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Ensuring a Stable Supply of Mo-99 in the U.S. without the use of HEU

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Ensuring a Stable Supply of Mo-99 in the U.S. without the use of HEU
Technetium-99m (Tc-99m) is a radioisotope used in approximately 80% of all medical imaging procedures across the globe. With a half-life of approximately six hours, this important medical radioisotope cannot be stockpiled and must be either used immediately upon direct production or repeatedly milked from generators bearing the parent isotope, molybdenum-99 (Mo-99), which has a half-life of approximately 66 hours. Historically, Mo-99 has been produced in research reactors by the irradiation of targets bearing highly-enriched uranium (HEU) followed by chemical separation and purification. In order to minimize the proliferation risks posed by medical isotope production, the U.S. National Nuclear Security Agency (NNSA) has funded a multi-year program to accelerate the deployment of technologies to produce Mo-99 without the use of HEU. Internationally, this work has focused on replacing HEU targets with low-enriched uranium (LEU) equivalents. Within the U.S., operating under a full cost-recovery paradigm, NNSA has directly funded the research and development of accelerator-based technologies and reactor target-based technologies via cost-sharing Cooperative Agreements with potential commercial producers.
One of the Cooperative Agreement partners, NorthStar Medical Radioisotopes (NorthStar), is pursuing a dual production pathway for Mo-99: irradiation of enriched Mo-98 targets in the University of Missouri Research Reactor (MURR) and electron beam accelerator-based production using Mo-100 targets at their production site in Wisconsin. NorthStar's production method supplants the traditional generator-based supply chain by use of the NorthStar RadioGenix system in radiopharmacies.
Another Cooperative Agreement partner, SHINE Medical Technologies (SHINE), uses a deuteron beam accelerator and tritium gas target to produce high-energy neutrons. These neutrons are thermalized and multiplied before irradiation of a liquid LEU target solution in a subcritical configuration. After each production cycle, the Mo-99 is extracted from the LEU solution, which is reconditioned and recycled to minimize total uranium usage. The SHINE production method is designed to be compatible with the existing Tc-99m generator manufacturer supply chain.
The third Cooperative Agreement partner, NorthWest Medical Isotopes (NWMI), produces Mo-99 using LEU solid targets that are able to be irradiated in multiple research reactors and shipped to their target processing facility in Missouri for dissolution and Mo-99 extraction and purification. Like SHINE Medical Technologies, the NWMI production method is designed to be compatible with the existing Tc-99m generator manufacturer supply chain.
The fourth Cooperative Agreement partner, Niowave Inc. (Niowave), uses a superconducting electron linear accelerator to irradiate a neutron-generating target surrounded by LEU production targets. After each production cycle, the targets are dissolved and Mo-99 is extracted and purified. Like SHINE and NWMI, the Mo-99 produced by Niowave is designed to be compatible with the existing Tc-99m generator manufacturer supply chain.
The organization also provides technical support by making resources from the U.S. Department of Energy National Laboratories available to potential commercial producers. In addition to the Cooperative Agreement partners, U.S. National Laboratory assistance has been provided to both international producers and U.S. potential producers who have not been directly-funded by NNSA. An overview of the U.S. National Laboratory technical support will also be given.

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