14

PACIFIC NORTHWEST LABORATORY
ISOTOPE DEVELOPMENT PROGRAM
QUARTERLY REPORT:

NOVEMBER 1972 - JANUARY 1973

MARCH 1973

Battelle

Pacific Northwest Laboratories
Richland, Washington 99352

Prepared for the U.S. Atomic Energy
Commission under Contract AT(45-1):1830

NOTICE

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, 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.

PACIFIC NORTHWEST LABORATORY
operated by
BATTELLE
for the
U.S. ATOMIC ENERGY COMMISSION
Under Contract AT(45-1)-1830

Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151
Price: Printed Copy \$3.00; Microfiche \$0.95

3 3679 00061 9702

BNWL-1308-13
UC-23
Radioisotope and
Radiation Applications

PACIFIC NORTHWEST LABORATORY
ISOTOPE DEVELOPMENT PROGRAMS
QUARTERLY REPORT: NOVEMBER 1972 - JANUARY 1973

Compiled by J. H. Jarrett

March 1973

BATTELLE
PACIFIC NORTHWEST LABORATORIES
RICHLAND, WASHINGTON 99352

CONTENTS

INTRODUCTION	1
SUMMARY	2
EVALUATION OF LARGE SCALE USES OF PURIFIED FISSION PRODUCT XENON . .	5
STRONTIUM FLUORIDE COMPATIBILITY	6
MEDICAL ISOTOPE GENERATOR	8
BIOMEDICAL SOURCE DEVELOPMENT PROGRAM	10
CIRCULATORY SUPPORT SYSTEMS	12
Dosimetry Studies	12
Radiological Engineering Studies	12
ADVANCED SOURCE DEVELOPMENT PROGRAM	13
NUCLEAR TECHNIQUES FOR SEABED MINERAL EXPLORATION	15
ATLANTIC RICHFIELD HANFORD COMPANY (ARHCO) FISSION PRODUCT ACTIVITIES	18

PACIFIC NORTHWEST LABORATORY
ISOTOPE DEVELOPMENT PROGRAMS
QUARTERLY REPORT: NOVEMBER 1972 - JANUARY 1973

Compiled by J. H. Jarrett

INTRODUCTION

This report, BNWL-1308-13, is the 25th report of a series initiated in 1966 to provide detailed and timely information on the results of the radioisotope applications program and related research being conducted at the Pacific Northwest Laboratory by Battelle-Northwest for the U. S. Atomic Energy Commission. The previous reports of the series are BNWL-385, 466, 570, 680, 681, 781, 877, 924, 1010, 1085, 1177, 1256, and 1308-1 through 1308-12.

This report covers the three-month period, November 1972 through January 1973.

SUMMARY

EVALUATION OF LARGE SCALE USES FOR PURIFIED FISSION PRODUCT XENON

The use of fission product xenon in the sputtering process was successfully demonstrated at Battelle-Northwest. No ^{85}Kr could be detected in a copper deposit thus prepared. The AIRCO purification of fission product xenon for use in radiation detection equipment being developed by the University of California is continuing. Much of the starting material was inadvertently lost and was replaced by atmospheric xenon spiked with ^{85}Kr .

STRONTIUM FLUORIDE COMPATIBILITY

Testing continues on the high purity inert SrF_2 compatibility couples. The 1500-hr tests have been completed and the couples are being evaluated. Testing was started on the compatibility couples prepared using WESF grade $^{90}\text{SrF}_2$.

MEDICAL ISOTOPE GENERATOR

The feasibility of a system to provide ^{13}N for medical uses is being investigated. A device in which ^{13}N is generated via an α, n reaction with ^{10}B in an HBO_2 melt shows promise of technical feasibility. Investigation of user requirements will define the practical feasibility of the complete system.

BIOMEDICAL SOURCE DEVELOPMENT PROGRAM

The highlight of the last quarter was a visit and consultation with Dr. E. D. Thomas of the University of Washington Medical School in Seattle. Dr. Thomas, a leader in transplant immunology, reiterated the need for a blood irradiator for immune suppression in transplants. Work continues on building irradiators fueled with ^{90}Sr - ^{90}Y , ^{147}Pm and ^{170}Tm .

CIRCULATORY SUPPORT SYSTEMS

Parametric computations of dose rates to organ systems and whole body continued, varying the source size and location.

Noncirculatory heat exchangers were designed for abdominal implantation of $^{238}\text{PuO}_2^{16}$ sources in swine.

ADVANCED SOURCE DEVELOPMENT

Six source preparation runs were made with the new $^{241}\text{AmO}_2$ sputtering target. Excellent adherence both between the stainless steel substrate and sputtered americium oxide layer, and between the sputtered americium oxide layer and the sputtered platinum containment layer was demonstrated. Also, the sputtering equipment was operated continuously for 15 hr with the need for only infrequent minor adjustments to maintain near steady-state conditions. The preparation of sources suitable for evaluation by ORNL is planned for the next period.

NUCLEAR TECHNIQUES FOR SEABED MINERAL EXPLORATION

Open ocean tests of the seabed mineral analyzer were successfully completed 5 km off Islamorada, Florida, in water depths to 15 m. These tests showed that all of the components of the seabed mineral analyzer work properly under actual ocean conditions. An additional detector, a 10.2 cm thick by 15.2 cm diameter sodium iodide crystal, was evaluated for its efficiency and resolution versus that of the Ge(Li) diode. The data taken in situ on some 13 elements and manganese nodules indicate that the detector of choice for any underwater survey must be based on the specific job being undertaken--for multiple element analysis, a Ge(Li) detector, and for high efficiency detection of a few noninterfering elements, a NaI(Tl).

ATLANTIC RICHFIELD HANFORD COMPANY (ARHCO) FISSION PRODUCT ACTIVITIES

A study was completed which showed there were no significant problems associated with segregated encapsulation of fuel-grade and non-fuel-grade ⁹⁰Sr in the Waste Encapsulation and Storage Facility (WESF).

Two inert strontium fluoride (Hastelloy C-276) capsules were prepared for qualification testing.

EVALUATION OF LARGE SCALE USES OF PURIFIED FISSION PRODUCT XENON

C. A. Rohrmann

Of all the fission products, Xe has the highest fission yield. Although many of the Xe isotopes are radioactive, they all have such short half-lives that their activity would be insignificant after allowing time for normal fuel reprocessing.

In the past, the extreme rarity of Xe in nature has clearly inhibited its consideration for specific large-scale uses even where its properties give it definite and unique advantages. But now, Xe could be made available in surprisingly large quantities. Perhaps the most important and beneficial use of Xe would be for human surgical anesthesia. Another of the potential uses is as a filler gas in incandescent light bulbs with significant increase in both brightness and efficiency.

The scope of the PNL program is to: (1) establish the quality of Xe which can be accepted or generally licensed for consumer uses, (2) determine what industries would be interested in evaluating fission product Xe for large-scale application, (3) distribute specimens to participating evaluators, (4) compile evaluation results, and (5) prepare a final report on the results of this total effort.

The first demonstration of a potential future large scale use for fission product xenon was completed at Battelle-Northwest. A specimen of the gas was used for vapor phase deposition of a massive metallic copper specimen by the sputtering technique. Although xenon is not considered as the ideal gas for copper, its use was satisfactorily demonstrated. Its specific applicability in deposition of the heavier metals including plutonium was thus assured. An excellent deposit of copper was readily obtained. No radioactivity from residual ^{85}Kr still present in the xenon could be detected in the specimen.

Most of the material being purified at AIRCO for the University of California was lost due to pressure relief malfunctions in the processing equipment. The material is being replaced by AIRCO with ^{85}Kr spiked atmospheric xenon to complete the test of the applicability of commercial facilities for low level ^{85}Kr removal from fission product xenon and at the same time provide U of C with the purified material. U of C is to use the material in an ionization type radiation detection "camera" which is being developed. This material should be delivered to U of C early in the next period.

STRONTIUM FLUORIDE COMPATIBILITY

H. T. Fullam

At Hanford, strontium will be separated from the high level waste, converted to the fluoride, and doubly encapsulated in small high-integrity containers from subsequent long-term storage. The fluoride conversion, encapsulation and storage will take place in the Waste Encapsulation and Storage Facilities (WESF). The encapsulated strontium fluoride represents an economical source of ^{90}Sr if the WESF capsule can be licensed for heat source applications under anticipated use conditions. The objectives of this program are to obtain the data needed to license the $^{90}\text{SrF}_2$ WESF capsules. The information needed for licensing can be divided into three general areas:

- 1. Long-term SrF_2 compatibility data*
- 2. Chemical and physical property data on $^{90}\text{SrF}_2$*
- 3. Capsule property data such as external corrosion resistance, crush strength, etc.*

The current program is designed to provide the required information.

The program plan for FY 1973-74 was reviewed by DAT and returned. The plan has been revised slightly and will be issued as a BNWL-B document. The only major change has been to decrease the 2200-hr compatibility tests to 1500 hr.

Testing of the high purity inert SrF_2 compatibility couples is continuing as scheduled. The 1500-hr tests have been completed, and the couples are now being evaluated. Visual examination of the test specimens indicates very little attack.

Testing has started on the couples prepared using $^{90}\text{SrF}_2$ produced by the WESF flowsheet. The 1500-hr tests will be completed in March and 4400-hr tests in July. The ^{90}Sr feed solution was obtained from ARHCO and converted to the fluoride in three liter batches in the 325-A hot cell. Approximately 1300 g of $^{90}\text{SrF}_2$ were prepared in 18 separate batches. Analysis of the various batches indicates a product purity of >98 wt%. Overall strontium loss during preparation of the $^{90}\text{SrF}_2$ was about 3%. However, most of the loss occurred in just three runs; and for most of the batches, the strontium loss was <1%. The process used to prepare the $^{90}\text{SrF}_2$ was as follows:

1. Three liters of ^{90}Sr solution were taken to pH 9 with 50% NaOH solution.
2. The resulting slurry was filtered through a glass frit filter. The filter cake was washed with 250 ml of dilute NaOH solution.
3. The combined filtrate and wash solutions were heated to 60°C , and a 10% excess of NaF was added to precipitate the $^{90}\text{SrF}_2$.
4. The resulting slurry was digested at 60°C for 1 hr with stirring.
5. The $^{90}\text{SrF}_2$ slurry was filtered through a glass frit filter; and the cake was washed with 1.5 liters of hot ($\sim 60^{\circ}\text{C}$) distilled water.
6. The $^{90}\text{SrF}_2$ was dried on the filter and then transferred to an alumina crucible.
7. The crucible plus $^{90}\text{SrF}_2$ was fired at 1100°C overnight.
8. After cooling, the $^{90}\text{SrF}_2$ was ground in a mortar, weighed, sampled for analysis, and transferred to a storage container.
9. The filter cake from the hydroxide precipitation was dissolved in 2M nitric acid and the solution sampled for Sr analysis.
10. The filtrate and wash solution from the $^{90}\text{SrF}_2$ filtration step were combined and sampled for strontium analysis.
11. The various batches of $^{90}\text{SrF}_2$ were combined, blended, and sampled for analysis.

The test couples were fabricated in the 325-A hot cell. The procedure used was similar to that used in preparing the high purity inert SrF_2 couples, except an inert atmosphere was not used in the loading and welding operations. Testing of the $^{90}\text{SrF}_2$ couples is being conducted in a 324 building hot cell.

Efforts are now under way to prepare a high purity $^{90}\text{SrF}_2$. Ion exchange is being used to purify the ^{90}Sr solution obtained from ARHCO. Once the strontium is purified it will be converted to SrF_2 by NaF addition. The hardware required for the high purity $^{90}\text{SrF}_2$ couples has been fabricated, and couple preparation will begin as soon as the $^{90}\text{SrF}_2$ is prepared.

MEDICAL ISOTOPE GENERATOR

J. W. Bartlett and J. H. Jarrett

Medical diagnostics and research frequently use isotopes. Availability of isotopes is limited, however, by the supply system, i.e., isotope half-lives must be long enough to survive relatively long delays between generation and use.

The objective of this program is to investigate the technical and economic feasibility of an isotope generator that could be installed in a facility such as a hospital and thereby supply short-lived isotopes for immediate use. Availability of such a device could open new areas of isotopes-using diagnostics, eliminate unwanted aftereffects from long-lived isotopes, and reduce radioactive waste disposal problems.

Major emphasis has been placed on development of a generator to produce ^{13}N . Such a device could use previously developed technology for α -generated isotopes.

Major effort on this program was started during the report period. Initial investigations centered on determination of which short-lived isotopes might be generated via α -n and α -p reactions in quantities sufficient for practical use. Calculations for the 50 reactions and products considered showed that only ^{13}N , generated via α ,n reaction with ^{10}B , could be produced with sufficient yield. These calculations were then extended to include short-lived nuclides that might be produced via n, γ reactions (e.g., with a ^{252}Cf neutron source). Thirty-six reactions of this type were considered; ^{56}Mn , ^{60}mCo , and ^{108}Ag were found to be generated in quantities significantly above the others.

Factors involved in getting ^{13}N out of a generator were then studied. Free energy calculations showed that formation of B^{13}N would be favored for a source geometry involving a ^{10}B layer deposited on the α source. Also, the rate of generation of ^{13}N molecules would be low, 2×10^5 molecules/cm². This is several orders of magnitude less than the normal density of adsorbed gas on a vacuum system wall.

These results indicate that the solid-surface type of generator would be difficult to make practical. In contrast, however, free energy calculations for ^{13}N formation from a melt (236°C) of HBO_2 suggest that B^{13}N is not

avored in this system. Also, diffusion of the ^{13}N out of the matrix would be faster than from the solids. However, the presence of oxygen and hydrogen will reduce the α flux available for ^{13}N formation. Calculations to determine the effects of these diluents are still in progress.

The feasibility and design of an engineered ^{13}N generator for medical applications can be strongly affected by user requirements. Since the half-life of ^{13}N is only 10 minutes, all operations involved in one-time uses would have to be completed in time spans on the order of half an hour; alternatively, steady-state production of ^{13}N from the generator will have to be high enough and coupled directly to the application to make longer-term use practical. Thus, even though production of ^{13}N may be technically feasible, development of a practical generator will require attention to the total system of application.

BIOMEDICAL SOURCE DEVELOPMENT PROGRAM

B. I. Griffin, F. P. Hungate, J. H. Jarrett and F. T. Cross

The objective of this program is to design and fabricate portable sources for blood irradiation in support of an ongoing AEC-DBER program (Dr. F. P. Hungate, PNL, Principal Investigator) to evaluate extracorporeal blood irradiation. Close liaison is being maintained with AEC-DBER staff and members of the medical community to assure optimum program responsiveness to source development needs.

The highlight of this past quarter was the visit of Dr. E. Donnall Thomas, Professor and Head of the Division of Oncology at the University of Washington Medical School in Seattle. Dr. Thomas is a pioneer in ECBI (Extra Corporeal Blood Irradiation) for the treatment of chronic lymphocytic leukemia. His current interests are in the treatment of acute myeloblastic leukemia and aplastic anemia using irradiation as a key immuno-suppressive technique prior to bone marrow transplants. Dr. Thomas pointed out that much money has been spent on the development of blood irradiators yet the need still exists today for an irradiator. Probably the reason is that the medical protocol to be followed in the use of an irradiator has been in a continual state of flux. The University of Washington, Drs. Scribner, Marchioro and Thomas, and Dr. Hume at the University of Virginia are in need of blood irradiators for further experimental medicine work in the area of suppression of the immune response in kidney transplants.

The problems to be solved are not ones of fundamental research and development but rather are ones of putting together bits and pieces of separate technologies in a synergistic manner; that is, so that the sum will accomplish the desired goals that neither the medical community nor engineers would accomplish separately.

At present we are designing and plan to fabricate and test a ^{90}Sr - ^{90}Y irradiator which, if not portable, will be easily transportable. Such a device obviates many difficult, but soluble, materials problems and short cuts long lead times for isotopes such as ^{170}Tm and ^{204}Tl which appear to be

the favored isotopes in the trade-off between irradiation of the blood to the desired level and shieldability from a safety viewpoint. Both ^{204}Tl and ^{170}Tm have lead times for acquisition that exceeds the time left in the fiscal year. The work on a ^{147}Pm irradiator will be carried on concurrently.

The design of the ^{90}Sr - ^{90}Y irradiator will follow the work of Slatkin and Robertson⁽¹⁾ using the computer code BETBLUD and ISOSHLI-II. The source strength will be on the order of 1 Ci. External dose rates will be <50 mrem/hr on the surface of the irradiator; transit dose rates will be 50 to 100 rads for a flow rate of 100 ml/min and tube diameter of 0.25 cm. The total weight of the irradiator will be on the order of 4 lbs. Shielding materials will be Hevimet - a machinable tungsten alloy. The surface over which the blood flows will be silastic.

The goal for testing such a device includes both dogs and primates (baboons) with the ultimate goal of humans. Other radionuclides such as ^{170}Tm and ^{204}Tl will be considered for longer-term development efforts. Ultimately, one or the other will be used in a near-optimum portable irradiator.

REFERENCE

D. N. Slatkin and J. S. Robertson, "Extracorporeal Irradiation of Blood by Beta-Emitting Isotopes: Principles of Dose Calculations," Radiation Research, vol. 44, pp. 846-854, 1970.

CIRCULATORY SUPPORT SYSTEMS

F. T. Cross and B. A. Crea

The main objective of this program is to determine the dose from radioisotopic heat sources suitable for circulatory support systems. This is accomplished by measuring the dose rates within and surrounding various tissue equivalent phantoms.

Part of the program concerns the prediction of the measured dose rates by the development of computational codes. The computer codes are also used in parametric studies and for the prediction of the in-phantom dose rates from sources not available for measurement.

Another part of the program concerns the development of radioisotopic source holders for use in an animal study aimed at assessing the combined effects of heat and radiation in Hanford miniature swine implanted with 50 W plutonium heat sources.

DOSIMETRY STUDIES

Parametric computations of dose rates to organ systems and whole body were continued varying the source location and physical size.

RADIOLOGICAL ENGINEERING STUDIES

The design of noncirculatory heat exchangers for abdominal implantation of $^{238}\text{PuO}_2^{16}$ sources continued. Preliminary drawings of heat exchangers for dissipating heat directly to surrounding tissue utilizing both spherical and oblate spheroid geometry were prepared.

In addition, fabrication of two circulatory radioisotopic source holders containing telemetry systems was completed for thoracic implants in swine in early February. One source holder will contain a 50 W $^{238}\text{PuO}_2^{16}$ source while the other will act as a sham in a control animal.

ADVANCED SOURCE DEVELOPMENT PROGRAM

W. F. Riemath and J. H. Jarrett

The objective of this program is to evaluate present and future heat and radiation source application requirements and to relate them to present and future encapsulation technology.

The goal of the current work is concerned primarily with the development of thin-film encapsulation and evaluation techniques for alpha-photon sources. Emphasis will be directed toward the technique of sputtering as a means to obtain thin films of radioisotope and containment materials.

In source preparation runs performed late in the previous period, poor adherence was observed between the sputtered americium oxide layer and the sputtered platinum containment layer. This problem was solved during the present report period by depositing the platinum layer on heated, americium oxide coated substrates. The heating was accomplished by sputter-etching the coated substrates which had been placed on ceramic chips to minimize conductive heat transfer to the water-cooled base plate. Ultimately, a resistively heated substrate plate should be used for source preparation. This would offer more precise temperature control, and would eliminate removal of a significant amount of the sputtered americium oxide layer during substrate heating by sputter-etching.

Six source preparation runs were made during the report period. In addition to preparing sources having well adhering sputtered platinum containment layers, the continuous operation of the glove box sputtering system for 15 hr while depositing americium oxide was demonstrated in two runs. The equipment was left operating unattended for a period of over 8 hr without incident.

During these longer-term americium oxide deposition runs discrete particles were observed on the substrate. The particles were found to be unattached to the sputtered americium oxide layer. The origin of these

particles is presently being investigated. Their presence is unacceptable for high integrity thin-film (alpha) radiation sources as the thin sputtered platinum containment layer is unable to provide particle containment. The resulting radiation sources easily develop "pin hole" size leaks at particle locations.

Sources suitable for evaluation at ORNL will be prepared early in the next period. Stainless-steel substrates will be used. The sources will have a sputtered americium oxide layer and a sputtered platinum containment layer.

NUCLEAR TECHNIQUES FOR SEABED MINERAL EXPLORATION

N. A. Wogman, H. G. Rieck, Jr., H. L. Nielson, J. R. Kosorok
and R. W. Perkins

In recent PNL studies of the composition of deep ocean sediments, it has been demonstrated that various mineral deposits and commercial-grade ores can readily be identified by neutron activation and instrumental analysis. From preliminary analysis, it is evident that the elemental composition of most mineral deposits can be easily identified at concentrations well below those of economic importance. In-place experience with ^{252}Cf as a neutron source has confirmed these conclusions. Two methods for in-place seabed mineral exploration are being investigated. The first involves placing a neutron source and detector system on the ocean floor. The second method involves bringing the samples on-board ship and employs a shipboard ^{252}Cf irradiator and a $\text{Ge}(\text{Li})$ spectrometer. The former technique has the advantage of very rapid analyses, and the latter technique has the advantage that mineral depth profiles can be defined from core sampling. Primary emphasis of the program is presently directed toward the design, construction, and the laboratory and sea floor calibration of the in-place seabed nuclear probe.

During the latter part of November and early December, the in situ nuclear probe underwent a series of rigorous ocean tests off the Florida Keys near Islamorada, Florida. The purpose of these tests was: 1) to evaluate the probe for in situ analysis of specific minerals peculiar to the Florida Keys, 2) to calibrate the probe in situ with samples of known elemental composition, and 3) to rigorously evaluate the mechanical and electrical operation of the probe in the marine environment. In addition to the main objectives of the AEC program, this work also included studies for NSF and private work for International Nutronics, Inc. The tests included 8 days of shipboard operation during which detection capabilities of the probe were determined.

For these studies, the Nuclear Data computer components were located in the forward hatch of a 15 m long vessel. The 0.2 mg ^{252}Cf neutron source was stored aft in a 900 kg shipping cask. During the 2-min transfer period of the neutron source from the cask to the probe, precautions were

taken to limit crew dose rates to less than 5 mrem/hr. Radiation exposure to AEC contractor personnel from handling the ^{252}Cf source was minimal. The maximum exposure to one individual was 60 mrem for 11 days of operation. Daily manipulation of the source by this individual was responsible for the exposure. The highest exposure to personnel not involved with direct handling of the source was 6 mrem for the entire experimental period. During the field testing of the nuclear probe, several calibration studies were made, in addition to the actual in situ assay of the sea floor which was conducted at approximately 40 locations.

All the data for these calibrations were recorded on magnetic tape and have since been analyzed in the laboratory.

The in situ testing and analyses of the Florida minerals, manganese nodules and calibration elements were conducted at locations ranging out to 5 km from the Florida coast and to depths of about 15 m.

Three days of operation were devoted to assay of synthetic samples for calibration purposes. These samples, containing Ag, Cu, In, Ti, Dy, Co, Mn, V, W, Au, Mo, Al and Mg were added to CaCO_3 shell material or dunite sand. The synthetic mineral samples used in the tests were prepared by mixing 1-liter solutions of known elemental concentrations with the dunite or local shell material in plastic containers 30 cm in diameter by 10 cm thick. The total weight of each sample was approximately 8 kg. Simulated manganese nodule beds were prepared in a similar manner by placing nodules on top of the sediment materials in these plastic containers. These standards and nodules were then positioned by scuba divers and analyzed by the nuclear probe. Measurements were made with both the 15% efficient Ge(Li) detector and with the 10.2 cm thick by 15.2 cm diameter sodium iodide detector. These measurements have provided the essential calibration data necessary for calculating the concentrations of the various elements in sea floor material from the observed gamma rays spectra. For all of these measurements, irradiation decay and counting periods of 30 to 120 sec were used, and the irradiation source was 0.2 mg of ^{252}Cf . The photopeak with the sodium iodide detector was approximately 20 to 40 times that of the Ge(Li) diode, but its inferior resolution

limits its use for many applications. The efficiencies for the in situ detection of the various elements were found to be in good agreement with those observed in laboratory simulation studies; however, the difficulty of precise laboratory simulation warrants sea floor calibrations where precise measurements are desired.

During these sea trials several minor shortcomings in the probe design, including both electronic and mechanical problems, were encountered. The more serious of these involved the failure of underwater connectors and the reliability of the source detector rotating mechanism. These shortcomings are currently being corrected.

ATLANTIC RICHFIELD HANFORD COMPANY (ARHCO) FISSION PRODUCT ACTIVITIES

G. E. Benedict

The Atlantic Richfield Hanford Company (ARHCO) is presently recovering fission products, ^{90}Sr and ^{137}Cs , in the Waste Processing Facility (B Plant) for later encapsulation as SrF_2 and CsCl in the Waste Encapsulation and Storage Facility (WESF). These operations are under contract to the Atomic Energy Commission's Division of Production and Materials Management. ARHCO also has some engineering effort supported by the Division of Applied Technology (DAT) to provide current and projected information on the ^{90}Sr and ^{137}Cs production capabilities and product quality and availability. ARHCO has liaison responsibilities with Pacific Northwest Laboratory (PNL) and DAT to provide information which will aid possible licensing and commercial use of the $^{90}\text{SrF}_2$ capsules to be produced in WESF.

A study was completed on the economic, as well as operational and safety, factors involved in encapsulating the non-fuel-grade strontium first followed by separate encapsulation of the fuel-grade material. No significant problems were found in implementation of this segregated encapsulation and capsule storage. The segregated operating mode is presumed to be desirable and the production schedule is planned accordingly with WESF starting up on non-fuel-grade strontium. No fuel-grade capsules will be produced prior to FY 1976 unless it is deemed necessary for equipment testing.

Two inert strontium fluoride (Hastelloy C-276) prototype capsules were fabricated and shipped for use in qualification tests. Return of the capsules after completion of the test was requested. By that time, the development effort on ultrasonic testing of Hastelloy C-276 welds will be complete and an evaluation of whether the prototype capsules were typical of planned-production capsules can be made.

Preparation of the annual report outlining ARHCO fission product activities is nearing completion. The document entitled, "Atlantic Richfield Hanford Company - Fission Product Activities Report," authored by R. Y. Lyon will be issued as ARH-2613. Information will be current as of November 1, 1972.

DISTRIBUTION

No. of
Copies

OFFSITE

1	<u>AEC Chicago Patent Group</u> G. H. Lee
10	<u>AEC Division of Applied Technology</u> D. S. Ballantine R. L. Butenhoff D. W. Cole F. D. Haines W. S. Holman J. E. Machurek J. N. Maddox L. A. Miller W. E. Mott R. W. Shivers
1	<u>AEC Division of Biomedical and Environmental Research</u> J. D. Goldstein
2	<u>AEC Division of Production and Materials Management</u> R. K. Heusser W. L. Lennemann
1	<u>AEC Division of Reactor Development and Technology</u> W. D. Holloman
10	<u>AEC Division of Space Nuclear Systems</u> R. T. Carpenter G. P. Dix D. S. Gabriel M. J. Gaitanis J. S. Griffo N. Goldenberg W. K. Kern A. P. Litman G. A. Newby F. C. Schwenk

No. of
Copies

1	<u>AEC Dayton Area Office</u> D. D. Davis
2	<u>AEC Oak Ridge Operations Office</u> J. H. Kahn C. Davis, Jr.
1	<u>AEC Sandia Area Office</u>
1	<u>AEC Savannah River Operations Office</u> W. D. Sandberg
192	<u>AEC Technical Information Center</u>
1	<u>Aerospace Corporation, Los Angeles (AF)</u>
1	<u>Airesearch Manufacturing Company, Los Angeles</u>
2	<u>Air Force Aeronautical Systems Division</u>
1	<u>Army Reactors Field Group</u>
1	<u>Aro, Inc. (AF)</u>
1	<u>Bellcomm, Incorporated (NASA)</u>
1	<u>Bendix Corporation (NASA)</u>
3	<u>Brookhaven National Laboratory</u> J. Cusack B. Manowitz L. G. Stang, Jr.
1	<u>Central Intelligence Agency</u>
2	<u>Douglas Aircraft Corporation, MSSD (AF)</u>
1	<u>Dow Chemical Company, Rocky Flats Division (Golden)</u> T. Drouillard
1	<u>General Dynamics, Fort Worth (AF)</u>
1	<u>General Electric Company (AEC) (NASA)</u>

No. of
Copies

1	<u>General Electric Company, MSVD; Cincinnati</u> M. Bromberg
1	<u>General Electric Company, MSVD; Valley Forge</u> P. E. Brown
1	<u>General Electric Company, Vallecitos Laboratory</u> J. F. Jaklevick
1	<u>Grumman Aircraft Engineering Corporation (NASA)</u>
2	<u>Hughes Aircraft Company, Aerospace Group,</u> Culver City, California F. N. Magee K. W. Cowans
1	<u>Los Alamos Scientific Laboratory</u> University of California Los Alamos, New Mexico H. A. O'Brien, Jr.
1	<u>Massachusetts Institute of Technology, (Rasmussen) (AEC)</u>
1	<u>Massachusetts Institute of Technology, (Lexington) (AF)</u>
2	<u>Mound Laboratory (AEC)</u> W. T. Cave R. K. Flitcraft
1	<u>NASA Ames Research Center</u>
4	<u>NASA Goddard Space Flight Center</u> W. C. Isley (1)
1	<u>NASA Langley Research Center</u>
1	<u>NASA Lewis Research Center, Cleveland</u> Lloyd Shure
1	<u>Laboratory of Nuclear Medicine and Radiation Biology</u> UCLA 900 Veteran Avenue Los Angeles, CA 90024 K. L. Swinth

No. of
Copies

2	<u>NASA Manned Spacecraft Center</u> Tony E. Redding (1)
1	<u>NASA Marshall Space Flight Center</u>
2	<u>NASA, Washington</u>
4	<u>National Reactor Testing Station</u> Aerojet Nuclear Company P.O. Box 1845 Idaho Falls, Idaho R. J. Gehrke
1	<u>Navy, Nuclear Power Division (Washington)</u> Graham Haigie (NAVFAC)
1	<u>Navy Air Systems Command</u>
2	<u>Naval Facilities Engineering Command</u> L. Derderian T. P. Fleming
1	<u>Navy Office of the Chief of Naval Operations</u>
3	<u>Navy Ordnance Systems Command</u>
1	<u>Navy Ship Systems Command Headquarters</u>
1	<u>Navy Space Systems Activity</u>
1	<u>Nuclear Materials and Equipment Corporation (AEC)</u> C. S. Caldwell
2	<u>Oak Ridge National Laboratory (AEC)</u> J. H. Gillette A. F. Rupp
1	<u>Radio Corporation of America (AEC)</u>
1	<u>Rand Corporation (AF)</u>
1	<u>Savannah River Laboratory</u> Aiken, South Carolina D. H. Turno

No. of
Copies

- 1 Sanders Nuclear Corp., Nashua, N.H.
 Douglas Harvey
- 1 TRW Space Technology Labs, Redondo Beach, California
 W. M. Bowes
- 1 Westinghouse Electric Corporation, Lima (NASA)
- 1 Wright-Patterson AFB, Dayton, Ohio
 Capt. D. C. De Pree

ONSITE

- 1 AEC Chicago Patent Group
 R. M. Poteat
- 2 AEC Richland Operations Office
 W. E. Lotz
 Attn: B. J. Melton
 H. A. House
- 9 Atlantic Richfield Hanford Company
 G. E. Benedict
 G. L. Borsheim
 H. H. Hopkins
 G. A. Nicholson
 G. C. Oberg
 A. E. Smith
 P. W. Smith
 M. J. Szulinski
 ARHCO Files
- 5 Donald W. Douglas Laboratories
 M. Lewis
 D. E. Knapp
 W. E. Matheson
 E. E. Warner
 Files
- 1 Douglas United Nuclear
 J. W. Riches

No. of
Copies

46

Battelle-Northwest

J. W. Bartlett
R. E. Burns
T. D. Chikalla
D. L. Condotta
F. T. Cross
G. G. Culver
G. J. Dau
D. C. Deonigi
K. Drumheller
P. L. Farnsworth
J. W. Finnigan
H. T. Fullam
J. J. Fuquay
M. F. Gillis
B. I. Griffin
A. J. Haverfield
F. P. Hungate
J. H. Jarrett (4)
R. S. Kemper
R. W. McKee
E. T. Merrill
J. E. Minor
I. C. Nelson
L. L. Nichols
J. M. Nielsen
R. E. Nightingale
R. W. Perkins
A. M. Platt
W. F. Riemath
F. P. Roberts
C. A. Rohrman
J. R. Sletager
H. H. Van Tuijl
P. C. Walkup
E. J. Wheelwright
N. A. Wogman
C. L. Wood
Technical Information Files (5)
Technical Publications