Future Supply of ^{238}Pu for Radioisotope Power Systems

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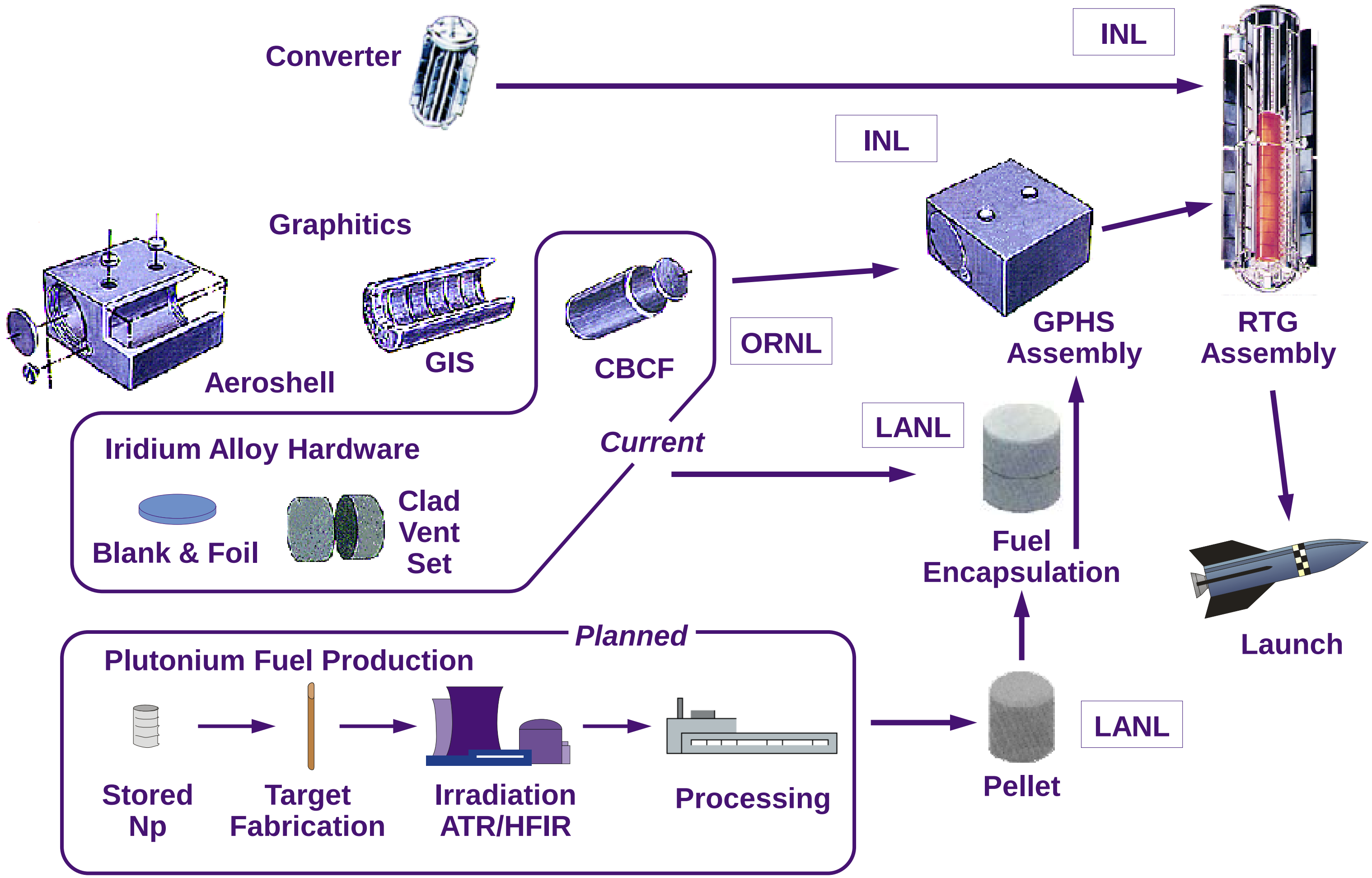
Many Manufacturing and Assembly Activities Are Required for Radioisotope Power Systems



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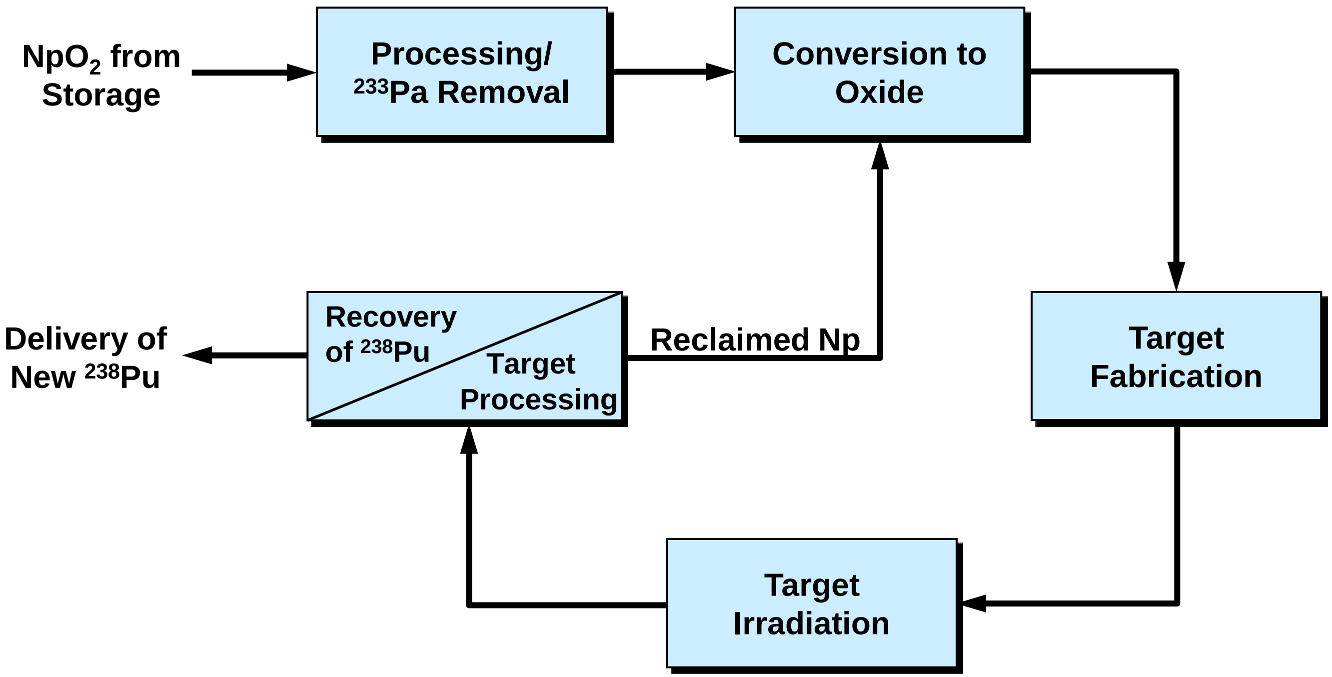
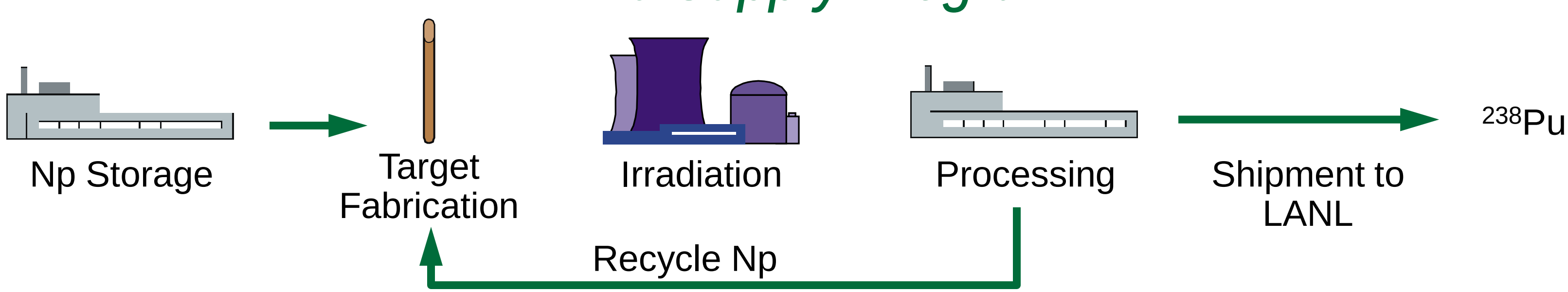
Approach for ^{238}Pu Supply Program



^{238}Pu Supply Program



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^{238}Pu was Supplied Using the Weapons Production Infrastructure at SRS

- Irradiation of neptunium oxide mixed with aluminum powder in aluminum clad targets to produce ^{238}Pu (~6 vol.% NpO_2)
- Target fabrication was based on larger (~3" O.D., ~12' long) targets that were designed for K reactor, a heavy water moderated ^{239}Pu production reactor
- Reactor target volume allowed large batches of ^{238}Pu to be made in a single campaign (~12 kg batches)
- H-canyon was used for recovery of ^{238}Pu as product and ^{237}Np for recycle
- K reactor has been shut down; weapons production halted
- Restarting production will require use of existing reactors and infrastructure

Reactor Characteristics Desired for ^{237}Np Conversion to ^{238}Pu

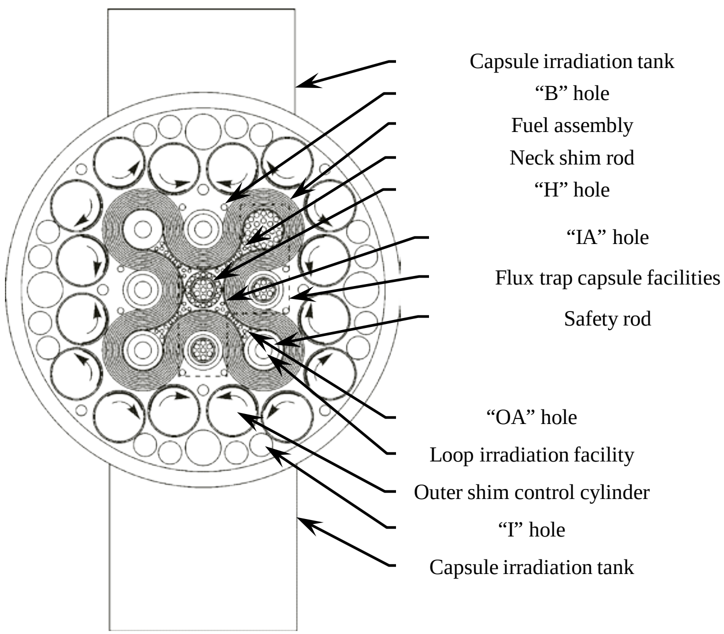
Characteristic	Desired to maximize ^{238}Pu	Desired to minimize ^{236}Pu impurity
Neutron spectrum	High thermal flux	Minimize high energy flux[1]
Photon spectrum	Large diameter	Minimize high energy flux[2]
Target size	Maximize loading	Small diameter
Neptunium loading		Minimize loading

Notes:

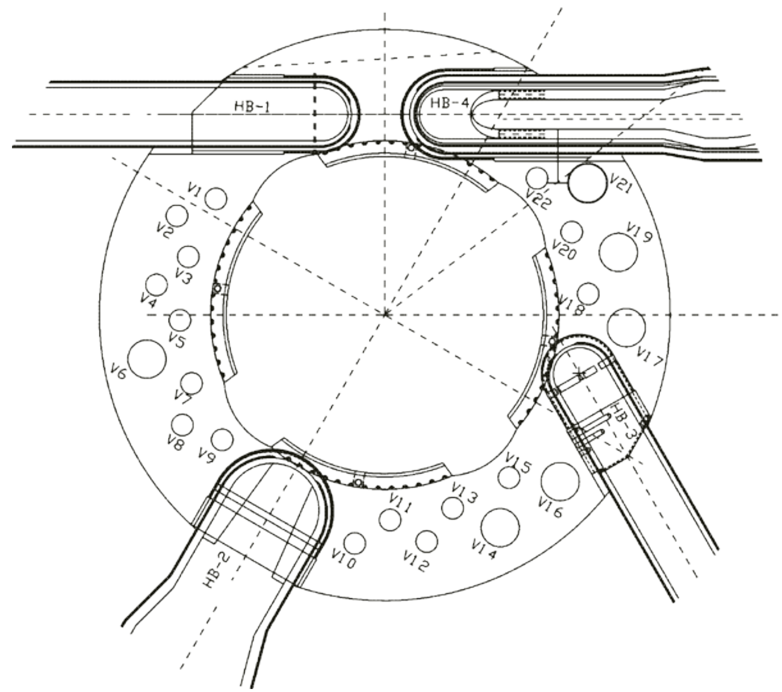
1. Increasing the water or other moderator content in the test position can augment natural high-energy neutron flux suppression in a thermal reactor.
2. High energy photon flux can be suppressed by avoiding or minimizing materials with high energy photon yields and reduced by incorporating photon shielding materials in the test position.

Cross Section of DOE Reactors Showing Irradiation Facilities

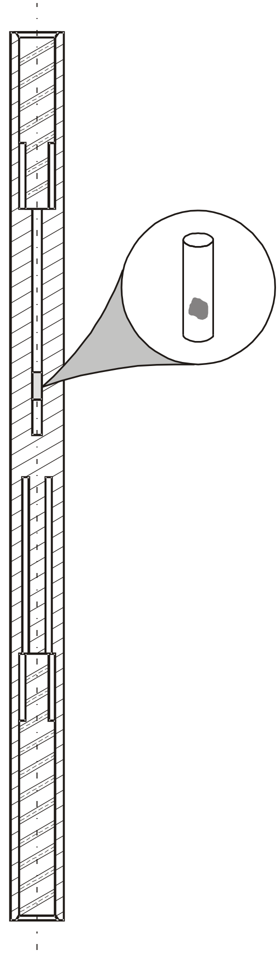
Cross section of the INEEL/Advanced Test Reactor depicting irradiation facilities



High Flux Isotope Reactor (HFIR)



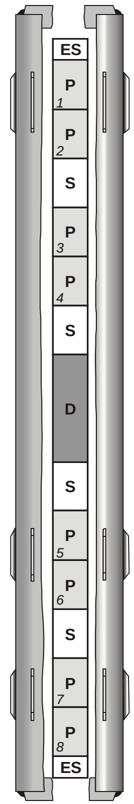
Target Design has Stepped Through 3 of 4 Phases



Dosimeter Targets

^{236}Pu Content of Unperturbed Reactor Flux

Characterize ATR Neutron and Gamma Spectral Influence on ^{236}Pu



Pellet Targets

Influence of Pellet NpO_2 Loading on ^{236}Pu

Demonstrate Pellet Performance

Array Targets

Examine Influence of Multi-Target Self Shielding on ^{236}Pu Impurity

Data on Fission Gas Product Release from Pellet Matrix

Prototype Targets

Prototype Manufacturing Methods

Target Quality Control

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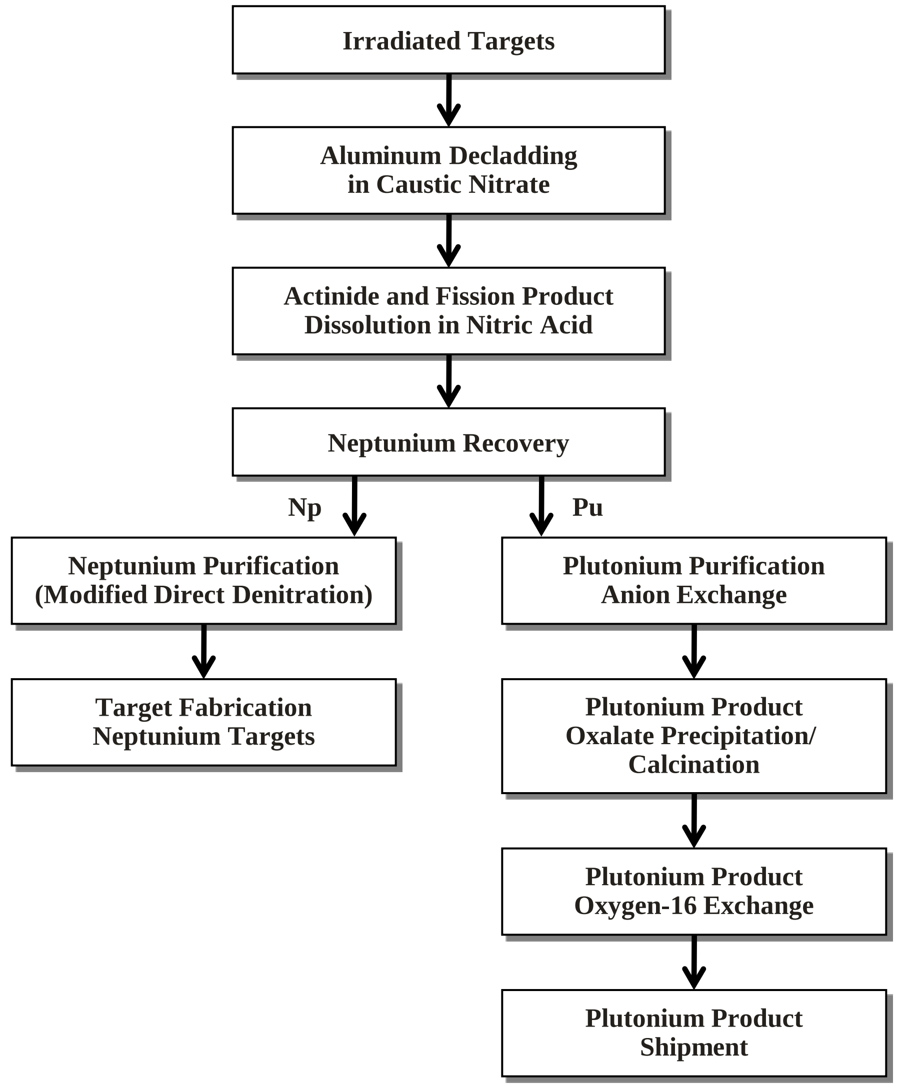
ORNL DWG 2000-277R

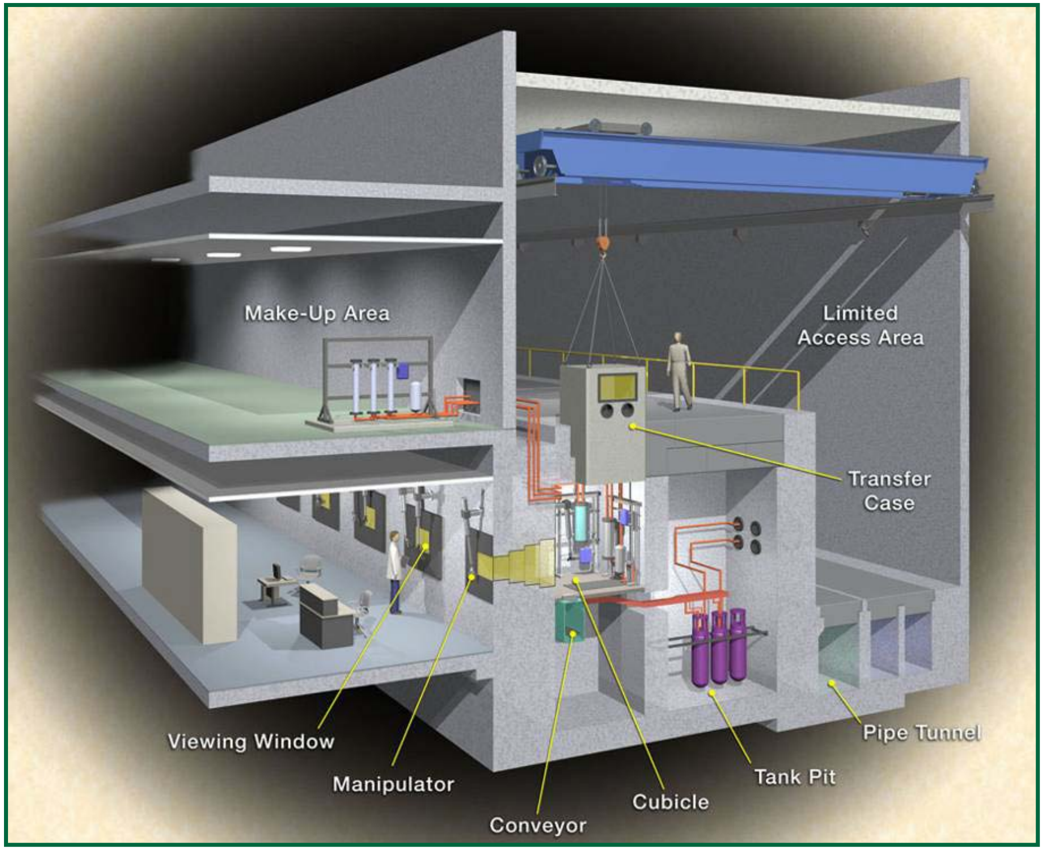
A Processing Flowsheet for ^{238}Pu Recovery was Developed to Optimize Throughput and Minimize Footprint



Challenges:

- Design targets; fabricate and irradiate ~500 targets/year
- Optimize or enhance existing chemical processing equipment to recover needed quantity of ^{238}Pu
- Product purity of recovered materials and purification
- Waste disposition

REDC Hot Cells Have Unique Processing Capabilities



- Facilities contain laboratory, glove box, and engineering-scale hot cell facilities
- Hot cells were designed to handle alpha, beta-gamma, and neutron-emitting radionuclides
- Process equipment in place to dissolve, separate, recover and purify heavy element products and dispose of fission product wastes
- Fully remotely operated and maintained
- In-house analytical chemistry to support isotope production, process development, and R&D activities
- Currently operating with approved DOE Category 2 Safety Basis

Summary of Analyses to Date Show That ^{238}Pu Supply Can be Met with Existing Facilities

- ^{238}Pu supply of 1.5–2kg can be met with existing reactors and hot cell facilities
- ^{236}Pu content will be higher than historical values
- Target development and preparing for irradiated target processing should proceed as rapidly as possible

QUESTIONS?