

Creating a Stable Supply of Rare Elements for Medical and Industrial Applications Using a Molten Salt Nuclear Reactor

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Nuclear fission creates rare elements that are not found in nature and are discarded in traditional reactor fuels. These elements are useful for many industrial and medical processes, such as thickness gauging and cancer treatments. Our team is designing a new generation molten salt nuclear reactor with a sole focus on continuous production and extraction of these elements.

The Reactor:

The reactor uses low enriched uranium fuel with a graphite moderator, boron control rods, and a Hastelloy-N vessel.

Model Validation:

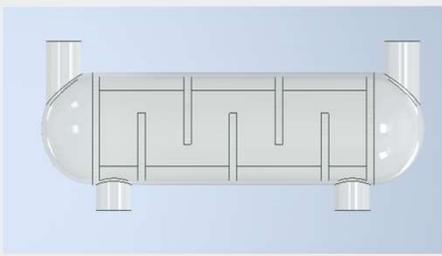
The model to the right was used with SERPENT Code to model the core neutronics.



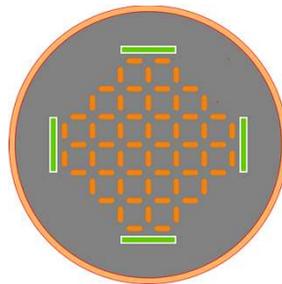
Transfer of Heat:

The reactor will run at 250 kW and the resulting heat will be rejected to the atmosphere with a series of heat exchangers like the one below.

The system will be driven by natural circulation.



Our Products	Their Uses
Promethium-147	Industrial thickness gauges and electric blanket thermostats
Cesium-137	Cancer treatments and imaging sources
Iodine-129	Diagnoses of thyroid disorders
Iodine-131	Treatment for thyroid cancer
Iodine-133	Treatment for thyroid disorders
Krypton-85	Industrial indicator lights and thickness gauges
Molybdenum-99	Generates technecium-99m, which is used in medical imaging



Model Features, color coded:

Control Rods

Fuel Channels

Graphite

Hastelloy-N Reactor Vessel

Downcomer Fuel

Product Extraction:

1. Helium is bubbled through fuel in a section of pipe
2. Volatile fission products are freed and sent to be fluorinated
3. Once the contents are in their highest ionized state, they are filtered for particulate matter
4. They are then directed to a halide trap, where they are split to a distillation and additional traps
5. The distillation process separated wastes, molybdenum-99, and iodine products
6. The additional traps separate hydrogen isotopes, oxygen, and noble gasses including the helium used to free the products