The Mysteries of Reprocessing Spent Nuclear Fuel: Why Some of Our Best and Brightest Are Figuring Out Ways to Remove Vast Amounts of Excess Plutonium From the Biosphere, While Others Are Planning to Make More

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Editor's Note: This is the fourth in a continuing series of essays by M&GS associate editor David Rush about the efforts in the post-Soviet republics to deal with a disturbing nuclear legacy -- the environmental damage caused by nuclear weapons development and production, the enduring consequences of the Chernobyl tragedy, and, more recently, the debate about the role of nuclear power in the evolving Russian economy. As our "beat" reporter in Russia, Ukraine, and the other republics, Dr. Rush combines his role as a professional advisor to the scientific and medical communities on matters of radiation and health with a deepening personal interest in the future of this struggling and suffering people. Dr. Rush's previous M&GS articles include: "Letter from Kiev and Moscow: Nuclear Realities 10 Years After Chernobyl" [M&GS 1996;3:A3]; "Russian Journal, July 1995" [M&GS 1995:133-34]; and "A Letter From Krasnoyarsk: Disarmament, Conversion, and Safety After the Cold War."] [M&GS 1995:19-25] M&GS 1996;3:A10

The Third International Radioecological Conference, "The Fate of Spent Nuclear Fuel: Problems and Reality," took place from 24 to 26 June, 1996, in Krasnoyarsk, Russia. It was held at a crucial moment in the checkered history of nuclear power generation and at a suspenseful moment for Russians -- between rounds of the presidential elections.

The contrasts and contradictions that were obvious in Russian society at large were also reflected in the conference. (In the former USSR, the military sector comprised as much as 70% of the gross national product during the Cold War, in contrast with about five or six percent in the U.S.) Some of us travelled to the former secret military city, Krasnoyarsk-26, a prosperous oasis in a desert of economic chaos and dishevelment, in what, from all appearances, had to be a civilian bus: windshield shattered, it was unable to climb anything but slight inclines unless we got off and walked. The bus was nursed along by a gifted driver who knew the quirks of his vehicle the way an Indian mahout is supposed to know his elephant. (He had pasted a picture of a bare breasted woman in the front of his bus: a casual chauvinism that was evidenced by a similar image prominently displayed on the walls of one of the local antinuclear activist offices. Ironically, women seem to be doing much more than their share of the work needed to make anything in Russia function.)

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Obstacles to Open Science

Almost every shade of opinion can be published in the new Russia: there were 12 newspapers in our host city of one million people. Even so, there was almost no visible evidence that we were in the midst of a bitter and historic election: no posters or sound trucks, just a few newspapers pasted on scattered bulletin boards. One sensed uncertainty about how disagreement would be resolved. This uncertainty was reflected in the conference: Russia has only a weak tradition of open science, with its concomitant frank discussion, the give and take of criticism and peer review, and the corrections that follow. The holdover of Soviet culture seems to militate against civil and open public discourse. We thus heard some very current and thorough work on the cytogenetics of radiation exposure and on environmental radiation contamination, along with some pedestrian and sloppy research, with essentially are no opportunities for constructive interchange among investigators. Even were there scientific meetings at which to have such discussion there would not be enough money for scientists to attend them.

On the other hand, personal connection seems possible across great gaps. It was heartening, for example, to see a young Greenpeace activist chatting unselfconsciously with one of the directors of K-26. Russian hospitality remains profoundly generous and rules of personal etiquette remain very important: I left a banquet after what must have been the fifteenth toast, having been told that only the first eleven are dictated by protocol. Such formalities are not, however, a substitute for collaboration and communication to promote open and dissident science; indeed, we were confronted privately with a surprising amount of fairly petty criticism of the work of others, criticism which, if delivered impersonally and constructively, almost surely would have been helpful in the struggle to create a just and informed society. A greater feeling of common purpose and cohesion is urgently needed; I found the citizens' movements far ahead of the scientists and doctors in this task. The tools for democratic and respectful resolution of conflict are only just being formed.

The site of the conference was chosen with careful intent: just 26 kilometers downstream from the Siberian city of Krasnoyarsk along the banks of the Yenisei River, is the site of Krasnoyarsk 26 (K-26), now also called Zheleznogorsk [Figure 1]. K-26 is the former Soviet Union's third and last military plutonium (Pu) production site. Here, three plutonium production reactors and accessory industrial plants were built entirely underground, to decrease their vulnerability to nuclear attack.

There is no current demand for more military plutonium. Rather, western scientists and some Russians are trying to figure out how to remove from the biosphere the plutonium that has been extracted from decommissioned nuclear warheads, forever and in a form in which it cannot be reused to make nuclear weapons. Thus, two of K-26's three reactors were shut in 1992 as part of the Gore-Chernomyrdin agreements. The third is scheduled to be closed after a nearby coal-fired power station is completed, providing an alternative source of heat and electric power for the closed city of 100,000 that was built to house the staff and families of the euphemistically titled Mineral and Chemical Combine.

In the late 1970s, work was started on the second Soviet reprocessing plant for spent nuclear fuel at K-26, called RT-2. (RT-1, at the Mayak complex near Chelyabinsk in the southern Urals, has been reprocessing spent nuclear fuel from naval reactors and from the earliest Soviet civilian reactor designs since 1988. Its throughput has been going down precipitously since a peak in the late 1980s [1]). Work on RT-2 was stopped in 1986 for a number of reasons: there was no perceived need for more plutonium, either for nuclear weapons, or for power generation in breeder reactors or mixed with uranium in so called MOX fuel; moreover the world price for the far safer, and easier to use alternative, uranium, had, contrary to some forecasts, come down instead of rising sharply.

Illusory Promises

The promise that reprocessing would be integral to the production of endless amounts of cheap power had proven false and critics contend that reprocessing generates more, not less, radioactive waste than initial storage of spent nuclear fuel (this is disputed by some nuclear industry insiders). The reuse of the plutonium and uranium produced by reprocessing entails either mixing them together (mixed oxide, or MOX, fuel) and using MOX fuel in light water reactors, or using plutonium alone in so-called fast breeder reactors. The combination of fast breeder technology and reprocessing has given the illusory promise of endless, cheap, renewable energy; hence Japan's current plans to acquire 30 tons of plutonium and thus achieve energy independence. (Conference participants heard that Japan's Pu stockpile is likely to rise to about 100 tons by 2010.)

Both MOX and fast breeder technologies, however, have proven much more complex, expensive, unreliable, and dangerous than the early rosy projections of the nuclear

industry and its national and international acolytes (the former Soviet, French, British, and Japanese governments and the International Atomic Energy Agency in particular). The commercial nuclear power industry is unlikely to embrace MOX and fast breeder technologies, not because of the terrible security problems in creating, storing, and using vast amounts of plutonium, but because of the terrible costs. (One conference report asserted that the French breeder reactor, Superphenix, has set in its checkered history a dubious world record for the cost of the electricity: $1.30/Kwh, vs $0.02-0.04 from other sources).

It is confusing why anyone would want to invest more billions of dollars in reprocessing plants (the not-yet completed Japanese Rokkasho plant is now expected to cost $17 billion -- twice the initial estimate -- and six to seven times the amount of the much dirtier operating European plants). The U.S. rejected reprocessing in the late 1970s and Germany abandoned its completed seven billion DM breeder reactor and did not build its planned reprocessing plant. Why build more capacity when existing plants are underutilized and their products are of such questionable value?

William Walker of Sussex University gives the following reasons for the survival of reprocessing in France (Cogema) and the United Kingdom (Sellafield):

> * these began as military programs and were not subject to civilian, especially local civilian, review;
> * there has been much inertia due to heavy prior investment;
> * electric utilities have been attracted to the idea of using reprocessing plants for storage of spent nuclear fuel as local storage capacity is exhausted;
> * the costs are mostly borne by German and Japanese utilities rather than locally;
> * political control in France and Great Britain is centralized relative to other European countries, so that local and regional concerns can be overridden rather easily [2].

Walker does not believe reprocessing will survive in the long term.

A Jobs Program for Unemployed Military Workers?

Why is there interest in another reprocessing plant at K-26? The answer is straightforward: K-26 is in desperate financial straits. The technical workforce has dropped by at least a third, from a peak of 12,000 to an acknowledged 8,000. We were told that many highly qualified professional personnel are now forced to do whatever work they can find, sometimes in menial jobs. K-26 has diversified; it now builds satellites. We witnessed the almost comical presence of a Samsung television assembly plant in one of the unused RT-2 buildings, in the middle of a very high security area, hard up against several thousand spent nuclear fuel assemblies sitting in their holding pools. K-26 hopes its economic savior will be the completion of RT-2. This is a strategy for economic survival for K-26, but a potential plague for most of its neighbors.

Times really have changed in Russia. One example: K-26 now finds it needs a heavyweight public relations department. While hardly as smooth as their glossy western counterparts (they readily admitted to us that the people who live in Krasnoyarsk would just as soon K-26 did not exist), Russian PR people share the tendency of their Western counterparts for hyperbole and artfully selective use of data. As we drove by the artificial lake in the residential part of K-26, we were told how the residents of the closed city love to swim and fish in the lake's pure water and eat the uncontaminated berries they pick right outside RT-2's security fence. The Russian "spin managers" omitted to mention that the two reactors closed in 1992 used open cooling technology: Yenisei river water was pumped in to cool the reactors and were dumped untreated and with all its radioactive waste right back into the river. This caused massive, if uneven, pollution downriver and plutonium is detectable in high concentrations 2,000 kilometers north at the mouth of the river in the Arctic.

Politics of Reprocessing

K-26 residents recently voted to maintain the city as a closed site. (A visitor still needs prior permission, a visa, to enter this small magic kingdom [see sidebar, "A Visit to K-26"].) One cannot much blame the local population: the residential part of the complex is modern, clean, a kind of weird Swiss village inserted into the drabness of Russia. Keeping the city closed has achieved what affluent guarded and fenced residential communities in the U.S. aim for: material goods are kept inside and those who might want to earn or take some of them are kept out. The administration and residents of K-26 hope that RT-2 will be an economic savior, now that the world finds little need for more of its primary product -- plutonium for thermonuclear weapons.

Tom Clements, who follows plutonium issues for Greenpeace [see sidebar on confer-

ence participants], gave his assessment of the geopolitical realities for reprocessing. Clements felt that because of its opposition to the creation of yet more plutonium in the world, the U.S. would try to convince countries over which it has influence (notably South Korea) not to contract to reprocess spent nuclear fuel at RT-2. Without such international contracts and funding, the billions of dollars needed for completion and operation of the plant cannot be raised.

The next speaker, Prof. Yuri Yershov, a member of a high level Russian review panel on RT-2, forcefully responded that Russia did not need or welcome advice from foreign governments -- or foreigners in general -- on its national decisions. Yershov then proceeded to conclude that the project made almost no sense at all. His sensitivity to outside pressure probably flowed from several sources, including the loss of confidence and sense of well being that followed the loss of Russia's superpower status and possibly a desire to demonstrate that he was not a western (U.S.) pawn in contending with domestic hard line nationalists (the communists before the election were attacking Yeltsin in these terms). Yershov's sensitivity was easily understandable, but it led him to assert that the decision making process in present day Russia is balanced and fair, even within the Ministry of Atomic Energy (Minatom), whose legacy includes the nuclear devastation of Russia's environment, population, and economy. Minatom built, managed, and owned K-26. This writer cannot be as optimistic as Yershov.

Mycle Schneider of the World Information Service on Energy (WISE), Paris, described the terrible pollution record of Cogema and how reprocessing has left more, not less, residual radioactive waste than primary storage.

Paul Wilcox of British Nuclear Fuels (BNFL) had by far the conference's most elegant slides, which he used to defend his position that BNFL's reprocessing activities are environmentally sensitive, technically competent, will bring prosperity to the local community, and are an obligatory part of the developed nations' energy future. Martin Forwood of Cumbrians Opposed to a Radioactive Environment (CORE) told a very different story, describing BNFL's history of obfuscation and deception, regular radioactive leaks into both the Irish Sea and into the air, and unfulfilled promises of jobs for local people.

Jinzaburo Takagi, a nuclear chemist who worked for years in the Japanese nuclear industry, spoke of the leak of radioactive sodium from the Monju fast breeder reactor in Fukui Prefecture, north of Kyoto, last December. Takagi said the leak and, even more, the subsequent industry coverup, had engendered deep hostility by the Japanese public to Japan's plutonium program. Monju remains closed. Its reopening and the opening of Japan's reprocessing plant have become uncertain. The Japanese reprocessing plants, along with the cancelled German plant, suffer from the inherent faults of these technologies. They also suffer commercially because they are designed to pollute far less than Cogema (the worst) or Sellafield, which results in higher operating expenses. This concern for safety means they cannot offer their services as cheaply as the dirtier French and British plants.

Thus, the participants at this conference were left with an inescapable conclusion: a decision that could profoundly in-crease the danger of nuclear proliferation and terrorism -- and that could prove economically wasteful in the long run -- was going to be taken for a parochial and short term benefit that might, in any case, prove illusory: a jobs program for underemployed technicians and scientists from the formerly massive Soviet military establishment. ❧

References

1. International Physicians for the Prevention of Nuclear War, Institute for Energy and Environmental Research. Nuclear wastelands: A global guide to nuclear weapons production and its health and environmental effects. Cambridge, MA: The MIT Press. 1995.

2. Walker W. Why does reprocessing survive in Europe? In The fate of spent nuclear fuel: problems and reality. Third international radioecological conference (proceedings). Krasnoyarsk. 22-27 June, 1996.