

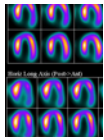
Medical Isotope News from the Nuclear Energy Institute

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Nuclear Energy Insight

March 2010—In a move that may ease the shortage of medical isotopes, the National Nuclear Security Administration (NNSA) has inked agreements with Babcock & Wilcox Technical Services Group Inc. and GE Hitachi Nuclear Energy to develop new technologies for supplying diagnostic and cancer-fighting treatments.

The program is part of NNSA's Global Threat Reduction Initiative to minimize or eliminate civilian use of highly-enriched uranium, including in research reactors that produce medical isotopes.



The new technology “offers a new path forward for the creation of a reliable, domestic supply of molybdenum-99 without the use of [highly-enriched uranium],” said NNSA Administrator Thomas D’Agostino. “This pragmatic approach addresses a critical U.S. medical community need while supporting President Obama’s goal of reducing the risk posed by use of HEU.”

Molybdenum-99 decays into technetium-99m, a radioisotope used in about 80 percent of all nuclear medicine procedures, including evaluations of the heart, kidneys, lung, liver, spleen, bones and blood flow. With a half-life of 66 hours, molybdenum-99 must be delivered to hospitals on a frequent basis. This is particularly challenging given that the United States imports all of its supply.

There are only five major producers of molybdenum-99 in the world. Global supplies are tight and the situation is getting worse.

A Canadian research reactor, one of the world’s leading suppliers, has been off-line since last May for maintenance and is expected to remain so at least through April. Another major supplier, in the Netherlands, will be off-line through August for scheduled maintenance. Combined, these two facilities supply more than 80 percent of the molybdenum-99 used in the United States, according to the Society of Nuclear Medicine.

The NNSA agreements with Babcock & Wilcox and GE Hitachi Nuclear Energy each has the potential to provide half the U.S. supply of molybdenum-99. Both projects are in the planning stages and will announce later when they will go on-line.

Meanwhile, another new supply source could help ease the isotope shortage in the near term. In February, Covidien, a global producer of healthcare products, announced an agreement with the Institute of Atomic Energy in Poland to irradiate targets at the Maria Research Reactor in Poland. It is estimated that the facility could produce up to one million patient doses of technetium-99m within the next six months.

“This is an historic agreement. It is the first time in decades that a new reactor has been brought into the global supply chain for medical isotopes,” said Timothy Wright, president of pharmaceuticals at Covidien. “We are excited that we will now be working together to provide more than a million patients around the globe with access to a critical medical isotope during this serious shortage.”

Clinton Power Station Will Produce Cobalt-60

Illinois’ Clinton Power Station will host a pilot project that will produce medical radioisotopes used in cancer treatment and food sterilization.

The project involves a partnership between Exelon, which operates the plant, and GE Hitachi Nuclear, who produces fuel for the plant. It could produce enough cobalt-60 for about 300,000 cancer treatments over the life of the project.

And how much electricity from the 1,450 mega-watt plant will be diverted to this project? None at all, according to Exelon. “We view this as an opportunity for Exelon to support an important medical technology that saves people’s lives,” said Exelon Nuclear President and Chief Nuclear Officer Charles Pardee.

The first shipment is expected in 2012.

Technetium-99m and Radiation Medicine

Meeting Demand With Best Practices, New Reactors

Many medical isotopes and radiation sources are produced when target material, usually uranium, is irradiated with neutrons, coming from the controlled fission taking place in a research reactor. Atoms in the target capture some of those neutrons, thus becoming heavier isotopes.

The most common radioisotope used in diagnosis is technetium-99m, with more than 30 million procedures per year. Four of five diagnostic imaging procedures in nuclear medicine use this isotope.

Just five research reactors produce about 95 percent of worldwide demand for molybdenum-99, from which technetium-99m is fabricated. These are the Petten High Flux Reactor in the Netherlands; BR2 at Mol in Belgium; Osiris at Saclay, France; NRU at Chalk River, Canada; and the Safari-1 at Pelindaba, South Africa. These facilities are all more than 40 years old.

Several incidents in 2007 and 2008 have highlighted the unreliability of medical isotope supply, particularly technetium. Unexpected simultaneous maintenance outages of the aging research reactors caused critical shortages of the molybdenum-99 precursor element. Complicating the situation is the complex and constrained distribution of the isotopes, exacerbated by the short half-lives of the precursor and daughter isotopes. A need for increased production capacity and more reliable distribution is evident.

An international workshop held recently in Paris to discuss global solutions concerning the ongoing supply of medical isotopes brought together representatives of government, industry and the nuclear medicine community from 16 countries and several international organizations.

The workshop chairman, Nuclear Energy Agency Director General Luis Echávarri, said in a concluding report that the international community had become “increasingly concerned” about shortages of the isotope. “Outages of these reactors and of the downstream processing facilities have recently resulted in significant shortages of Tc-99m,” he said.

As a response to the most recent shortage, the Petten reactor was given permission by Dutch authorities to re-open before completing its scheduled maintenance. This echoes a similar situation last year in Canada.

Meanwhile, the new OPAL reactor in Australia has recently opened and is expected to commence molybdenum-99 production soon. And early in February, two companies in the United States (Babcock & Wilcox Technical Services Group and Covidien) signed an agreement for the manufacture of molybdenum-99 using an innovative liquid-phase technique involving low-enriched uranium.

The B&W-Covidien program could meet more than half of the demand in the United States, which currently imports all its molybdenum-99.

Even with these recent developments, the vulnerability of the isotope supply chain is expected to persist for several years because of the age and increasing maintenance requirements of the current reactors.

—*Nuclear Energy Insight, March 2009*

Medical Isotopes in Short Supply

Insight Web Extra

November 2009—The most important of the medical isotopes used to detect, diagnose, treat or evaluate illnesses such as cancer and heart disease is in short supply. Shortages of technetium-99m (Tc-99m) are catching the eye of practitioners and policymakers alike.

Technetium-99m is used in about 80 percent of nuclear medicine procedures. It is derived from another element, molybdenum-99 (Mo-99), which is produced in uranium-fueled research reactors.

After injection into the body, technetium-99m goes to specific disease sites in the body or concentrates in organs such as the heart. Imaging devices such as PET scanners then pinpoint the exact locations and extent of disease and help identify the best treatment. The procedures can also be used to monitor patients' responses to treatment.



Technetium-99m has a short half-life—radioactive decay depletes its strength by half every six hours. It decays in the body quickly without giving the patient a large radiation dose, but because of this short half-life, the isotope must also be produced and delivered quickly. Therefore, only a few days can elapse between ordering and using the material.

The vast majority of the worldwide supply of molybdenum-99 is produced in nuclear facilities located in five countries: Belgium, Canada, France, South Africa and the Netherlands. Until recently, two reactors—one in Canada, the other in the Netherlands—each produced approximately one-third of the world's supply. About 80 nations use molybdenum-99 based procedures, and the United States consumes nearly one-half of the worldwide supply.

However, these isotope-producing reactors have been operating for an average of 45 years and increasingly are being shut down for extended periods of maintenance. Canada's facility has been undergoing major repairs since May and is not expected to be back online until the first quarter of 2010. The Dutch reactor is also expected to be out of commission for up to six months next year, as will France's. Both the Canadian and French reactors will shut down permanently in 2015. And although a new Dutch reactor has been proposed, it will not come online at least until 2016. These events are disrupting the production of molybdenum-99 and affecting medical care throughout the world.

Increasing unavailability of technetium-99m is already leading to delayed diagnoses and treatment. A recent survey suggests that 75 percent of physicians are delaying diagnostic procedures by at least a day, and a third have delayed them longer than a month.

The situation has caught the attention of Congress and the White House. Legislation ([H.R. 3276](#)) introduced last summer by Reps. Edward Markey (D-Mass.) and Fred Upton (R-Mich.) to promote the domestic production of these materials could soon pass into law.

It is recognized that encouraging U.S. production of this important isotope is a high priority. One potential source is the University of Missouri Research Reactor, which could meet up to half of U.S. demand with minimal changes to the present design. Other promising designs include a Babcock & Wilcox aqueous reactor concept, and various accelerator-based facilities. However, these solutions are years down the road.

—Read more articles in [Nuclear Energy Insight](#) and [Insight Web Extra](#).