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NEW THOUGHTS ON CLOSED-LOOP, CLOSE-COUPLED PROCESSING FOR IRRADIATING Np-237

by

O. F. Hill

[redacted]

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NEW THOUGHTS ON CLOSED-LOOP, CLOSE-COUPLED PROCESSING FOR IRRADIATING Np-237

by

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Chemical Processing Division

August 5, 1966

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ISOCHEM INC. [redacted]

Richland, Washington 99352

August 5, 1966

Battelle Memorial Institute
Pacific Northwest Laboratory
Richland, Washington

Attention: Mr. E. E. Voiland, Manager
Chemical Research

Subject: NEW THOUGHTS ON CLOSED-LOOP, CLOSE-COUPLED PROCESSING FOR IRRADIATING Np-237

Gentlemen:

Recent studies* on irradiating neptunium-237 suggest strongly that close-coupled, reactor operation has many advantages. Among these are:

- Minimum out-of-reactor time for the neptunium, possibly to as little as a few days per "cycle".
- High conversion of neptunium-237 to plutonium-238.
- Reduced parasitic adsorption of neutrons by the plutonium-238 to form plutonium-239.

Among objections to an aqueous loop have been:

- Severe reactor control problems in the event of loss of the aqueous solution of neptunium from the reactor.
- Aqueous systems contribute further to the over-moderation of the reactors.
- Severe iodine problems in processing the aqueous stream for neptunium recycle.
- Control of fission and radiolysis gases in the loop.

The Molten Salt Reactor Experiment (MSRE) has been successful recently in that the reactor has operated for significant periods of time. Thus, the feasibility of handling fluoride salts in a neutronic environment is established.

* G. F. Owsley, "Maximizing Pu-238 Production from Np-237 Irradiation," DUN-1277 RD.

[redacted]

Battelle Memorial Institute
Attn: Mr. E. E. Voiland

August 5, 1966

This note is prepared to suggest that the irradiation of fluoride salts containing neptunium-237 offers many advantages for the production of plutonium-238 and to request that exploratory studies be initiated. A schematic block flow diagram to represent conceptual processes is attached.

Advantages claimed include the following:

- Neptunium is recovered promptly and returned to the reactor environment.
- Iodine is probably controlled since it would be condensed from a closed system as IF_5 and/or IF_7.
- The processes are adaptable to continuous or, at least, semi-continuous operation.
- The processes probably remove the major fission product poisons from the salt prior to recycle of the salt.
- Loss of product plutonium-238 through the parasitic capture of neutrons to form plutonium-239 is minimized.

To establish early feasibility of the concept, the following studies should be undertaken promptly.

- Reactor physics studies to determine desirable range of neptunium-237 concentration in the molten salt, to determine the need for in-reactor cooling, to qualitatively evaluate molten salt irradiation vs solidified salt irradiation, to define the potential nuclear hazard problems.
- Determine whether any fluorination studies have been performed to establish that indeed NpF_6 can be volatilized from the molten salt. If they have not been, perform same.
- From a literature search determine the conditions under which PuO_2 can be precipitated from the molten salt. Also, determine the information known, if any, on fission product precipitation with the PuO_2 (degree of poison decontamination).

Your thinking and explorations should not be restricted to the processes outlined here, but could include examination, as you suggest, of other

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means of obtaining plutonium and/or neptunium separation from the salt. The advantage of fluorination is its removal from the system prior to plutonium removal, and thus removing any neptunium interference with plutonium isolation. Also, of major importance is that the processes outlined here permit the early return of the neptunium to the reactor.

Very truly yours,

O F Hill

Principal Chemical Engineer
Research and Engineering
Chemical Processing Division

OF Hill bp

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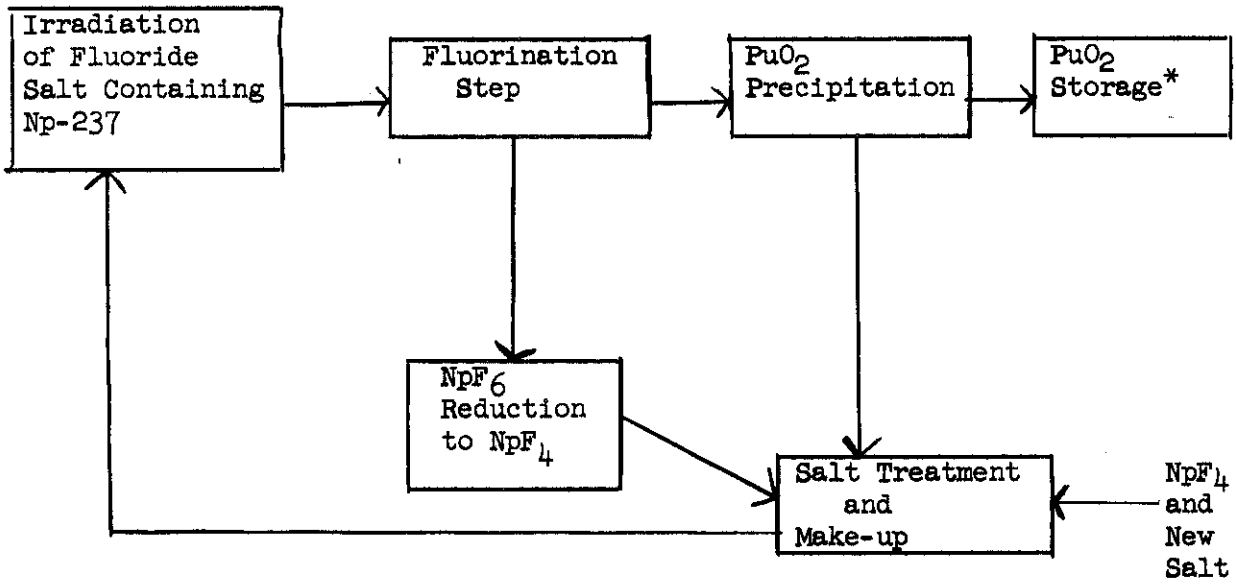
SALT LOOP PROCESSING OF NEPTUNIUM-237



* Further processing and purification on campaign basis in Isochem facilities.

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