SCIENCE NEWS of the week

Isotope Vulnerability Imperils R&D

Last week, the Canadian government narrowly averted a strike by union workers at its nuclear reactor in Chalk River, Ontario. Within days of a strike, supplies of technetium-99m in the western hemisphere would have disappeared. In the United States alone, clinicians and researchers depend upon this radioactive isotope — used in the vast majority of all nuclear-medicine procedures — to conduct some 36,000 diagnostic tests daily.

The threatened strike brought home to many policymakers, industrialists, and physicians the implications of having no domestic source of such an important isotope. Indeed, the United States' reliance on foreign isotopes is only growing, reports a General Accounting Office (GAO) study released last week.

Increasingly over the past three decades, industry, medicine, and research have come to rely on manufactured isotopes — artificially derived variants of naturally occurring elements. Many, like technetium-99m, are radioactive. Others, such as carbon-13, are stable (nonradioactive). Though differing in the number of neutrons their nuclei possess, isotopes of a given element tend to share similar chemical properties. So one can be substituted for another and then detected and mapped on the basis of its mass or emitted radiation.

Today, for example, "80 to 90 percent of all drugs that [win] Food and Drug Administration approval — not just the radioactive ones — go through a period of research and development requiring the use of radioisotopes," notes radiation biologist Carol S. Marcus. Why? Such studies "show you where a drug goes," observes Marcus, director of the Nuclear Medicine Outpatient Clinic at Harbor-UCLA Medical Center in Torrance, Calif.

Despite a heavy and growing reliance on isotopes by science and medicine, GAO finds that the federal government has maintained a policy for the past 45 years of cutting back on its production and sales of isotopes. Today, the Department of Energy (DOE) generates less than 5 percent of the isotopes sold globally. Those it does produce, GAO notes, "are not otherwise available domestically and some have [only] a limited worldwide backup source." And now, GAO finds, this DOE program is in jeopardy.

In late 1990, Congress established a revolving fund to finance DOE's isotope production and distribution program, seeding it with a one-time infusion of $16 million. Since then, DOE has been forced to run this program on a totally self-supporting basis. By Oct. 1, GAO now reports, the program's revolving fund "is expected to have a balance of less than $500,000 or possibly be insolvent."

If the fund runs dry, DOE can continue to mine its stockpiles of stable isotopes since they don't decay. But the agency may be forced to severely reduce the volume or spectrum of radioisotopes it provides. And that could hit the science community hard: GAO notes that the vast majority of DOE-produced radioisotopes find use in research only.

This observation comes as no surprise to Kristen D.W. Morris of the Society of Nuclear Medicine in Washington, D.C. There exist almost no domestic sources of reactor-produced isotopes, such as molybdenum-99, she notes, "and only minimal, very unreliable supplies of accelerator-produced isotopes."

"If a federal program could go bankrupt, the DOE's isotope program would be," observes Rep. Mike Synar (D-Okla.). The decision to make "this vital program be 100 percent self-supporting has been a failure," he charges, "and needs to be reassessed."

Many isotope users agree. Federal law prohibits DOE from competing with U.S. firms in the production of isotopes. The result "has probably been one of the most spectacularly successful examples of technology transfer [from government to industry]," according to Robert W. Atcher, a nuclear chemist at Argonne (Ill.) National Laboratory.

Unfortunately, "giving away all your winners and keeping only the stuff that's unprofitable is no way to run a business," notes nuclear chemist Richard L. Hahn at Brookhaven National Laboratory in Upton, N.Y. And that is precisely what DOE has been asked to do, he maintains.

For instance, the revolving fund never carried enough money to do more than maintain smoothly running operations, GAO notes. So when a contamination incident related to the production and delivery of cesium occurred, DOE incurred repeated cost overruns. Not only did customers receive late deliveries, but DOE's revolving fund was debited an extra $2 million, GAO reports.

Nor can the isotope-financing account afford costly and badly needed capital improvements. Within three to five years, DOE is currently planning on shutting down the only two accelerators in its system — at Brookhaven and Los Alamos (N.M.) National Laboratory — capable of making large volumes and a broad spectrum of isotopes, according to Michael J. Welch of Washington University School of Medicine in St. Louis. "Without a replacement facility, certain aspects of the medical community are going to be in big trouble," he told SCIENCE NEWS.

Studies of the human brain and other organs — especially in healthy individuals — frequently rely on positron emission tomography (PET) scanners for noninvasive imaging. But researchers calibrate PET scanners with a decay product of germanium-68. "And the only place you can get the germanium is at [DOE's accelerator at] Brookhaven. Without that isotope, virtually all existing PET scanners will be an order of magnitude more difficult to use," Welch contends.

Hahn cites Gammasphere — a $20 million physics facility to study nuclear structure, now under construction at Lawrence Berkeley (Calif.) Laboratory — as another enterprise whose value could be compromised if scientists lose access to certain DOE-derived isotopes within a few years.

Isotope availability problems already appear to be limiting some U.S. studies, several scientists told SCIENCE NEWS. Hahn, for instance, recalls that at an informal National Academy of Sciences workshop that he co-chaired last February, at least one researcher told him, "I used to decide to do my experiments based on what would work best, then go out and order the [isotopes]. But the situation has changed. Now I look to see what materials I can get — and then decide what research they allow."

Atcher cites problems with astatine-211, a heavy, short-lived relative of iodine. To date, his work with the isotope suggests that tumor cells may incorporate it into their DNA when it is delivered via a tumor-seeking monoclonal antibody or a compound that binds to the estrogen receptors often found in abundance on certain tumors.

Such bull's-eye targeting of its cell-killing energy makes this isotope "one of the most exciting potential therapies for gynecologic cancers, like ovarian and breast cancers," Atcher asserts. But it needs testing in humans. Though Argonne provides him the tiny amounts of astatine he needs for in-house work, Atcher says, one of his colleagues at the University of Pittsburgh "could never get enough astatine to prove or disprove the therapy's potential" — even though he had a grant for a human trial.

But help may be on the way.

Synar plans hearings later this month to study the isotope program's funding crisis, and the National Academy of Sciences has just received approval to study isotope availability. Meanwhile, the Society of Nuclear Medicine has launched a campaign encouraging Congress to earmark funds for a capital-improvement project: the first federal accelerator dedicated solely to the production of research isotopes.

— J. Raloff