FMF
Fuel Manufacturing Facility

The entire operation of manufacturing metallic fuel elements is performed in this single facility. The facility is capable of producing enough fuel to supply a 1400 megawatt advanced liquid metal reactor — enough to provide all the electricity needed by about one and one-half million households.

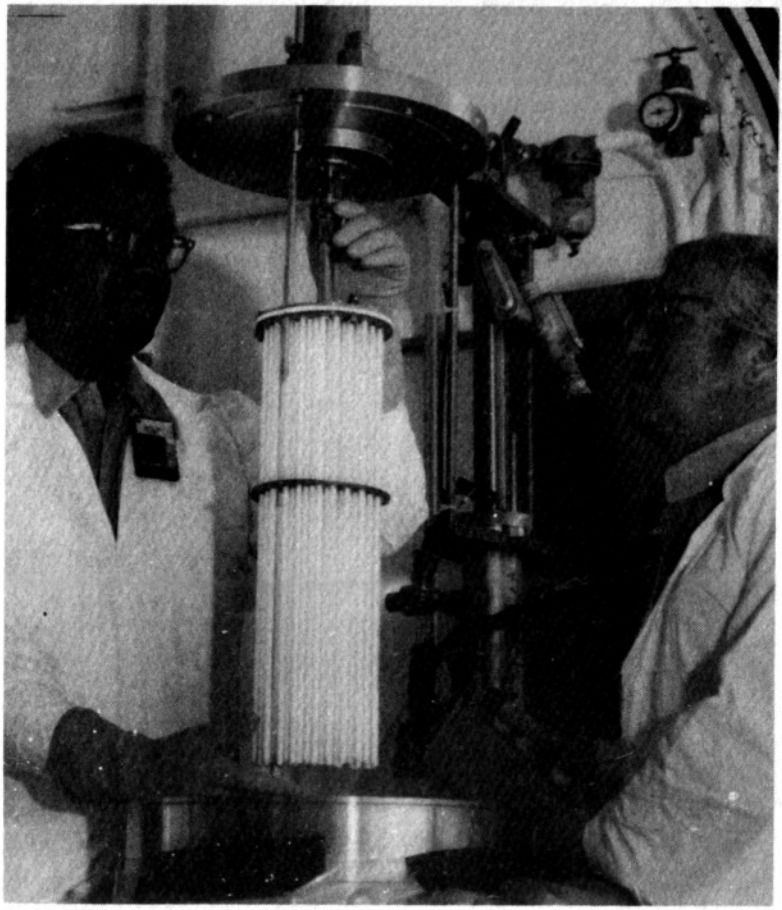
The complete manufacturing of the metallic fuel is straightforward, simple, cheap, and surprisingly easy to do.

First, molds, straw-like tubes with one end closed, are prepared for the casting. Quartz is used because it will not soften or distort when filled with molten metallic fuel. The inside of each mold is first coated with a high-temperature ceramic paint. About 110 of these molds are then loaded into a pallet. Then the pallet is taken to the furnace room for the fuel casting operation.

Meanwhile, the feed-stock — consisting of the end pieces chopped from previously cast fuel slugs, leftover fragments from previous castings, rejected slugs, and fresh feedstock — is loaded into the crucible.

The furnace and its enclosure prevent release of particulates into the atmosphere, maintaining a clean environment for the workers. The furnace basically consists of an area for the molds and another for the crucible containing the feedstock.

The furnace is large enough to accommodate two casting stations within the controlled argon atmosphere. Each of these stations contains an induction coil heat source surrounding the crucible.



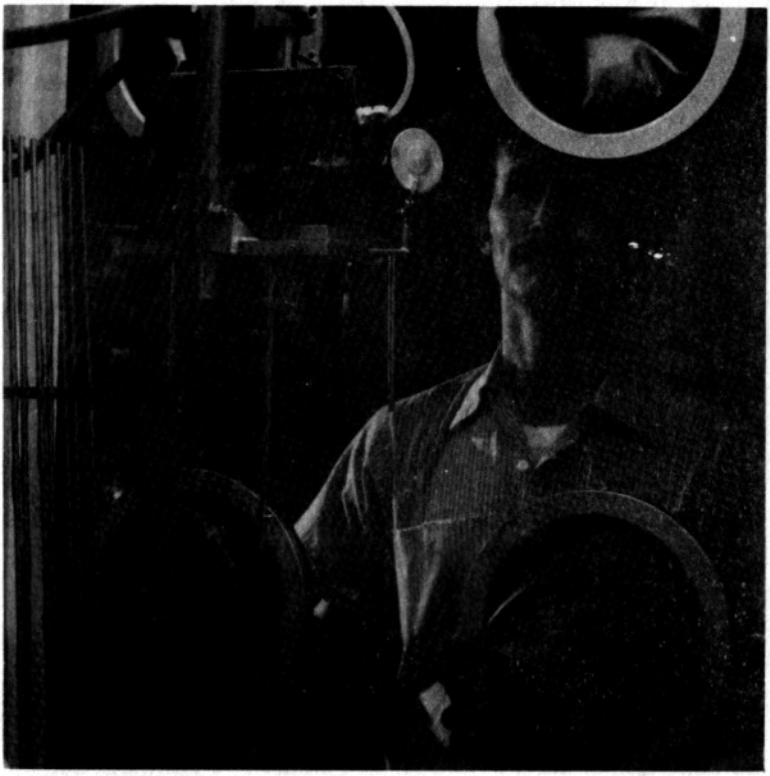
Casting

Between the crucible and coil is a layer of zirconium oxide insulation to prevent large heat losses from the crucible and to keep the induction coil cool. The mold pallet is positioned above the crucible until the fuel is molten and ready for injection casting.

The furnace system is then ready for the direct melting of the raw and recycled materials for casting the fuel to final dimensions.

As the crucible heats up, the uranium and zirconium feedstock melts. The melt is then magnetically stirred to assure homogeneity of the melt before casting. When the proper temperature is reached, the system is evacuated by a vacuum pump.

The molds are then submerged into the melt, the unit is pressurized, and the molten fuel is injected into the evacuated molds. This takes less than a second. Once filled, the molds are withdrawn from the remaining melt and cooled — producing about a hundred metallic fuel pins — all in one operation. This process is simpler and more direct than that used to produce fuel for the current operation of commercial reactors.



Element Manufacturing

This one-step fabrication process has many advantages. Yields are high. Recycle material is easily used in subsequent castings. The cost is low because the process is simple, straightforward, and flexible.

After casting, the quartz molds containing the solidified fuel slugs are removed from the furnace for processing. The slugs are demolded and mechanically sheared to length. Next, they are sampled for chemical analysis, measured, and weighed.

The fuel slugs are enclosed in stainless steel jackets for use in the reactor. Sodium to fill the space between the fuel slug and the jacket is extruded, measured, and placed in the jacket first. The jacket is heated in a low-temperature furnace to melt the sodium. Then the slugs are lowered into the jacket and allowed to settle to the bottom. The liquid sodium fills the space between the fuel slug and the inside wall of the jacket.

Each fuel element is then tested for leaks to ensure a good closure weld, and taken to a furnace for bonding at about 500°C. This causes the sodium to wet the surfaces and assures that there are no gas bubbles between the fuel slug and the jacket. Each element is then tested to make sure that the bond quality is satisfactory.

Each fuel element is x-rayed and inspected for weld quality and bond integrity. The sodium level is checked, and the fuel structure is inspected for defects.

The final assembly is simple and straightforward. The elements are loaded on to a hexagonal grid, placed into a hexagonal shaped can, and welded .