MOLYBDENUM-99

SHINE receives construction permit from NRC

SHINE Medical Technologies will still need to obtain an operating license before it can produce the medically important radioisotope.

On February 26, the Nuclear Regulatory Commission issued a construction permit to SHINE Medical Technologies for a facility to be built in Janesville, Wis., for the production of molybdenum-99 through fission of low-enriched uranium. The commissioners had authorized the issuance of the permit the previous day, after completing their review of the permit application, which began with a mandatory hearing on December 15 (*NN,* Jan. 2016, p. 60). SHINE applied for the permit in 2013, and the NRC staff completed its technical reviews last October.

A SHINE spokesperson informed *Nuclear News* that construction is to begin in early 2017, and commissioning (with test batch production) in late 2018. SHINE also intends to apply for an operating license in 2017. While it will be regulated under the NRC's 10 CFR Part 50 (because even though there is not a reactor involved, neutrons would produce fission of U-235), the facility might in general be comparable to a light-industrial plant, so the actual time required for construction and startup might indeed be shorter than that for other nuclear facilities. SHINE expects to begin commercial sales from the facility in early 2019.

SHINE's system would use an accelerator to incite fusion in a target and drive the resulting neutrons into uranium enriched to about 19.75 percent U-235. As difficult as it has been to make fusion succeed as a net-gain energy source, the use of accelerators to fuse heavy hydrogen isotopes and produce fusion neutrons (with a net loss in energy) has been well established for many years. SHINE's system maintains the uranium solution as a subcritical assembly, and the usual variety of fission products are expected from the neutron injection. SHINE plans to extract molybdenum-99, and perhaps other radioisotopes that have commercial value. Everything else would be in a waste stream that SHINE would confine and eventually dispose of as low-level waste.

Molybdenum-99 has a half-life of 66 hours, decaying by beta-particle emission to either technetium-99 or technetium-99m, a higher-energy form that emits a gamma ray of about 0.14 MeV (with a six-hour half-life) and then is the same as Tc-99. That gamma ray makes for good medical imaging. Mo-99 is made into a "generator" from which enough Tc-99m arises to provide useful images when material from the generator is injected into a patient. Tc-99m is used in more than 80 percent of all nuclear medicine procedures, although it is strictly for diagnosis, rather than treatment.

Mo-99 has not been produced for medical use in the United States for more than two decades, and supply sources in Canada and the Netherlands involve old, soon-to-close reactors that have been prone to long outages. The short half-lives make for a very short shelf life. The National Nuclear Security Administration, as part of its campaign to reduce the use of high-enriched uranium worldwide, has made funding available for new Mo-99 ventures in this country. Among those planning systems that require NRC licensing, SHINE was the first to get to the point of application submittal, and it is now the first to receive a construction permit. The SHINE spokesperson stated that the company expects to apply for about an additional $10 million from the NNSA, for which the project is eligible, and that it has raised approximately $50 million to date from a variety of sources.

In recognition of the issuance of the construction permit, SHINE held a celebration on March 10 that was attended by Janesville native son Paul Ryan, the Speaker of the U.S. House of Representatives. NN