NEWSLINE

Belgian Companies Propose New Solution for Isotope Production

"We consider that no structural long-term solution for this vulnerable situation exists if one remains with reactor technology."

The supply of ^{99}Mo in the world is "characterized by a strong concentration of production capacity in a few sites," according to Luc Van Den Durpel, a project leader at the Nuclear Research Centre in Belgium (SCK-CEN). Because of the difficulties with public acceptance, licensing and other reactor considerations in many countries, says Van Den Durpel, "we consider that no structural long-term solution for this vulnerable situation exists if one remains with reactor technology."

SCK-CEN has developed a nonreactor system for isotope production, in collaboration with Ion Beam Applications (IBA), a Belgian company specializing in the design of cyclotrons for medical applications. The Accelerator Driven Operated New Irradiation System (ADONIS) uses a cyclotron to accelerate protons, which are conducted to a subcritical assembly where they collide with a lead-bismuth target and produce neutrons by spallation. These neutrons, after passing through a water moderator, irradiate targets made of ^{235}U. Fission of the ^{235}U produces radioisotopes, especially ^{99}Mo, that can be extracted by conventional processing technologies.

ADONIS is not new technology in its components. Cyclotrons are well established in scientific research. Moreover, similar irradiation targets are used all the time. However, SCK-CEN believes combining the two technologies can reduce the cost and reliably help meet the demand for ^{99}Mo, the most widely used medical radioisotope.

The ADONIS cyclotron measures 7 meters in diameter and 3 meters high, according to SCK-CEN, and produces a 2-mA beam of 150-MeV protons. The spallation target produces neutrons with an energy spectrum similar to the neutrons from ^{235}U fission. A variety of irradiation targets can be installed and removed individually, allowing the user to shape the neutron multiplication while remaining far enough from criticality. The flux around the irradiation targets is optimized for ^{99}Mo production at 1–2 $\times 10^{14}$n/cm^2/s but can be increased. The targets can be loaded and unloaded with the facility on line, and production can be matched to market needs. SCK-CEN calls the system inherently safe, with a simple, fail-safe construction. Continuous operation is possible with a minimum of human intervention, thus reducing personnel costs.

The price SCK-CEN quotes for initial construction of ADONIS is less than $50 million, with annual operating costs of $2 million, a feasible investment for a radiopharmaceutical company or group of companies, according to SCK-CEN. One ADONIS installation would have a maximum capacity of 50% of the world's demand for ^{99}Mo. Capacity could be increased by adding cyclotrons and/or subcritical assemblies.

About two years ago, MDS Nordion International, the world's largest supplier of ^{99}Mo, considered an early idea of SCK-CEN's for a cyclotron-based isotope production system. Ian Trevena, vice president of isotope products at Nordion, says the company felt that this predecessor of ADONIS looked interesting but was a little theoretical. Nordion had some concerns about the calculations and the target handling. "We handle irradiated targets all the time," says Trevena, "but we only handle one at a time, and we don't handle a target in an area where you have a cyclotron system. You're asking for something to be designed that's got a target handling capability associated with a reactor and put it in a cyclotron facility. Whenever you match technologies, you can sometimes worry about what happens at the interfaces."

In the end, Nordion was more comfortable with building two reactors that will eventually replace the company's aging NRU isotope-production reactor.

After consulting with authorities in Europe and the United States, SCK-CEN estimates the time for licensing and building an ADONIS system would be only four years. Nordion's Trevena admits that licensing ADONIS could be as easy as licensing a cyclotron, but says it is not certain until it is actually tested with a regulatory body.

Other possible applications for ADONIS include neutron beam research, neutron activation analysis, transmutation/partitioning studies and proton beam research.

For more information about ADONIS, contact ADONIS Project, Luc Van Den Durpel, SCK-CEN, Boeretang 200, B-2400 Mol, Belgium. E-mail: adonis@sckcen.be or Pascal Cohilis, Ion Beam Applications, Rue J Lenoir 6, B-1348 Louvain-la-Neuve, Belgium.

—Allen Zeyher