antimony (Sb^{125} - 2.7y)

Equipment for precisely controlled electrodeposition was put into operation. Sb^{125} and Te^{125} were separated from the parent Sn and from each other by electrodeposition. This method, which shows great promise for radioisotope separations, will be explored thoroughly in 1951.

10. Fission Products

A run using "W" slugs was completed during December. Fractions are now being purified to produce Ba^{140} , Sr^{89} , and short-lived rare earths.

Purified preparations of Nd^{147} and $Ce^{141-144}$ were made; analyses are given below.

I. Radioisotopes: - (Continued)10. Fission Productsa. Neodymium (Nd¹⁴⁷ - 11d)

Total Nd ¹⁴⁷ -----	2.47 mc
Concentration-----	0.165 mc/ml
Gross Alpha-----	35 c/m/ml
Total Solids-----	1.3 mg/ml
NVM-----	0.0 mg/ml
Acidity-----	0.729 N (HNO ₃)
HM-----	< 10 ppm

b. Cerium (Ce¹⁴¹⁻¹⁴⁴ - 30.6d, 275d)

Total Ce ¹⁴¹ -----	198 mc
Total Ce ¹⁴⁴ -----	54 mc
Concentration Ce ¹⁴¹ -----	0.44 mc/ml
Concentration Ce ¹⁴⁴ -----	0.12 mc/ml
Total Solids-----	0.4 mg/ml
NVM-----	0.3 mg/ml
HM-----	5 ppm
Gross Alpha-----	60 c/m/ml
Acidity-----	0.77 N (HCl)

Fission Products Development Work During 1950

The ion exchange system in 706-C Building was operated throughout the year to supply a large portion of the fission products shipped, particularly short-lived material. In general, all fission product orders were filled with a shortage of Ba¹⁴⁰ and Ru¹⁰⁶ developing toward the end of the year. It was not possible to furnish Eu and Sm, for which one or two orders were received. At the end of the year, the fission product cell was decontaminated for repairs.

It was demonstrated that it is not practical to separate long-lived Cs¹³⁷ from uranium solution with the 706-C equipment. New equipment was set up to obtain Cs¹³⁷ from Tank Farm waste.

I. Radioisotopes: - (Continued)

10. Fission Products Development Work During 1950

A small (0.1 slug) pilot unit for tributyl-phosphate extraction of UNH was set up in 910 Building. Several runs were made on this batch extraction system which demonstrated that the TBP system is the choice method for preparation of gross fission products. The extraction of U and Pu was so complete that it was possible to offer a new product, mixed fission products, for distribution. This was not possible previously because of the stringent Pu specifications on fission products. Carbon tetrachloride was used as a diluent in the experimental work and was found to be satisfactory. A new fission product plant, to be built in conjunction with the new I¹³¹ plant, will be designed around column extraction of U with CCl₄-TBP. This installation will be completed in late 1951 and at that time the 706-C facilities will be abandoned.

Two large (ten-curie) Cs¹³⁷ sources were ordered to be prepared as point sources for high priority work. A plant was designed, built, and put into operation, the sources being completed two and a half months after the order was received. The facilities for producing thirty curies of Cs¹³⁷ per month are now a part of the permanent equipment. This equipment is located in the Tank Farm Area and Building 908. The process is based upon the co-crystallization of Cs with ammonium alum.

A large demand for Sr⁹⁰ arose during the year and this was met by processing approximately twenty curies in the equipment in Building 907, using old slugs dissolved in the 706-D dissolver.

I. Radioisotopes: - (Continued)10. Fission Products Development Work During 1950

The purification process was improved, allowing both fuming HNO_3 and HCl-ether separations as well as ion exchange purifications with Versene complexing agent.

The Pilot Plant (Building 205) processed some rods from the Chalk River Plant, using the Redox process, and part of the waste was stored in an underground stainless steel tank for radioisotope separations. The Cs^{137} plant in the south Tank Farm was greatly expanded to accommodate a six-inch diameter ion exchange column and other processing equipment to allow fairly large-scale production of Sr^{90} , long-lived rare earths, and Ru^{106} . The chemical process was worked out during the year, using a flowsheet developed by the Chemical Technology Division as a starting point. This unit should be in operation by March, 1951. Wastes from W-3 may also be used in this equipment, as well as future Purex wastes from the Pilot Plant and Metal Waste Recovery Plant.

Processes for purification of fission products were improved. Nb^{95} of high purity, made by MnO_2 co-precipitation and ion exchange, gave a characteristic absorption curve when mounted on polystyrene. Nb^{95} preparations are estimated to contain less than 1 ppm of impurity. Extremely pure fractions of Nd^{147} were produced in which the 0.1 mev beta which had been listed in earlier charts (1947) was identified, but later editions do not include the 0.1 mev beta.

I. Radioisotopes: - (Continued)10. Fission Products Development Work During 1950

TTA extractions proved useful in separating the rare earths from Pu. A final clean-up of Pu was frequently made with TTA on fractions which had been purified by ion exchange.

Heated ion exchange columns (100° C.) in the form of a spiral became the principal tool in fission product purification. Much sharper separations were obtained than with conventional columns; in many cases, a twenty-four-inch-long column had as high as 800 theoretical plates. The cycle time was cut down by a factor of ten. The heated ion exchange column was also used on millicurie amounts of fission products as an analytical tool. A "preview" of the separations to be made in the curie-level run may be obtained in this manner; this information proved to be very valuable in operating columns.

Small amounts of Eu and Sm were separated by the group for the first time. The material was not shipped, but was retained for chemical and radiation studies. It is hoped that larger quantities of these two rare fission products will be obtained from Tank Farm waste.

11. Chalk River Waste Separations

Construction of the cells and the operating gallery for the unit to produce radioisotopes from Tank Farm waste was almost completed.

I. Radioisotopes: - (Continued)

11. Chalk River Waste Separations

The water demineralizer unit was designed and installed. The glass-lined tanks were reconditioned and installed. Special fittings for connecting glass-lined nozzles to Tygon tubing and glass pipe were designed, but are not yet fabricated.

The Instrument Department checked one of the surplus L & N recorders and found it unsuitable for use with a Q826 electrometer. It will be necessary to procure a Brown recorder.

None of the equipment ordered has been received. The delivery date of the electrometer has been changed from January 15, 1951, to sometime in March.

Most of the glassware for the process has been designed, but very few units have been fabricated.

12. Fission Product Purification Cell (910 Building)

The cell floor and semi-hot drain were completed. Construction of the walls is about to begin. Considerable work on design and location of various features, such as the carrier-shield part, tracks, openings for manipulators and vision, etc., remains. The Instrument Department was given design criteria for a rotating column effluent receiver actuated by a mechanism receiving signals from an ion chamber.

Small laboratory work benches were moved from 906 and 907 Buildings to Building 910 for installation on the second and third levels.

I. Radioisotopes: - (Continued)13. High Specific Activity (N, γ) Radioisotopes

The production of high specific activity (relative to X-pile irradiation units) materials, purified, analyzed, and in solution form, made by irradiating certain elements at "W" was increased during the year. Procedures were developed for handling and purifying Ir¹⁹², Fe⁵⁵, Fe⁵⁹, Ni⁶³, Hg²⁰³, Se⁷⁵, Sb¹²⁴, Ag¹¹⁰, Ta¹⁸², Tl²⁰⁴, Sn¹¹³, W¹⁸⁵, Zn⁶⁵, Co⁶⁰, Cd¹¹⁵, Cs¹³⁴, Sc⁴⁶, Cr⁵¹, Tb¹⁶⁰, Tm¹⁷⁰, Lu, Er, Yb¹⁶⁹, and Dy. In addition to increasing specific activity by increased neutron flux, enriched radioisotopes made at Y-12 were used very successfully in producing very high specific activity Fe⁵⁵, Fe⁵⁹, Sn¹¹³, and Cr⁵¹.

14. Cyclotron Radioisotopes

The processing of cyclotron targets was started in January; during the year most of the important cyclotron radioisotopes were separated and purified. Procedures were adapted from those published in the literature, or used at Berkeley or MIT. However, new procedures were developed for the following separations: Be⁷ from Li, Na²² from Mg, Co⁵⁷ from Fe, Fe⁵⁹ from Co, Mn⁵² from Cr. In almost all cases, the preparations were carrier-free. The following targets were processed during the year: three Be⁷, two Co⁵⁷, two I¹²⁵, two Fe⁵⁹, one As⁷³, one Sr⁸⁵, three Mn^{52,54}, four Na²², one Zn⁶⁵.

I. Radioisotopes: - (Continued)15. Miscellaneous Worka. Co⁶⁰ Sources

Cobalt 60 sources were loaded in special holders

as follows:

U. S. Dept. of Agriculture-----	1 curie
Bethlehem Steel Company-----	3 sources, 250 mc, 250 mc, 400 mc
Ill. State Dept. of Public Health--	9 sources, 100 mc each; 8 sources,
	125 mc each; 1 source, 1 curie
Veterans Adm., Fort Logan, Colo.---	5 sources, 500 mc, 400 mc, 300 mc,
	200 mc, 100 mc
Thomas B. McGuire Company-----	1 source, 25 curies
National Bureau of Standards-----	3 sources, 4 curies each
St. John X-Ray Company-----	2 sources, 300 mc, 160 mc
E. V. Camp Steel Works-----	1 source, 6 curies
University of North Dakota-----	2 sources, 400 mc, 150 mc
U. S. Naval Research Laboratory----	1 source, 25 curies
Industrial Gamma & X-Ray Company---	1 source, 1 curie.

b. Be⁷ Preparation

A special Be⁷ isotonic solution was prepared for the University of North Carolina.

c. Neutron Source

A neutron source was loaded into a special shield for the Bulk Shielding Program.

d. C¹⁴ Sources

Twenty C¹⁴ planchets were produced for Anton Electric Company.

e. Sr⁹⁰ Sources

Sr⁹⁰ sources were made as follows:

Los Alamos-----	1 source, 250 mc
Bellevue Medical Center-----	1 source, 25 mc
Radiation Research Corporation----	1 source, 25 mc.

I. Radioisotopes: - (Continued)15. Miscellaneous Workf. Y⁹¹ Source

A 250-millicurie source was prepared for Los Alamos.

g. Cs³⁷ Source

A 500-millicurie source was prepared for Los Alamos.

Miscellaneous Development Work During 1950

The amount of work in this category showed the greatest increase of any type work done by the Department.

Sources of many kinds were made, led by encapsulated Co⁶⁰; ninety-three separate sources were made containing a total of 171,180 mc of Co⁶⁰. Twelve Sr⁹⁰ sources were made in thin window, flat, one-inch diameter aluminum source holders. Techniques were developed for crimp-sealing the edge of these sources. Sources of Ce¹⁴⁴, Nd⁹⁵, C¹⁴, Y⁹¹, and Ru¹⁰⁶ were also made. The strength of these sources ranged up to 50,000 R/hr (beta) at contact. Methods were developed for electroplating inactive Ru and Ag as protective coverings for Ru¹⁰⁶ plated sources. Co⁶⁰ pellets were plated with a thin coating of silver. Thin films of Co⁶⁰ were plated on platinum (for beta) and protected with an inactive Co plate. Co⁶⁰ was formed into radium-type needles, plated with gold for protection and beta filter, and irradiated in the pile. Needles of the same type were also made by putting thin Co⁶⁰ wires inside stainless steel needles.

Solutions of many radioisotopes were made up to meet specifications of customers. For example, Be⁷ was made up at a specified concentration, in an isotonic solution, sulfate concentration adjusted to that of blood, and pH held at 4.5

I. Radioisotopes: - (Continued)15. Miscellaneous Development Work During 1950

Letters of inquiry regarding techniques and special information about radioisotopes increased in volume. Many jobs were performed for other ORNL divisions; for example, dilute solutions of gross fission products in five-gallon lots were prepared for the U. S. Army-Health Physics Division's clothes decontamination experiments.

A purification system was designed for continuously purifying water in the ORNL pile canal by pumping the water through beds of sand and through an exchange resin and then back into the canal. The equipment will be installed this spring.

Many pieces of equipment were designed during the year. Some of the more notable were: remote control stainless steel crystallizer, glass crystallizer, spiral ion exchange columns, Be_3N_2 pellet crusher, Stang reactor for ion exchange resin, and a low temperature gas fractionating column. A total of 198 design sketches and drawings were made; 122 work orders and 74 purchase requisitions were issued.

16. General Summary for the Radioisotope Processing Area During 1950

Installation of the remote control packing equipment was completed and packaging begun in this area in late January. Just prior to beginning its use, a motion picture of the operation of this equipment was made by the AEC. The equipment proved satisfactory except for the skyshine from the storage barricade and the resulting high background in the operating area. To reduce this background, two-inch-thick

I. Radioisotopes: - (Continued)16. General Summary for the Radioisotope Processing Area During 1950

leak skyshine shields were added in the west half of the barricade for storage of the hotter samples. Also, fabrication of a heavier lead shield is underway for one section, although it is anticipated that this will not entirely alleviate the condition.

The hood and cell exhaust blowers and stack were turned over to the Operations Division and put into operation in January. Operation has been satisfactory except for some overheating of the blower bearings in warm weather; also, in the first few weeks of operation some coils of the 125 HP motor burned out and were replaced by the vendor. The 706-C and 706-D cell exhausts were tied into the 900 Area in February and March, and tying in of the hoods to this system was completed in November. The experimental Trion precipitators in the 706-C and 706-D exhaust system were test run by the MIT Practice School. The glass wool and paper filters in this system were replaced once during the year after two months of operation; they were plugged by concrete chipping dust from construction work in 706-C Building.

The hot off-gas blower was put into operation in February, and has operated satisfactorily. The hot off-gas filter was installed in April and the hot off-gas lines from 706-C and 706-D were tied into this system; also, a line from the hot labs in Building 105 was tied into this system in December. Installation of the hot off-gas electrical precipitator was completed in

I. Radioisotopes: - (Continued)

16. General Summary for the Radioisotope Processing Area During 1950

August and testing of this equipment and the filters to determine efficiency and optimum operating conditions was begun by the Chemical Technology Division.

II. Tank Farm:

1. General

- a. No work was done this month on the constant proportional sampler in the new weir box on the discharge side of the Settling Basin.
- b. Several months ago, the 36-inch manhole on W-7 tank was uncovered in order to determine whether or not a piece of equipment would go into this opening. The manhole has been open since that time. Last week a concrete pipe, the size of the manhole, was poured around the hole, extending the opening of the tank to the top of the ground. This manhole extension was installed in order to provide a large opening into the tank to install a pump to move the uranium out of W-7 for metal recovery.

A six-inch opening was also cut into the top of W-7 tank this month to facilitate the removal of the uranium precipitate from this tank. The opening was cut with a core drill and is located on the opposite side of the tank from the large manholes.

- c. A leak in a gasket in the jet line from W-12 to W-5 was found in the W-12 jet pit. It was repaired. In all probability, this leak has contributed to the high activity in the Retention Pond recently.

II. Tank Farm: - (Continued)

2. Wastes Discharged to White Oak Creek

Approximately 18.07 curies of beta activity were discharged from the Settling Basin this month.

From December 5 to 12, a total of 15.18 curies were discharged. The source of high activity cannot be definitely proven but all evidence available indicated that it originated at Building 706-HB. There are two reasons for this belief:

- a. This building was the only one in the Restricted Area handling this amount of activity.
- b. The chemical waste tank at this building had been filled over its rated capacity, while the overflow line is tied directly to the Settling Basin.

ACTIVITY DISCHARGED TO WHITE OAK CREEK

<u>Discharged From</u>	<u>NOVEMBER, 1950</u>		<u>DECEMBER, 1950</u>	
	<u>Gallons</u>	<u>Beta Curies</u>	<u>Gallons</u>	<u>Beta Curies</u>
Settling Basin	22,906,000	5.47*	23,002,000	18.07*
Retention Pond	391,537	<u>0.51</u>	508,608	<u>0.77</u>
TOTAL		5.98		18.84
Contributed by Evaporator	less than 0.12*		less than 0.13*	

3. Chemical Waste Evaporator

The volume reductions and evaporation rates were lower this month. High specific gravity solutions were evaporated from W-6 and W-8, the concentrate storage tank.

II. Tank Farm: - (Continued)

3. Chemical Waste Evaporator

The evaporator was shut down this month for the following reasons:

- a. To experiment with the foam-indicating probes. These probes have not yet been proven satisfactory.
- b. No feed solution could be jetted from W-5 to the evaporator for a period of fifteen hours. Some waste from Chicago had been emptied into W-5 and this solution interfered with the operation of the W-5 to evaporator jet. Thorough agitation of the solution enabled the jet to operate.
- c. To tie the evaporator into the new steam line.

WASTE EVAPORATOR OPERATION

<u>Gallons Fed to Evaporator</u>	<u>Gallons of Concentrate to W-6</u>	<u>Volume Reduction</u>	<u>Beta Curies to Evaporator</u>	<u>Beta Curies to Settling Basin</u>
DEC. - 156,831	24,124	5.5:1	769.33	0.13
NOV. - 244,246	22,828	9.7:1	294.13	0.12

4. Waste Tank Inventory

<u>Tanks</u>	<u>Gallons Capacity</u>	<u>HOT PILOT PLANT STORAGE</u>			
		<u>Gallons In</u>	<u>Gallons Out</u>	<u>Discharged To</u>	<u>Free Space</u>
W-3,13,14,15	48,500	296	0	---	9,374
<u>CHEMICAL WASTE STORAGE</u>					
W-5	170,000	208,431	156,831	Evaporator	24,000
<u>EVAPORATOR CONCENTRATE STORAGE</u>					
W-6, 8	340,000	19,200	72,000	Evaporator	146,400
<u>METAL WASTE STORAGE</u>					
W-4,7,9,10	543,000	5,360	68,400	Evaporator	271,592

II. Tank Farm: - (Continued)

5. Summary of Operation During 1950

The Year 1950 has seen a great improvement in the operating conditions at the Tank Farm. The most important accomplishment has been the decrease in the amount of activity discharged into White Oak Creek. The following table gives a comparison of the discharge for the Years 1950 and 1949:

<u>Year</u>	<u>Beta Curies From Settling Basin</u>	<u>Beta Curies From Retention Pond</u>	<u>Total</u>
1950	172	15	187
1949	1,035	19	1,054

Almost the entire decrease in the activity discharged can be attributed to the fact that the waste evaporator was successfully operated for the first full year since its start-up in June, 1949. The wastes which contained the bulk of the activity were processed through the evaporator and, as a result, contributed less than 4% of the total of 187 curies discharged to the Creek. The balance of the activity came from the process waste lines over which there is practically no control because of the lack of monitoring facilities and poor piping layout. This condition should be corrected when the Plan "H" Program changes to the process waste system are completed. It is now very obvious that no appreciable decrease in the activity discharged to the Creek can be expected until these changes are made.

The waste evaporator operated satisfactorily most of the year; no unusual difficulties were encountered. The following are the significant operating data for the Year 1950, compared to that

II. Tank Farm: - (Continued)

5. Summary of Operation During 1950

of the last five months of 1949, the first period for which accurate data were available:

EVAPORATOR OPERATION DATA

	<u>Gallons Processed</u>	<u>Beta Curies in Feed</u>	<u>Beta Curies Discharged to Settling Basin</u>	<u>Decontamination Factor</u>	<u>Average Rate of Processing</u>
Year 1950 -	2,481,207	22,631	7.56	2,994	283 gal/hr
8-1-49 ---- thru 12-31-49	1,248,709	4,813	81.30	592	342 gal/hr

The decontamination factor of 2,994 is approximately three times that for which the equipment was designed. The great improvement during the Year 1950 can be attributed to:

- a. Improvement in operating techniques.
- b. Decrease in the processing rate made possible by the improvement in the Tank Farm waste inventory.
- c. The addition of a conductivity measurement device in the condensate line which enables the operator to detect a foam-over in its early stages and to correct the condition before a large amount of activity is sent to the Settling Basin.

Further improvements in the efficiency of the waste evaporator operation are expected in 1951 by the addition of a condensate vapor scrubber column to the present evaporator. The order for the column has been placed with the manufacturer and it is expected to be put into operation in April, 1951.

II. Tank Farm: - (Continued)5. Summary of Operation During 1950

The Chemical Technology Division is also experimenting with contact probe foam level indicators. Should these probes be proven practical, the efficiency of the evaporator will undoubtedly be increased and the operation possibly be made automatically controlled.

The waste tank inventory has been tremendously improved during the year. By processing the metal waste supernatant through the evaporator, it was possible to increase the free space in the metal waste tank from 129,600 to 271,592 gallons. The inventory of the chemical waste tanks has also been improved sufficiently so that current wastes can normally be handled without running short of free space. The degree of improvement, however, cannot be accurately measured because it is impossible to determine the condition of W-6 and W-8, the evaporator concentrate storage tanks. The material in these tanks is periodically brought back to the evaporator for further concentration after the solids have settled out to the bottom. How long this process can be continued is questionable, although it is expected that more tanks will be made available for storage of the concentrate by the metal recovery process before the free space becomes critical.

III. RaLa (Ba¹⁴⁰ - 12.5d):

Processing of dummy runs was held up pending receipt of a new filter being fabricated at the shops. This filter is expected to eliminate filtering difficulties experienced in the past by its relatively large surface area.

The following work was done on the new RaLa equipment:

1. Fabrication of the resin cubicle frame and shroud was completed. Piping and tank installation has begun. One cubicle is at present equipped with the sampler mechanism.
2. The six-ton crane was mounted and is now operating. Catwalks were installed across the top of the monorail.
3. The cone manipulator was received and installed in the loading cubicle.
4. The charging head bracket and charging heads were located and installed.
5. The new panel board for the resin cubicle was received and mounted. The piping is being installed and gauges and instruments are being mounted.
6. The woodwork in Building 706-D is being repainted.

The ventilating fan motor bearing failed and the bearing was replaced.

The third-level hoist was re-equipped with new bearings and gears to guarantee continued safe operation.

The next shipment date has been tentatively scheduled by Los Alamos to be February 15, 1951.

III. RaLa (Ba¹⁴⁰ - 12.5d): - (Continued)

Summary of Operation During 1950

A total of four batches containing 17,050 curies of product was shipped this year. This small number of batches was adequate to satisfy the requirements at Los Alamos. All batches were shipped on schedule. The following table shows a comparison of significant production figures for the Years 1949 and 1950:

	<u>1949</u>	<u>1950</u>
Number of Shipments-----	9-----	4-----
Curies Shipped-----	28,073-----	17,050-----
Curies per Shipment - Average-----	3,119-----	4,262-----
Pounds of Uranium Used-----	3,863-----	1,145-----
Curies Produced/Pound of U-----	7.27-----	14.89-----
Chemical Yield-----	60.5%-----	70.8%-----

The comparatively high chemical yield for the Year 1950 was due to the fact that less equipment breakdown was experienced during these four runs than in any four consecutive runs previously made; also, the difficulties once experienced with incomplete metathesis were eliminated by minor changes made in the chemical flowsheet during the Year 1949.

The relatively high number of curies produced per pound of uranium was mainly due to the exclusive use of Hanford-irradiated uranium instead of uranium irradiated in the ORNL pile. The complete change was accomplished in April of 1949.

In addition to the four regular runs processed for shipment to Los Alamos, a batch of seventy-four Hanford-irradiated slugs was dissolved, extracted, and combined with the wastes from the run made in January, 1950, for the Chemical Technology Division. This run was made for processing through a specially-built

III. RaLa (Ba¹⁴⁰ - 12.5d): - (Continued)Summary of Operation During 1950

experimental resin column cubicle to determine the feasibility of separating Ba¹⁴⁰ by a resin column ion exchange process. The results obtained from this experimental work were considered adequate proof that the ion exchange method of separation would be superior to our present method of separation.

One of the Laboratory's greatest sources of air contamination in previous years was brought under control in February when the RaLa off-gas facilities were tied into the 900 Area stack. Three of the four runs were made with the new tie-in and have proven that the problem has been eliminated.

After the successful completion of the experimental work to determine the feasibility of RaLa production by the ion exchange method, a Construction Request (CR-110 for \$287,000) for the modification of the existing equipment and the addition of new equipment to facilitate the ion exchange process was approved by the Atomic Energy Commission in April, 1950. The project was justified by the anticipated increase in the demand for RaLa at Los Alamos and by the need for more reliability, efficiency, purity of product, and safety in operation than the existing process could provide.

The project was divided into two phases:

1. The installation of filters for the separation of the extraction and metathesis cakes.

III. RaLa (Ba¹⁴⁰ - 12.5d): - (Continued)Summary of Operation During 1950

2. The installation of resin columns and new product handling equipment.

The first phase, which was expected to improve the efficiency and reliability of the process, was scheduled to be completed by September, 1950. The second phase, which would permit the production of larger-sized batches and would improve the purity of the product and safety in operation, was scheduled to be completed by November, 1950. These completion dates, as scheduled, would have permitted the work at Los Alamos to proceed without interruption for lack of RaLa.

Since the start of construction, however, the schedule for the use of RaLa at Los Alamos has been revised several times and the construction completion dates were revised accordingly to relieve the pressure on the engineering and maintenance forces. The latest information received from Los Alamos before the end of the year was that it was only remotely possible that they would be in a position to use a batch by February 15, 1951. To make the product available to them from the new equipment by that time, the entire construction program is now scheduled for completion by February 1, 1951. The first phase has already been completed and is now undergoing several alterations and tests.

C. RADIOISOTOPE CONTROL DEPARTMENTI. General:

During December, 1950, there were 616 radioisotope shipments, compared with 661 during November and 760 during October, 1950.

In December, 1949, there were 430.

The breakdown according to separated and unseparated material is as follows:

	<u>December 1950</u>	<u>November 1950</u>	<u>December 1949</u>	<u>August, 1946, to December, 1950, Inclusive</u>
Separated Material				
706-D Area	498	504	361	14,861
Unseparated Material				
100 Area	<u>118</u>	<u>157</u>	<u>69</u>	<u>4,566</u>
TOTAL SHIPMENTS	616	661	430	19,427

The breakdown of shipments according to non-project, project, and foreign shipments is as follows:

	<u>December 1950</u>	<u>November 1950</u>	<u>December 1949</u>	<u>Total Shipments 1949</u>	<u>Total Shipments 1950</u>	<u>Percent Increase</u>
Non-Project	510	518	325	4,334	6,284	/ 45%
Project	93	119	88	943	1,572	/ 67%
Foreign	<u>13</u>	<u>24</u>	<u>17</u>	<u>320</u>	<u>219</u>	- 32%
	616	661	430	5,597	8,075	/ 44%

II. Hanford Irradiations:

Hanford has informed the Laboratory that several of the irradiations for radioisotope production are not consistent with the irradiation time specified in the original request. A letter has been prepared and sent to Hanford requesting revision of those requests involved; whereby, the irradiation time wanted for the samples will be in line with the time specified in the request.

II. Hanford Irradiations: - (Continued)

Hanford is expediting shipment of ten cobalt slugs so that this material can be used to fill current orders. It is expected that the cobalt will arrive at ORNL early in January, 1951.

III. Cyclotron Radioisotopes:

Following is a list of the outstanding orders for cyclotron radioisotopes now on hand:

<u>Material</u>	<u>Amount</u>	<u>Status</u>
Mn 54-----	2 mc-----	Material in process.
As 73-----	12 mc-----	Bombardment has been requested.

BOMBARDMENTS RECEIVED

	<u>M. I. T.</u>		<u>U. of CALIF.</u>		<u>U. of PITTSBURGH</u>		<u>WASHINGTON U.</u>	
	<u>Bombard-ments</u>	<u>Beam Hours</u>	<u>Bombard-ments</u>	<u>Beam Hours</u>	<u>Bombard-ments</u>	<u>Beam Hours</u>	<u>Bombard-ments</u>	<u>Beam Hours</u>
Be 7					8	235.00		
Na 22	1	109.75			5	201.75	4	300.00
Mn 52					2	20.00		
Mn 54							2	100.00
Co 57							2	50.00
Fe 59			5	263.10				
Zn 65	1	100.00						
Sr 85	1	50.00			1	10.00		
I 125							2	60.00
Molybdenum Metal					1	13.00	2	20.00
TOTAL RECEIVED	3	259.75	5	263.10	17	479.75	12	530.00

REQUESTED BUT NOT RECEIVED

Zn 65			1	40.00				
As 73					1	10.00		
TOTAL HOURS OUTSTANDING (Not Received or Requested)		490.25		446.90		260.25		220.00

III. Cyclotron Radioisotopes: - (Continued)SHIPMENTS OF CYCLOTRON-PROCESSED RADIOISOTOPES

<u>Material</u>	<u>No. Shipments December, 1950</u>	<u>No. Millicuries December, 1950</u>	<u>No. Millicuries To Date</u>
Be 7	4	32	159.073
Na 22	3	1.30	28.947
Mn 52	0	0	9.991
Co 57	0	0	2.0
Fe 59	0	0	1.5 mc and 1 S.I.
Zn 65	0	0	1.5

IV. Activation Analyses:

The status of the activation work remains the same as shown in the October report. No further information has been received from the Reynolds Metal Company of Sheffield, Alabama, in regard to the analyses of one hundred aluminum samples.

M. E. Ramsey
M. E. Ramsey, Director
Operations Division

V. S-F Material Control:

1. All work relative to the KAPL disc fabrication project was completed during December, 1950, including shipment of the material to Knolls. Enriched uranium aluminum alloy scrap was returned to Y-12 for reprocessing.
2. During the month, twenty-eight kilograms of 90-95% enriched uranium metal was received from Y-12 for rolling into discs. This material is for use in connection with the ANP program. After completion of fabrication, the material will be returned to Y-12. The twenty-eight kilograms are a part of seventy-five kilograms allocated by the Atomic Energy Commission for the ANP program.
3. In accordance with USAEC Bulletin GM-173, referred to in paragraph 5. of the November report, the SF office compiled and submitted the Laboratory's inventory report on all radium and radium compounds located at the X-10 Area.
4. A special report covering fissionable material usage and availability for return to production channels in case of emergency was issued during the month. The material balance on hand as of December 20, 1950, was used in this report. The report covered such data as name of person processing material by research division, quantity of U-233, Pu, and U-235 held by the individual, physical and chemical form, program on which material is being used, and the time in which material could be made available if required.

V. S-F Material Control: - (Continued)

5. The responsibility for design and coordination of the work required in connection with installing a uranium dissolver unit for use in dissolving non-irradiated SF alloyed scrap before returning to production channels has been accepted by the Radioisotope Development Department. Since most of the component parts are available, it is anticipated that the cost will not exceed \$1,000. Installation of such a unit was recommended by the USAEC SF Survey Group.
6. The program of surveying material balance areas was continued by the SF Office. During the month, six persons possessing SF material were visited and their material inspected and weighed where feasible. No apparent discrepancies were encountered.
7. The records of three analytical laboratories were audited during December, 1950. The records were found to be in good order and proper accounting had been made for all samples.
8. During the month, sixteen shipments were received and twenty-one shipments made, compared with sixteen receipts and twenty-one shipments last month. Eighteen new material requests were received and processed in December, 1950.

V. S-F Material Control: - (Continued)

9. Following is a summary of receipts and shipments of SF materials for the month of December, 1950:

RECEIPTS

<u>From</u>	<u>Material</u>	<u>Content</u>	
Argonne National Lab.	Normal Uranium (Waste)	9,200.00	gm.
Argonne National Lab.	Depleted Uranium (Waste)	3,950.00	gm.
Argonne National Lab.	Pu (Waste)	.186	gm.
Argonne National Lab.	Normal Uranium (Waste)	7,860.00	gm.
Argonne National Lab.	Depleted Uranium (Waste)	1,578.00	gm.
Batelle Memorial Inst.	Thorium Metal	511.00	gm.
Brookhaven National Lab.	Uranium Foil	1.04	gm.
C&CCD, K-25 Area	Depleted Uranium	0.40	gm.
C&CCD, Y-12 Area	Enriched Uranium Metal	0.93	gm.
C&CCD, Y-12 Area	Enriched Uranium Metal	716.67	gm.
C&CCD, Y-12 Area	Enriched Uranium Metal	5.07	gm.
C&CCD, Y-12 Area	Normal Uranium	260.00	gm.
C&CCD, Y-12 Area	Normal Uranium	285.00	gm.
C&CCD, Y-12 Area	Depleted Uranium	16.334	gm.
C&CCD, Y-12 Area	Normal Uranium (UNH)	458,945.8	gm.
C&CCD, Y-12 Area	Enriched Uranium Metal	13,650.91	gm.
C&CCD, Y-12 Area	Enriched Uranium Metal	12,502.08	gm.
Los Alamos Scien. Lab.	Pu (Solution)	0.056	gm.
Tracerlab, Inc.	Normal Uranium	3.83	gm.

SHIPMENTS

<u>To</u>	<u>Material</u>	<u>Content</u>	
Argonne National Lab.	Depleted Uranium (Sliced X-Slug)	676.00	gm.
Argonne National Lab.	Pu in Sliced Slug	0.01	gm.
Argonne National Lab.	Depleted Uranium (18 Slugs)	20,988.00	gm.
Argonne National Lab.	Pu in 18 Slugs	0.32	gm.
Argonne National Lab.	Normal Uranium (U-Zr Alloy)	19,392.00	gm.
Argonne National Lab.	Depleted Uranium (Sliced X-Slug)	511.00	gm.
Argonne National Lab.	Pu in X-Slug	0.01	gm.
Argonne National Lab.	Depleted Uranium (Slugs)	20,988.00	gm.
Argonne National Lab.	Pu in Slugs	0.27	gm.

V. S-F Material Control: - (Continued)

9. Summary of receipts and shipments for December, 1950.

<u>To</u>	<u>Material</u>	<u>Content</u>	
Brookhaven National Lab.	Normal Uranium Foil	0.10	gm.
C&CCD, K-25 Area	Depleted Uranium	0.40	gm.
C&CCD, K-25 Area	Normal Uranium (Turnings)	50.00	gm.
C&CCD, K-25 Area	Normal Uranium (Compounds)	1,533.12	gm.
C&CCD, Y-12 Area	Enriched Uranium (U/Al Alloy)	6.53	gm.
C&CCD, Y-12 Area	Enriched Uranium (U/Al Alloy)	2,454.07	gm.
C&CCD, Y-12 Area	Enriched Uranium (U/Al Alloy)	3.656	gm.
C&CCD, Y-12 Area	Enriched Uranium (U/Al Alloy)	0.668	gm.
C&CCD, Y-12 Area	Pu Solution	0.056	gm.
C&CCD, Y-12 Area	Depleted Uranium	0.287	gm.
Fairchild (NEPA)	Enriched Uranium Foil	9.119	gm.
General Electric, Schenectady	Enriched Uranium (U/Al Alloy)	6,403.28	gm.
General Electric, Schenectady	Enriched Uranium (U/Al Alloy)	2,184.09	gm.
Tracerlab, Inc.	Normal Uranium Foil	0.41	gm.
University of California	Thorium (Irradiated)	2.6	gm.
University of Rochester	U-233 (UO ₂ (NO ₃) ₂)	0.0012	gm.