14

BNWL-1845-30
UC-23

Pacific Northwest Laboratory Monthly Report on the Strontium Heat Source Development Program, Division of Nuclear Research and Applications, for November, 1976

H. T. Fullam

December 1976

Prepared for the Energy Research and Development Administration under Contract E(45-1)-1830

Battelle
Pacific Northwest Laboratories

BNWL-1845-30

NOTICE

PACIFIC NORTHWEST LABORATORY
operated by
BATTELLE
for the
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
Under Contract EY-76-C-06-1830

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 $_____*; Microfiche $3.00

*Pages	NTIS Selling Price
001-025	$4.50
026-050	$5.00
051-075	$5.50
076-100	$6.00
101-125	$6.50
126-150	$7.00
151-175	$7.75
176-200	$8.50
201-225	$8.75
226-250	$9.00
251-275	$10.00
276-300	$10.25

ERDA-RL RICHLAND, WA

BNWL-1845-30
UC-23

PACIFIC NORTHWEST LABORATORY MONTHLY REPORT ON THE STRONTIUM HEAT SOURCE DEVELOPMENT PROGRAM, DIVISION OF NUCLEAR RESEARCH AND APPLICATIONS FOR NOVEMBER 1976

H. T. Fullam

December 1976

BATTELLE
Pacific Northwest Laboratories
Richland, Washington 99352

CONTENTS

STRONTIUM HEAT SOURCE DEVELOPMENT PROGRAM

J. H. Jarrett, Program Manager
H. T. Fullam, Principal Investigator
D. G. Atteridge

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 $^{90}SrF_2$ heat sources and specifically the WESF $^{90}SrF_2$ capsules. The information needed for licensing can be divided into three general task areas:

Task 1 - Chemical and Physical Properties of $^{90}SrF_2$
Task 2 - $^{90}SrF_2$ 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 $^{90}SrF_2$

No activity

TASK 2 - $^{90}SrF_2$ COMPATIBILITY STUDIES

Long-Term Compatibility Tests

All of the long-term compatibility tests are continuing on schedule. Metallographic examination and electron microprobe analysis of the 1000 hr tests with $^{90}SrF_2$ and the 6000 hr tests with nonradioactive SrF_2 should be completed by the end of December.

Testing of Full-Size $^{90}SrF_2$ Capsules

ARHCO began sectioning the WESF $^{90}SrF_2$ capsule which had been held at 800°C for 5000 hr. However, after the outer capsule had been removed the power saw which was being used to section the capsule failed. Sectioning of the inner capsule will be delayed until a new saw is obtained.

Thermal Gradient Test

The thermal gradient test, using the Hastelloy C-276 capsule filled with nonradioactive SrF_2, has been completed. The capsule has been sectioned. Visual examination of the SrF_2 in the capsule showed a variation in the color of the SrF_2 along the length of the capsule; but there was no indication of the formation of a liquid phase anywhere in the capsule. The SrF_2 from various locations in the capsule will be analyzed to see if migration of impurities has resulted due to the thermal gradient.

Supplemental Short-Term Compatibility Tests

Metallographic examination of the bulk of the 4400 hr test specimens has been completed. Estimates of metal attack based on the photomicrographs are given in Table 1. A detailed discussion of the metal attack will be provided when all the test results are available.

TASK 3 - CAPSULE QUALIFICATION AND LICENSING

Program Plan

DNRA completed their review of the program plan for Task 3. The program plan is now being revised to incorporate DRNA comments, and the final version of the program plan will be issued in December.

Capsule Material Selection

The tests to evaluate the seawater corrosion resistance and oxidation resistance of thermally-aged specimens of Hastelloy C-4 and Hastelloy S are continuing. Preliminary results indicate that thermal aging of test specimens at temperatures of 600 to 900°C for 1000 hr has very little effect on the oxidation resistance and seawater corrosion resistance of the two alloys as compared to their solution heat treated condition.

D. G. Atteridge attended a meeting of the Superalloy Working Group at Cabot Corporation in Kokomo, Indiana in November. At the meeting it was learned that Cabot Corporation has available some small test specimens of Hastelloy C-4 and Hastelloy S which have been aged at various temperatures

for up to 16,000 hr. It was proposed that PNL obtain these test pieces from Cabot and prepare subsize tensile specimens from them for high temperature tensile tests. Arrangements are now underway to obtain the material.

TABLE 1. Estimated Attack of Test Specimens Exposed to Nonradioactive SrF_2 at 800°C

Material	Depth of Metal Affected,[a] mils			
	1500 hours		4400 Hours	
	Chemical Attack	Change in Microstructure	Chemical Attack	Change in Microstructure
Hastelloy C-276[b]	3	7	3	5
Haynes Alloy 25[b]	2	3	1	2
TZM[b]	1	0	1	0
Hastelloy C-4	5	12	3	13
Hastelloy B	4	15	3	11
Hastelloy B-2	10	18	(e)	(e)
Hastelloy S	7	15	3	12
Haynes Alloy 556	5	6	(e)	(e)
Inconel 617	7	14	(e)	(e)
Inconel 671	15	25	20	26
Incoloy 800	8	0	(e)	(e)
Rene 41	10	14	11	13
Udimet 700	>25	0	>25	>25
Monel 400	5	8	(e)	(e)
Nickel 200	7	10	8	8
Ingot Iron	3	0	4	7
Ductile Cast Iron	CR	CR[c]	CR	CR
316L SS	6	0	22	0
JS 777	6	7	(e)	(e)
Copper	>25	0	>25	0
Titanium	>25	(d)	>25	(d)
Hafnalloy 2525	>25	(d)	CR	CR
Molybdenum	2	0	<1	<1
Niobium	3	2	2	2
Ta-10% W	10	0	2	0
Mo-50% Re	2	0	(e)	(e)
W-26% Re	2	0	1	0
Rhenium	<1	0	<1	0
Iridium	0	0	(e)	(e)
Ir-0.3% W	0	0	(e)	(e)
Platinum	>25	(d)	>25	(d)
Gold	>15	(d)	>15	(d)

(a) Estimated from photomicrographs
(b) Tested as reference specimens
(c) CR Complete Reaction
(d) Could not be estimated because of extensive chemical attack
(e) Results not yet available

DISTRIBUTION

NO. OF COPIES

OFFSITE

1 ERDA Chicago Patent Attorney
9800 S. Cass Avenue
Argonne, IL 60439

A. A. Churm

1 ERDA Division of Biomedical and Environmental Research
Washington, DC 20545

J. N. Maddox

2 ERDA Division of Production and Materials Management
Washington, DC 20545

F. P. Baranowski
R. W. Ramsey, Jr.

11 ERDA Nuclear Research and Applications Division
Washington, DC 20545

R. T. Carpenter
G. P. Dix
T. J. Dobry, Jr.
N. Goldenberg
A. P. Litman (3)
J. J. Lombardo
W. C. Remini
B. J. Rock
E. J. Wahlquist

1 ERDA Oak Ridge Operations Office
P. O. Box E
Oak Ridge, TN 37830

D. C. Davis, Jr.

2 ERDA Savannah River Operations Office
P. O. Box A
Aiken, SC 29801

R. H. Bass
T. B. Hindman

NO. OF COPIES

27 ERDA Technical Information Center

1 Department of the Army
Headquarters, U.S. Army
Facilities Engineering Support Agency
Fort Belvoir, VA 22060

H. Musselman, Technical Director

1 E. I. duPont de Nemours and Company
Aiken, SC 29801

R. K. Huntoon

1 Electronics and Applied Physics Division
Building 347.3, AERE Harwell
Oxfordshire OX11 ORA
Great Britain

E. H. Cooke-Yarborough

1 General Atomic Company
P. O. Box 81601
San Diego, CA 92138

H. C. Carney

1 General Electric Company MSVD
P. O. Box 8555
Philadelphia, PA 19101

P. E. Brown

1 General Electric Company, Vallecitos Laboratory
P. O. Box 846
Pleasanton, CA 94566

G. E. Robinson

3 Los Alamos Scientific Laboratory
P. O. Box 1663
Los Alamos, NM 87544

S. E. Bronisz
R. A. Kent
R. N. Mulford

2 Monsanto Research Corporation
Mound Laboratory (ERDA)
Nuclear Operations
P. O. Box 32
Miamisburg, OH 45342

W. T. Cave
R. Dewitt

NO. OF COPIES

1 Naval Nuclear Power Unit
P. O. Box 96
Fort Belvoir, VA 22060

F. E. Rosell

1 Naval Facilities Engineering Command
Nuclear Power Division (FAC04N)
200 Stovall Street
Alexandria, VA 22332

A. A. Arcuni

1 Navy Office of the Chief of Naval Operations
Washington, DC 20390

Head, Reactor Branch

5 Oak Ridge National Laboratory
Oak Ridge, TN 37830

R. S. Crouse
J. R. DiStefano
J. Hammond
E. Lamb
A. C. Schaffhauser

3 Teledyne Energy Systems
110 W. Timonium Road
Timonium, MD 21093

P. Dick
R. Hannah
P. Vogelberger

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

C. C. Silverstein

ONSITE

2 ERDA Richland Operations

W. A. Burns
W. C. Johnson

NO. OF
COPIES

7 Atlantic Richfield Hanford Company

L. I. Brecke
H. H. Hopkins
R. E. Isaacson
L. M. Knights
C. W. Malody
J. D. Moore
H. P. Shaw

31 Battelle-Northwest

D. G. Atteridge
J. W. Bartlett
D. B. Cash
T. D. Chikalla
M. O. Cloninger
G. W. Dawson
T. F. Demmitt
R. L. Dillon
H. T. Fullam (3)
K. M. Harmon
A. J. Haverfield
J. H. Jarrett
R. S. Kemper
R. P. Marshall
R. W. McKee
R. D. Nelson
J. M. Nielsen
R. E. Nightingale
D. E. Olesen
L. D. Perrigo
A. M. Platt
W. E. Sande
J. L. Simmons
H. H. Van Tuyl
R. E. Westerman
Technical Information Files (3)
Technical Publications