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**Pacific Northwest Laboratory
Monthly Report to Advanced
Nuclear Energy Systems,
Space and Special Purposes
Division for July 1975**

August 1975

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PACIFIC NORTHWEST LABORATORY MONTHLY REPORT
TO ADVANCED NUCLEAR ENERGY SYSTEMS,
SPACE AND SPECIAL PURPOSES DIVISION
FOR JULY 1975

by
H. T. Fullam

August 1975

Battelle
Pacific Northwest Laboratories
Richland, Washington 99352

PACIFIC NORTHWEST LABORATORY
MONTHLY REPORT
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STRONTIUM HEAT SOURCE DEVELOPMENT PROGRAM

At Hanford, strontium will be separated from the high-level waste, then converted to the fluoride, and doubly encapsulated in small, high-integrity containers for subsequent long-term storage. The fluoride conversion, encapsulation and storage will take place in the Waste Encapsulation and Storage Facilities (WESF). This 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 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.

SHORT-TERM COMPATIBILITY TESTS

The first draft of the topical report summarizing the results of the short-term compatibility tests has been completed. The report has been expanded to include the thermodynamic analysis of strontium fluoride compatibility. As soon as the draft is typed it will be sent to DANES for review and comment.

LONG-TERM COMPATIBILITY TESTS

Based on current ARHCO scheduling, fuel-grade $^{90}\text{SrF}_2$ will be available from WESF in November. We will require 6 to 7 kg of the fuel-grade $^{90}\text{SrF}_2$

for the long-term compatibility tests, and efforts are now under way to arrange for shipment of the fluoride from ARHCO to PNL. Recently instituted shipping regulations require that the shipments be made using approved containers in a licensed cask. A suitable cask has been identified and is available for use at the time required. The fluoride will be shipped to PNL loose-packed in the standard double walled WESF capsule. Each capsule will contain about 1 kg of loose $^{90}\text{SrF}_2$ powder, thus requiring a total of seven capsules. At PNL the capsules will be transferred to a shielded cell where they will be opened and the fluoride removed for subsequent use. Preparation of the detailed work procedure and safety analysis review required for the fluoride shipment is now under way.

The testing conditions and couple design for the long-term compatibility studies have been defined. They will be reviewed with DANES at Germantown in August. Long-term testing of nonradioactive SrF_2 couples will start in September, while testing of the radioactive couples should start in December (depending on the availability of fuel-grade $^{90}\text{SrF}_2$ from ARHCO).

THERMAL AGING OF HASTELLOY C-4

When considering the use of superalloys as a containment material for $^{90}\text{SrF}_2$, the problem of thermal aging of the superalloy must be taken into account. For example, Haynes 25 provides good resistance to attack by WESF-grade $^{90}\text{SrF}_2$. However, Haynes 25 undergoes a severe loss of impact strength, toughness and ductility when thermally aged at 650 to 900°C, reducing its usefulness as a container material for $^{90}\text{SrF}_2$. Most superalloys undergo aging reactions when heated in the same temperature ranges that affect their mechanical properties. Hastelloy C-4 is reported to suffer less from thermal aging reactions than most superalloys. Therefore a series of thermal aging tests have been started to see if Hastelloy C-4 can be considered for use as the strength member of a double-walled container for ^{90}Sr in the range of 800 to 900°C. Hastelloy C-4 Charpy V Notch specimens are being tested at 600, 800 and 900°C for periods of 1000, 5000 and 10,000 hr and at 1000°C for 1000 and 5000 hr. Three specimens are being tested at each set of conditions.

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