**Quarterly Report on the
Strontium Heat Source
Development Program, Advanced
Nuclear Systems and
Projects Division for
October-December 1979**

H. T. Fullam

January 1980

**Prepared for the U.S. Department of Energy
under Contract EY-76-C-06-1830**

**Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute**

NOTICE

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

The views, opinions and conclusions contained in this report are those of the contractor and do not necessarily represent those of the United States Government or the United States Department of Energy.

PACIFIC NORTHWEST LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
Under Contract EY-76-C-06-1830

Printed in the United States of America
Available from

National Technical Information Service
United States Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151

Price: Printed Copy \$____*; Microfiche \$3.00

*Pages	NTIS Selling Price
001-025	\$4.00
026-050	\$4.50
051-075	\$5.25
076-100	\$6.00
101-125	\$6.50
126-150	\$7.25
151-175	\$8.00
176-200	\$9.00
201-225	\$9.25
226-250	\$9.50
251-275	\$10.75
276-300	\$11.00

QUARTERLY REPORT ON THE STRONTIUM HEAT
SOURCE DEVELOPMENT PROGRAM, ADVANCED
NUCLEAR SYSTEMS AND PROJECTS DIVISION
FOR OCTOBER-DECEMBER 1979

H. T. Fullam

January 1980

Prepared for
the U.S. Department of Energy
under Contract EY-76-C-06-1830

Pacific Northwest Laboratory
Richland, Washington 99352

SUMMARY

The 30,000-h compatibility tests with $^{90}\text{SrF}_2$ were completed, and the test capsules were shipped to Oak Ridge National Laboratory for sectioning and metallographic examination.

The 23 Hastelloy S and Hastelloy C-4 prototype outer capsules to be used in the qualification tests were radiographed and helium leak-checked. None of the capsules leaked, but radiographs of the capsule welds showed that weld penetration was only 50 to 70% of the desired amount. It has been decided to reweld the five capsules to be used for the impact (drop) test; the other capsules will be tested without being rewelded.

Some prototype outer capsules will be qualification tested in the as-fabricated condition, while others will be tested after aging for 8000 h at 650°C and 725°C .

CONTENTS

SUMMARY	ii
STRONTIUM HEAT SOURCE DEVELOPMENT PROGRAM	1
TASK 1 - CHEMICAL AND PHYSICAL PROPERTIES OF $^{90}\text{SrF}_2$	1
TASK 2 - $^{90}\text{SrF}_2$ COMPATIBILITY STUDIES.	1
TASK 3 - CAPSULE QUALIFICATION AND LICENSING	1
Capsule Fabrication	1
Capsule Testing Program	3

STRONTIUM HEAT SOURCE DEVELOPMENT PROGRAM

H. H. Van Tuyl, Program Manager
H. T. Fullam, Principal Investigator
D. G. Atteridge
F. A. Simonen

At Hanford, strontium is separated from the high-level waste, converted to the fluoride, and doubly encapsulated in small, high-integrity containers for subsequent long-term storage. The fluoride conversion, encapsulation, and storage 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 $^{90}\text{SrF}_2$ heat sources and specifically the WESF $^{90}\text{SrF}_2$ capsules. The information needed for licensing can be divided into three general task areas:

Task 1 - Chemical and Physical Properties of $^{90}\text{SrF}_2$

Task 2 - $^{90}\text{SrF}_2$ Compatibility Studies

Task 3 - Capsule Qualification and Licensing.

Efforts are proceeding concurrently on all three tasks to obtain the required information.

TASK 1 - CHEMICAL AND PHYSICAL PROPERTIES OF $^{90}\text{SrF}_2$ (H. T. Fullam)

Work has been restarted on evaluating the consequences of the rupture of a $^{90}\text{SrF}_2$ heat source capsule in the ocean. Recent developments in the modeling of ocean diffusion are being investigated. Selection of the model to be used will be made in January. At present it appears that a Pacific Northwest Laboratory modification of the Okubo and Pritchard three-dimensional model will be used.

TASK 2 - $^{90}\text{SrF}_2$ COMPATIBILITY STUDIES (H. T. Fullam)

The 30,000-h tests with $^{90}\text{SrF}_2$ were completed in October. The test capsules were shipped to Oak Ridge National Laboratory for sectioning and metallographic analysis of the metal specimens. Sectioning of the capsules is scheduled for January. These represent the last of the scheduled $^{90}\text{SrF}_2$ compatibility tests.

Oak Ridge has completed metallographic examination of the Hastelloy C-276 specimens from the WESF $^{90}\text{SrF}_2$ storage capsule that was held at 800°C for three years. The micrographs obtained are now being printed. The results will be reported when the micrograph prints are received from Oak Ridge National Laboratory.

TASK 3 - CAPSULE QUALIFICATION AND LICENSING

Capsule Fabrication

A total of 16 Hastelloy S and 7 Hastelloy C-4 prototype outer capsules were fabricated for use in the qualification testing program. Five of the capsules (3 Hastelloy S and 2 Hastelloy C-4) to be used for the impact test (30-ft drop) contained Hastelloy C-276 inner capsules filled with nonradioactive SrF_2 . Figure 1 shows typical inner and outer prototype capsules.

FIGURE 1. Prototype Inner and Outer Capsules for the $^{90}\text{SrF}_2$ Heat Source

The prototype capsules were helium leak-checked at a sensitivity of 10^{-9} cc/sec, and no problems were encountered. The capsule welds were radiographed, and it was found that in most instances the weld penetration was only 50 to 70% of the desired depth. The depth of penetration appears adequate for all of the capsule tests except for the capsules that are to be impact tested. It was decided to reweld the five capsules that are to be used for the impact tests, and to test the other 18 capsules without rewelding them.

Capsule Testing Program

The quality assurance plan for the capsule qualification testing program was reviewed and approved by Advanced Nuclear Systems and Projects Division and Pacific Northwest Laboratory Management.

Some of the prototype capsules will be qualification tested in the as-fabricated condition. The remaining capsules will be tested after thermal aging for 8000 h at 650°C and 725°C. Tensile and Charpy V notch specimens fabricated from the same lots of bar stock that were used in fabricating the prototype outer capsules will also be aged at 650°C and 725°C in vacuum. The specimens will be aged for various times up to 8000 h, then tested at room temperature to monitor the effects of thermal aging on the properties of the Hastelloy S and Hastelloy C-4 capsules.

DISTRIBUTION

<u>No. of Copies</u>		<u>No. of Copies</u>	
	<u>OFFSITE</u>		
	A. A. Churm DOE Patent Division 9800 S. Cass Avenue Argonne, IL 60439		D. C. Davis, Jr. DOE Oak Ridge Operations Office P.O. Box E Oak Ridge, TN 37830
	N. Goldenberg DOE Advanced Nuclear Systems and Projects Division Washington, DC 20545		W. T. Goldston DOE Savannah River Operations Office P.O. Box A Aiken, SC 29801
	T. J. Dobry, Jr. DOE Advanced Nuclear Systems and Projects Division Washington, DC 20545	27	DOE Technical Information Center
	T. J. Holleman DOE Advanced Nuclear Systems and Projects Division Washington, DC 20545		L. J. Jardine Argonne National Laboratory 9700 South Cass Avenue Argonne, IL 60439
	A. P. Litman DOE Advanced Nuclear Systems and Projects Division Washington, DC 20545		W. R. Pardue Battelle Columbus Laboratories 505 King Avenue Columbus, OH 43201
	J. J. Lombardo DOE Advanced Nuclear Systems and Projects Division Washington, DC 20545		R. T. Huntton E. I. duPont deNemours and Company Savannah River Laboratory Aiken, SC 29801
3	W. C. Remini DOE Advanced Nuclear Systems and Projects Division Washington, DC 20545		E. H. Cooke-Yarborough Electronics and Applied Physics Division Building 347.3, AERE Harwell Oxfordshire OX11 0RA GREAT BRITAIN
	B. J. Rock DOE Advanced Nuclear Systems and Projects Division Washington, DC 20545		H. C. Carney General Atomic Company P.O. Box 81601 San Diego, CA 92138
	N. R. Thielke DOE Advanced Nuclear Systems and Projects Division Washington, DC 20545		S. E. Bronisz Los Alamos Scientific Laboratory P.O. Box 1663 Los Alamos, NM 87544
	J. M. Maddox DOE E201 Washington, DC 20545		R. A. Kent Los Alamos Scientific Laboratory P.O. Box 1663 Los Alamos, NM 87544
	C. A. Cooley DOE Waste Management Division Washington, DC 20545		R. N. R. Mulford Los Alamos Scientific Laboratory P.O. Box 1663 Los Alamos, NM 87544

No. of
Copies

W. T. Cave
Monsanto Research Corporation
Mount Laboratory (DOE)
Nuclear Operations
P.O. Box 32
Miamisburg, OH 45342

R. Dewitt
Monsanto Research Corporation
Mount Laboratory (DOE)
Nuclear Operations
P.O. Box 32
Miamisburg, OH 45342

Department of the Army
Headquarters, U.S. Army
Facilities Engineering Support Agency
Ford Belvoir, VA 22060
H. H. Musselman, Tech. Dir.

Officer in Charge
Lt. J. H. Vogt
Naval Nuclear Power Unit
Code 70
Port Hueneme, CA 93043

2 A. A. Arcuni
Naval Facilities Engineering Command
Office of Special Assistant -
Nuclear Programs (04N)
200 Stovall Street
Alexandria, VA 22332

R. S. Crouse
Oak Ridge National Laboratory
Oak Ridge, TN 37830

K. W. Haff
Oak Ridge National Laboratory
Oak Ridge, TN 37830

J. Hammond
Oak Ridge National Laboratory
Oak Ridge, TN 37830

J. R. Keiser
Oak Ridge National Laboratory
Oak Ridge, TN 37830

E. Lamb
Oak Ridge National Laboratory
Oak Ridge, TN 37830

A. C. Schaffhauser
Oak Ridge National Laboratory
Oak Ridge, TN 37830

P. Dick
Teledyne Energy Systems
110 W. Timonium Road
Timonium, MD 21093

No. of
Copies

R. Hannah
Teledyne Energy Systems
110 W. Timonium Road
Timonium, MD 21093

W. A. McDonald
Teledyne Energy Systems
110 W. Timonium Road
Timonium, MD 21093

P. Vogelberger
Teledyne Energy Systems
110 W. Timonium Road
Timonium, MD 21093

C. C. Silverstein
Westinghouse Astronuclear Laboratory
P.O. Box 10864
Pittsburgh, PA 15236

ONSITE

4 DOE Richland Operations
W. A. Burns
D. Bogon
R. E. Gerton
H. E. Ransom

8 Rockwell Hanford Operations
L. I. Brecke
H. H. Hopkins
J. D. Kaser
E. J. Kosiancic
T. H. May
D. Ramey
J. P. Sloughter
C. R. Stroup

21 Pacific Northwest Laboratory
D. G. Atteridge
S. D. Dahlgren
H. T. Fullam (3)
M. H. Henry (2)
R. E. Nightingale
N. J. Olson
L. D. Perrigo
A. M. Platt
W. E. Sande
F. A. Simonen
H. H. Van Tuyl
Technical Files (5)
Publishing Coordination (2)