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MULTI-HUNDRED WATT HEAT SOURCE TECHNOLOGY-II

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The USAEC, Division of Space Nuclear Systems, has initiated work on an advanced heat source convertor design, designated as the Multi-Hundred Watt (MHW) program. The following paragraphs describe Mound Laboratory's efforts, in developing and testing areas, in support of the MHW program.

The MHW heat source consists of 24 (100-watt thermal) spherical modules, arranged in a 4 x 6 element cylindrical matrix. The fuel which comprises these modules is encapsulated in a 0.020-in. thick post impact containment sphere which is encased in a 0.5-in. thick wound graphite impact energy absorber. The four-sphere tiers are then inserted in graphite reentry aids, and the entire assembly is welded in an outer container as shown in Figure 1.

Two fuel candidates were considered: 1) plutonia-molybdenum cermet (PMC) and 2) pure plutonium oxide (PPO). PMC fuel sphere

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Machineability has been successfully demonstrated. High-fired, oxygen-16 exchanged, shard particles ranging in size from 105 to 250 μm were coated with 17.9 wt % molybdenum by chemical vapor deposition (CVD). These particles were then hot pressed at 1660°C for 10 min under 10,000 psi in POCO AXF graphite. The concave die surfaces were diffusion barrier treated by plasma spraying them with a 0.001-in. thick coating of tantalum and by adding 0.001-in. thick tantalum foil inserts. The resultant units had a power density of 3.0 w cm^{-2} (slightly lower than the current PMC specification) and were machineable to ± 0.005 -in.

PPO manufacturing development included the evaluation of six feed types: 1) high-fired hydroxide precipitation shards, $< 105 \mu\text{m}$, 2) ball-milled oxalate precipitate, 3) ball-milled hydroxide precipitate, 4) low-fired hydroxide particles, 5) outgassed oxalate-precipitate fuel, and 6) low-fired (1200°C) hydroxide shards, $< 297 \mu\text{m}$. The low-fired hydroxide shards were chosen as the most feasible feed type, since it met program requirements and was adaptable to various manufacturing processes. Hot pressing parameters are 1480°C for 15 min at 2500 psi in POCO AXF dies coated with colloidal graphite. Through this procedure it is possible to produce 100-watt spheres with a theoretical density of 80-85% and as-pressed diametral tolerances of ± 0.015 in.

Full-size fuel spheres (both PMC and PPO) have been subjected to a variety of test conditions. Such tests include short and long term operational temperature "soaks" of the fuel, and other environmental condition tests. Descriptions and results will be presented.

Other aspects of heat source development are reported. These include welding development, fabrication of test units, fabrication of fueled units and other related assembly development.