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BABCOCK & WILCOX MEDICAL ISOTOPE PRODUCTION SYSTEM STATUS

W. Evans Reynolds, PE
B&W Technical Services Group
MIPS Program Manager

Introduction:

B&W TSG one of the Babcock & Wilcox companies, has for some years conducted small scale development of its patented Uranyl Nitrate Medical Isotope Production System (MIPS). This application of an Aqueous Homogeneous Reactor (AHR) for isotope production was invented by B&W's Dr. Russell M. Ball in 1997. The MIPS approach will provide commercial scale production of medical isotopes, primarily ^{99}Mo, used to supply ^{99m}Tc for diagnostic imaging purposes, using a Low Enriched Uranium (LEU) salt solution as the fuel/target.

Recent heightened emphasis on controlling use of Highly Enriched Uranium (HEU) throughout the world in support of nuclear non-proliferation goals has motivated increased commercial interest in this safe and cost effective technology. Conceptual designs for commercial application have been developed and efforts are under way to establish a partnership with an established pharmaceutical firm familiar with current ^{99}Mo production technology and operating practice.

Feasibility:

AHR's have a long history dating from the beginning of the modern nuclear reactor program in the 1950's. Over 30 AHRs have been built throughout the world, accumulating over 149 years of combined experience. Two operating licenses have been granted by the U.S. Atomic Energy Commission, and numerous programs have been established to study criticality in uranium solutions. More recently, the Russian ARGUS reactor program, in operation since 1981, has demonstrated the successful production of ^{99}Mo and separation to U.S. Food and Drug Administration purity requirements.

Current systems and experience with the conventional ^{99}Mo production methodology, irradiated target-dissolution-separation-purification, are applicable to separation and purification of ^{99}Mo from AHR solution. MIPS' uranyl nitrate solution is similar to those current systems which dissolve targets in nitric acid. Recent research at Argonne National

Laboratory provides insight into performance of inorganic sorbents in an environment intended to approximate an AHR solution.

B&W TSG Conceptual Design:

Current concepts under consideration include a 200 kW reactor, capable of producing approximately 1,100 six day Ci/week of ^{99}Mo and other useful isotopes. The reactor would contain approximately 150 L of LEU solution and would operate at approximately 80˚ C and atmospheric pressure. A new reactor/separation/purification facility is envisioned with hot cell capacity for the several separation/purification/packaging and shipping functions as well as a waste management facility. Multiple reactor units with corresponding additional hot cells are under consideration to adjust facility capacity to meet a range of potential customer demands.

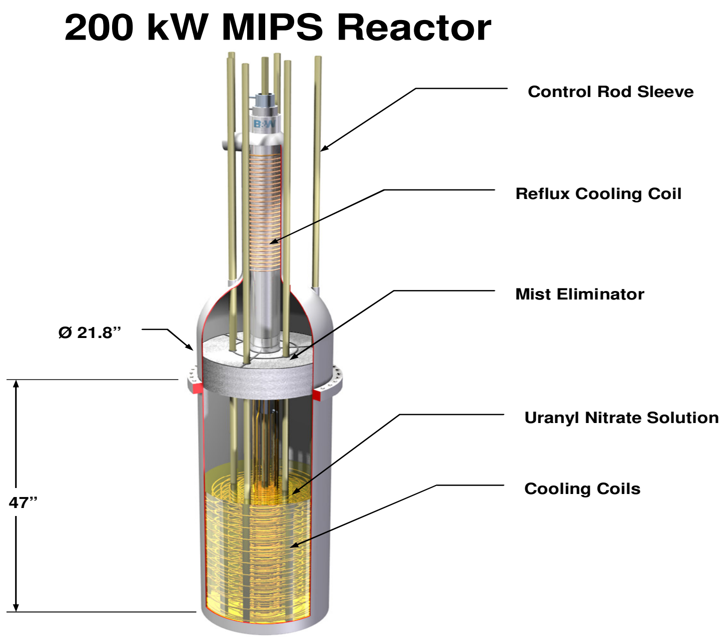

Figure 1

Sorbent separations technology to support a MIPS type production application is under development at Argonne National Laboratory, at B&W's Lynchburg laboratories and under subcontract by INVAP, SE in Argentina. A variety of sorbents and equipment configurations are being studied to optimize system throughput and efficiency.

Project Management:

The project management process established for this program draws from the U.S. Department of Energy Line Item management approach, incorporating a series of Critical Decision milestones (Figure 2). Each milestone reflects developments up to that point in time. These developments will then be reviewed by a select management committee for authorization to proceed to the next phase. The project is currently in Phase 1 R&D which will culminate in Critical Decision 1.

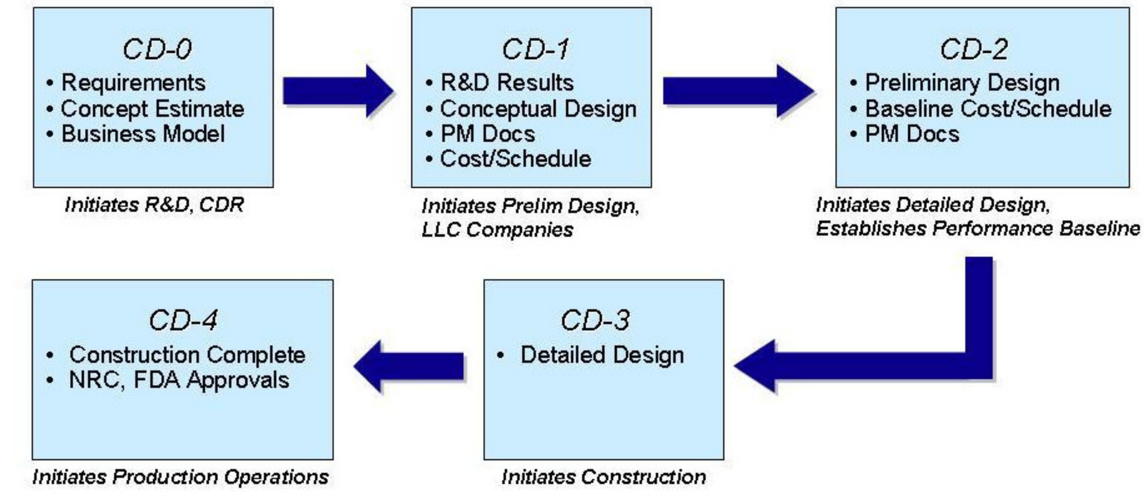

Figure 2

The planned development program anticipates 5 to 6 years duration from full funding to operation. The schedule (Figure 3) shows major project elements and approximate durations. Licensing by the U.S. Nuclear Regulatory Commission and approval to supply radiopharmaceutical products by the U.S. Food and Drug Administration are expected to be major, possibly critical path, activities.

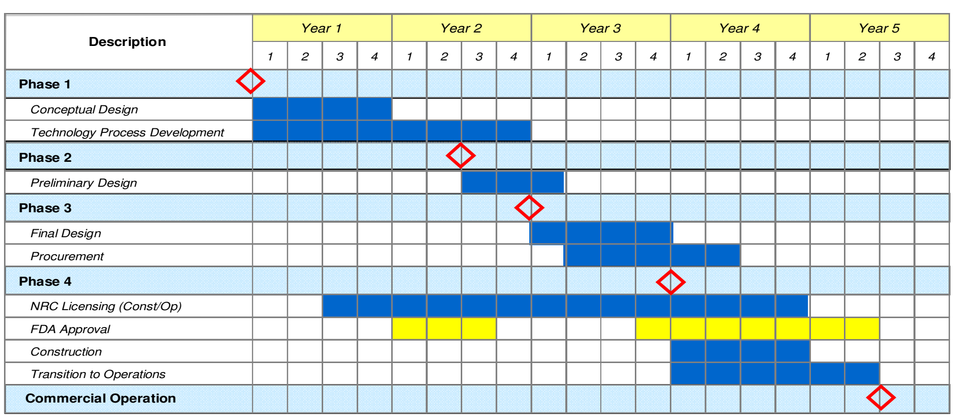

Figure 3 Licensing Approach:

Solution reactors are not specifically addressed in U.S. regulations, which cover nuclear reactors for power, commercial or research uses. All current non-power reactors in the U.S. are licensed as Class 104 Research facilities. Since a dedicated medical isotope production facility cannot meet both the 50% definition of a "Research" facility and remain commercially viable, consideration as a Class 103 Commercial facility seems to be the logical alternative. However, specific guidance for such a facility will require further interaction with U.S. NRC. Guidance such as that found in NUREG 1537, *Licensing of Research and Test Reactors* would seem to be an appropriate methodology, considering the low power levels and comparatively low hazard profiles of a MIPS reactor system.

Status:

Phase 1 R&D efforts are under way and commercial funding is in the planning stage along with ongoing discussions with the radiopharmaceutical industry. Conceptual designs have been developed based on both a single vessel 200 kW reactor and a multi-vessel device, essentially comprising four 50 kW modules. The selection process is progressing for these and other conceptual aspects of the facility.