

Responsible Expansion of Nuclear Power Requires Global Cooperation on Spent-Fuel Management

Nuclear energy growth on the scale needed to make a major contribution to mitigating climate change will remain wishful thinking unless some crucial requirements are satisfied. In addition to cost, safety, security, and peaceful use, there will have to be a sustainable solution for managing spent fuel and nuclear wastes—the so-called back end of the nuclear fuel cycle.

Highly radioactive spent fuel containing fissile plutonium should not end up in numerous locations scattered around the globe as more and more nations, both large and small, expand or introduce nuclear power. A small number of safely constructed and well-secured storage and disposal facilities must be the goal. The key challenge in this regard is the siting and construction of deep geological repositories for long-lived radioactive wastes. These repositories are expensive; even the smallest state-of-the-art deep facilities for high-level radioactive wastes (HLW) or spent fuel will cost several billion dollars. Even the much admired and most advanced small Finnish repository will cost around \$4.5 billion,¹ and cost estimates in the several tens of billions have been published for large programs such as those in the United States and the United Kingdom.

Many small nuclear programs or countries starting out in nuclear energy do not have the technical or financial resources to implement a national repository in a timely fashion. They will have to keep their spent fuel in interim storage facilities; this could result in numerous sites all around the world where hazardous materials will be stored for decades to hundreds of years. There must be a better way.

One safer and more secure option would be for nuclear-fuel suppliers to take back the spent fuel under a fuel “leasing” arrangement, in which they would pro-

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vide fresh fuel and take it back after irradiation. They would then add this leased spent fuel to their own larger stocks to be stored for later disposal, or for reprocessing and recycling into new fuels. However, although there is fierce competition among nuclear suppliers to provide reactors, fuels, and reprocessing services, as yet there are few willing to pursue this leasing approach.

The concept was included in the Global Nuclear Energy Partnership (GNEP) program, which the Bush administration launched in 2006 with the goal of restricting sensitive nuclear technologies to a limited number of supplier states.² In fact, the prospect of being able to return spent fuel to the supplier could well be the

only real incentive for small countries to accept restrictions on the peaceful use of nuclear energy like those proposed under GNEP—restrictions that go beyond those in the Nuclear Non-Proliferation Treaty. Unfortunately, the United States never made a serious offer to take back spent fuel in the GNEP discussions, and some other would-be supplier nations, such as France, even have national laws that prohibit taking back spent fuel unless the high-level wastes

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are returned to the user after reprocessing. The user country would therefore still require a geological disposal facility for these wastes. Moreover, if there were any cost savings in implementing a HLW repository rather than a spent-fuel repository, these would be far outweighed by the prices charged for the fuel reprocessing service.

Of all the nuclear suppliers, Russia has expressed the most support for fuel leasing and take-back. Russia's fuel-supply contract with Iran is a leasing contract, in which Iran is required to send the plutonium-bearing spent fuel back to Russia after it has been removed from the reactor. Current Russian law makes it possible to import foreign spent fuel for reprocessing and the return of wastes (as in France and Britain), but it also makes it possible for Russia to take back Russian-origin fuel without requiring return of the wastes, which appears to be the approach reflected in the contract with Iran.³ Russia has not yet offered such services widely, however, and with the current underdeveloped status of waste-disposal projects in Russia itself, some countries (and also the European Commission [E.C.]) would have reservations about taking up any Russian take-back offer.

The most promising option that remains open for small and new nuclear power programs is to collaborate with similarly positioned countries in an effort to implement shared, multinational repositories. Cooperation among geographi-

cally contiguous or nearby nations to develop shared regional repository projects may be the most credible approach, although the possibility that some country may decide to offer international repository services on a commercial basis cannot be excluded. The national advantages in sharing technology and in benefiting financially due to the economies of scale in implementing repositories are obvious. The global safety, security, and nonproliferation benefits of helping all nations have earlier access to state-of-the-art repositories are also clear. The big challenge, of course, is in achieving public and political acceptance in countries where repositories are hosted. Is it conceivable that a country and a local community within that country would willingly accept being a site for imported wastes?

Recent experience with national siting offers hope. Siting initiatives in several countries for either HLW or for low-level wastes have shown that success can be achieved through a modern strategy, one based on open communication, transparent documentation of potential benefits to host communities, steady accumulation of trust by the organization developing the repository, and recognition of the necessity of local acceptance. In a few countries (e.g., Finland, Sweden, South Korea), this has even led to competition between communities that want to host a repository. At the multinational level, it is possible that the same strategy may also succeed; however, as with the successful national programs, this may take several years.

Over the past few years, significant progress in this direction has been made in the Strategic Action Plan for Implementation of European Regional Repositories or SAPIERR project. The project, funded by the European Commission, has carried out a range of studies that lay the groundwork for serious multinational negotiations on the establishment of one or more shared repositories in Europe. The studies (all available on the website www.sapierr.net) have looked at legal and liability issues, organizational forms, economic aspects, safety and security issues, and the challenges of public involvement. The proposal that resulted from SAPIERR is a staged, adaptive implementation strategy for a European Repository Development Organization (ERDO). The first step in the strategy was to establish a working group of interested countries to carry out preliminary work to enable a consensus model for ERDO, using the SAPIERR findings as a starting point. The project team, realizing that further progress required commitments at the political level, contacted the energy or environmental ministries of potentially interested countries in the European Union. At the January 2009 pilot meeting of potential participants in the working group, 32 representatives from 14 European countries were present, all of whom had been nominated by their national governments.⁴ Also attending were observers from the International Atomic Energy Agency, the E.C., and American foundations. Strong support for further activities was shown, dates and venues for further meetings were decided, and all representatives undertook the task of formalizing the necessary agreements at the national level, which would enable the working group's activities for the next one to two years.

ERDO will be established in 2010, providing that a sufficient number of partner nations agree to the final proposals. It will operate thereafter as a sister organ-

ization to waste agencies from European countries that have opted for a purely national repository program, such as France, Sweden, Finland, and Germany.

By combining their resources in this way, the ERDO partners can also demonstrate to other regions of the world the feasibility of enhancing safety and security while increasing the economic attractiveness of nuclear power, even for small countries. ERDO also could act as a role model for regional groupings elsewhere. A number of Arab states have recently made clear that they intend to introduce nuclear power and have expressed a willingness to do so collaboratively. Close links being formed today between nuclear programs in Brazil and Argentina might usefully expand into a Central and South American grouping. In Asia, countries like Taiwan and South Korea have already experienced problems trying to implement disposal programs, and various other Asian states, such as Malaysia, Singapore, and Vietnam, have nuclear ambitions. An African regional grouping could also emerge, as various nations there are expressing interest in nuclear energy.

Joining forces to develop regional repositories could still have substantial advantages for small nuclear countries, even if the major nuclear powers at some stage reverse their policies and, for strategic or commercial reasons, offer to accept foreign spent fuel or radioactive wastes. By presenting a united front, and with the open alternative of a building a multinational regional repository, the partner countries would be much better placed in negotiations with potential large service providers over the economic and other conditions attached to any offer to take their spent fuel.

Nuclear power must be economically competitive to thrive. Disposal costs are not a major cost driver for large nuclear programs, but, for a country with only one or a few reactors, the multi-billion-dollar cost and substantial technical demands of establishing a national repository may be substantial factor in decisions. Regional repositories can help to address that problem. Moreover, if the spread of nuclear energy production is to occur without increasing the risks of global terrorism and nuclear proliferation, there must be close international scrutiny of all nuclear activities. This will be easier if all sensitive materials in the nuclear-fuel cycle are handled, stored, and disposed of at fewer locations. Shared disposal facilities for the spent fuel and highly radioactive wastes at the back end of the fuel cycle should be one key component in a secure global system.

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1. See http://www.posiva.fi/en/final_disposal/total_costs_and_funding_for_final_disposal/.
 2. The Obama administration has terminated GNEP's focus on near-term deployment of reprocessing facilities and fast reactors, but the fate of some of GNEP's proposed institutional approaches to the fuel cycle is less clear.
 3. For a useful discussion of the potential value of fuel leasing and of regional or international repositories, and of the Russian approach to this topic, see Committee on Internationalization of the Nuclear Fuel Cycle, U.S. National Academy of Sciences and Russian Academy of Sciences, *Internationalization of the Nuclear Fuel Cycle: Goals, Strategies, and Challenges* (Washington, DC: National Academies Press, 2008), pp. 40-42.
 4. The countries represented were Austria, Bulgaria, Czech Republic, Denmark, Estonia, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Romania, Slovakia, and Slovenia.