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GENERAL ELECTRIC COMPANY

HW-31407

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May 1973
By J E Savely 6-29-99
Verified By [illegible] 8-5-99

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RICHLAND, WASHINGTON — HANFORD ATOMIC PRODUCTS OPERATION

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SPECIAL RE-REVIEW
FINAL DETERMINATION
DECLASSIFICATION CONFIRMED
BY JP Derouin DATE 6-11-81
BY JW Jordan DATE 7-7-81

April 9, 1954 [redacted]

RESTRICTED [redacted]

This document consists of 5 pages. [redacted]

DEVELOPMENT TEST NO. 105-520-SI

SPECIAL IRRADIATION REQUEST NO. HAPO-130

IRRADIATION OF BISMUTH TRIFLUORIDE FOR THE PRODUCTION OF NEUTRON SOURCES

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OBJECTIVE

To determine the feasibility of using unprocessed irradiated bismuth trifluoride as a low intensity neutron source.(1)

BASIS AND JUSTIFICATION

Most of the neutron sources now being used in experimental work are manufactured by mixing radioactive polonium^{210} with beryllium. The extraction of polonium from irradiated bismuth, though inconvenient and expensive, is necessary for the production of compact, high intensity neutron sources. Since the sources must be replaced periodically (Po^{210} has a half life of 138 days) this inconvenience and expense is repetitive for a continuing program. Hence, it is of interest to develop a source which does not require this separation.

(1) HW-20686, "A Neutron Source Design Which Eliminates Radiochemistry From The Process of Production", J. O. Erkman, October 20, 1953.

[redacted]

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The application of neutron sources to drive exponential piles and sigma piles does not appear to place a stringent restriction on the dimensions of the source. It appears feasible that these applications can be satisfied with sources of lower intensity and larger dimensions. This may be realized by incorporating both the bismuth and the α - particle target material in the slug before exposure in the pile. After an exposure of 30 days in a flux corresponding to a power level of 4 MW/Ton, the slug containing BiF_3 should emit 3×10^5 neutrons/second, about 14% of its saturated emission. If the γ -ray emission is sufficiently low, this slug will serve as a prototype for useful neutron sources thus eliminating the inconvenience and expense of processing the irradiated bismuth.

Pile Facilities Required: Process tube containing no uranium in a region of high thermal flux.

SCHEDULE

An irradiation time of two to four weeks is desired, at a time and location to be determined by the Special Irradiations Sub-Unit. The poison column control facility will be considered for this irradiation.

CATEGORY

Plant Assistance: Extra shutdown time will not be required and is not authorized for this development test.

COSTS

Cost Code: XXXX-5903-130

Reactivity: Five inhours from displacement of metal.

Elevator Time: One hour for charging and discharging samples. If the poison control facility is used, the use of the elevator will not be required during shutdown.

Operations: 4 man-hours for charging and discharging the samples.

DESCRIPTIVE DETAILS

Powdered bismuth trifluoride will be loaded into one half of the container using an hydraulic press. Following the operation a perforated divider will be pressed firmly against the BiF_3. Sufficient lead will be loaded in the remaining half of the slug to move the center of gravity near to the center line of the slug. The end cap will be press fitted and welded. This design, shown on the accompanying drawing, will produce a slug having a wall thickness of 1/4" and a void space of approximately 20% for the collection of any gases that might be evolved during irradiation. In addition, about 9% of the volume occupied by the BiF_3 will be void, since the material cannot be compacted to the density of a solid.

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Reaction: $Bi^{209} + n \rightarrow Bi^{210}(RaE) \xrightarrow[5\ day]{\beta^-} Po^{210}$

Material and Amount: Approximately 240 grams of BiF_3 per slug.

Number of Slugs: Four

Slug Identification: 130-1, 130-2, 130-3, 130-4

Heat Generation: Less than 50 watts per slug, based on γ-ray absorption in bismuth metal.

SPECIAL INSTRUCTIONS

Data Required: Integrated flux as determined from temperature rise of adjacent tubes.

Hazards: There is a possibility that some fluorine may be evolved from the BiF_3 during irradiation. However, it is felt that the voids left in the slug, and the thickness of the can wall are sufficient to guarantee no possibility of a rupture. A search of the literature does not reveal any previous stability tests on BiF_3; however, tests have been run in the MTR on a mixture of 50% NaF, 46% ZrF_4, and 4% UF_4 for Oak Ridge National Laboratory. The material was irradiated in Inconel capsules at a temperature of 1500°F and power densities of 2.5, 3.8, and 8 KW/cc. It is reported that no deleterious changes due to irradiation were detected in the fluorine compounds.(2)

RESPONSIBILITY

The Reactor Section. Operations Sub-Section, will be responsible for all scheduling and for the operational safety and production continuity of the pile. M. W. Hulin, Special Irradiations Sub-Unit, has principal responsibility for the Technical Section's interests. J. O Erkman of the Physics Unit, Applied Research Sub-Section, who requests that this information be obtained will be responsible for issuing all reports pertaining to this test.

M. W. Hulin
Physicist
Pile Technology Sub-Section
ENGINEERING DEPARTMENT

MW Hulin:mdm

(2) ORNL-1[illegible], "Oak Ridge National Laboratory Status and Progress Report December, 1953", page 9.

[redacted]

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APPROVALS

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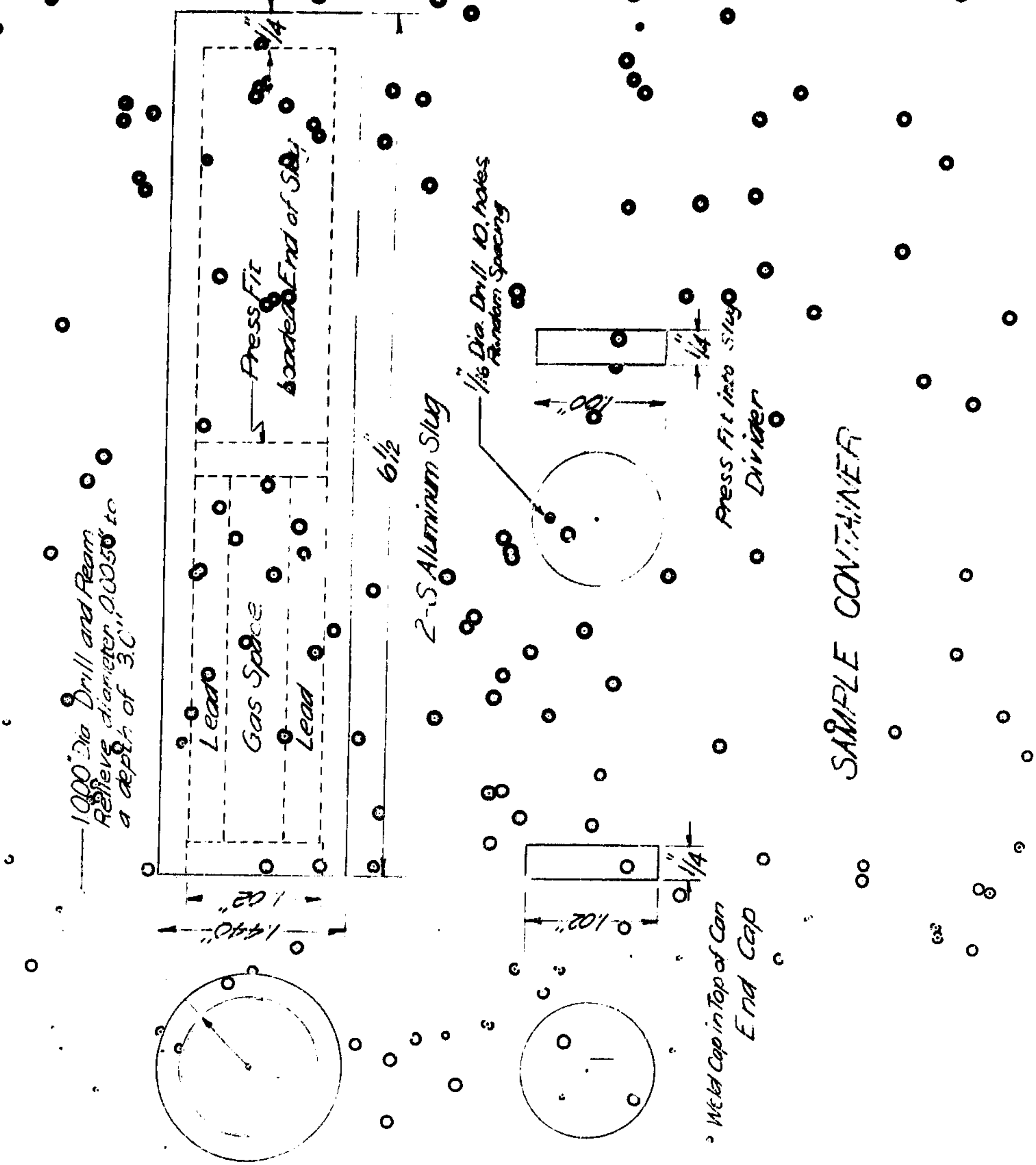

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