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Evaluating solutions to the nuclear waste problem

Most global nuclear technology agreements lack an important characteristic: They don't address how to safely deal with spent nuclear fuel. But two proposals suggest that viable options do exist.

BY CHARLES MCCOMBIE

SECURITY EXPERTS HAVE LONG FOUND THEMSELVES FACING A dilemma when it comes to the spread of sensitive dual-use nuclear technologies, namely uranium enrichment and spent fuel reprocessing. Since dual-use nuclear technologies are not banned under the Nuclear Non-Proliferation Treaty, the nuclear weapon states must provide incentives to encourage countries interested in developing nuclear power to forego their rights to sensitive aspects of the nuclear fuel cycle. The incentives are primarily the supply of reactor technology and the assurance of an uninterrupted supply of fresh fuel. But there is already a competitive open market for these services; so guaranteeing its continuation is not enough of an incentive by itself.

A more attractive offer would be for the fuel suppliers to take care of the waste—a contentious issue even in the larger nuclear countries. Russia and the United States have made constructive proposals toward this end, but the “take back” of spent fuel that was considered in the early days of the Bush administration’s Global Nuclear Energy Partnership (GNEP) and the Vladimir Putin-sponsored Global Nuclear Power Infrastructure (GNPI) is no longer discussed because of domestic public and political opposition to accepting foreign waste. In fact, most of the bilateral agreements between nuclear provider states (primarily the nuclear weapon states) and small states aspiring for a new or expanded nuclear power program simply do not address the long-term management and disposal of spent fuel and high-level waste (HLW).

Although the waste disposal problem is significant, it can easily be postponed since it does not present an imminent danger. State-of-the-art stores for spent fuel or HLW in pools, dry casks,

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or vaults are all relatively safe for extended periods of time. But if the waste disposal issue is ignored completely, the world will find itself in a situation where fissile or highly radioactive materials are stored at scattered locations in dozens of countries, which may not all have the resources or the social stability needed to ensure long-term safety and security. This scenario would be a dangerous and undesirable outcome. Therefore, two International Atomic Energy Agency (IAEA) proposals that address this potential problem are worth significant consideration: the add-on approach and the partnering approach.

The add-on approach. This method of nuclear waste disposal refers to a situation in which a large nuclear state that requires an expensive deep geologic repository for its own waste agrees to accept the waste of smaller countries as well. This might be for profit, with the large country benefitting from economies of scale, or it might be for security reasons, particularly in cases of spent-fuel transfer since every ton of spent fuel contains around 10 kilograms of weapons-usable plutonium. Proposals of this sort have been made in both the GNEP and GNPI projects. GNEP's proposal termed the latter option "take back"; that is, the United States would take back nuclear fuel it had sold to a GNEP member after it had been irradiated in a foreign reactor.

GNEP never introduced this take-back strategy properly into U.S. domestic policy because political opposition might have led to rejection of the initiative, thus endangering ambitious national plans for fuel reprocessing at proposed new U.S. facilities. In any case, GNEP's reprocessing plans now have been abandoned under the Obama administration, making the U.S. take-back scheme irrelevant. It is nevertheless important to note that even if an offer to take back fuel for reprocessing had been extended, it would not have solved small and new nuclear countries' disposal problems, unless all of the waste created in the reprocessing plant were retained by the United States. If the HLW and other long-lived radioactive wastes were to be returned, the smaller client country would still need to build an expensive deep geological repository, thus negating any benefit from a take-back scheme. In short, without full take back of the waste, direct domestic disposal is the easier and cheaper option for any state with a nuclear program.

Russia's GNPI proposal also had flaws. Due to the widespread domestic opposition to waste imports, Russian offers to take back fuel for reprocessing are normally conditional on HLW being returned to the fuel owner. The exception to this policy is the agreement Russia has with some of its former satellite states. Specifically, Russia is prepared to accept the spent fuel it supplied to these former Soviet states and to retain all reprocessing products from that

fuel. Moscow has proposed a similar agreement for Iran's almost-completed, Russian-built Bushehr nuclear plant, partly in order to address Western concerns regarding Iran accumulating large quantities of spent fuel.

The prerequisites for successful siting of a geological repository—whether national or multinational—are that the stakeholders recognize they have a common need for a repository, that sufficient trust and confidence is placed in the implementing body, and that everyone accepts that the host is entitled to benefits for providing a valuable disposal service.

It is conceivable that an add-on solution to small nuclear states' waste disposal needs may emerge in the future—particularly if increasing global security concerns convince one or more of the nuclear weapon states to accept spent fuel without insisting on the return of HLW. This was, after all, a normal practice in the 1970s by France and Britain, both of which still operate commercial reprocessing facilities with international clients but that now insist on returning HLW. Alternatively, a large non-nuclear weapon state such as Japan may be able to accept considerable quantities of foreign fuel for reprocessing without significantly increasing its own self-generated HLW stores.

A final option would be for a country with a small or non-existent nuclear program to offer disposal services for profit. Studies have shown that such a scheme could be a tremendous economic opportunity if political opposition could be surmounted. At the end of the 1990s, a major proposal along these lines was made for an international repository in Australia—but intense political opposition prevented even an open public discussion on the issue. Of course, the international nuclear community should not support such an option unless state-of-the-art disposal facilities were implemented and operated in the host country. The global benefits are so large that advanced nuclear states should be prepared, if necessary, to assist any willing host country in this regard. Furthermore, the IAEA would need to provide strong monitoring and control functions.

The partnering approach. Despite the potential for an add-on solution, the most realistic approach to ensuring that safe and secure disposal facilities are available to all countries with spent fuel is the partnering concept. Specifically, a group of countries with (likely small) radioactive waste inventories that require deep geological disposal would come together to identify one or more regional repository sites. So far, however, this has been written off as an unlikely scenario since national governments are unlikely to volunteer as hosts. But national governments are increasingly aware that repositories must be sited in willing local communities, and local support for a multinational initiative may be no less likely than

local support for purely national facilities. Thus, multinational repository siting may be more challenging in practice but no different in principle than the task faced by modern national siting efforts.

The prerequisites for successful siting—whether national or multinational—are that the stakeholders recognize they have a common need for a repository, that sufficient trust and confidence is placed in the implementing body, and that everyone accepts that the host is entitled to benefits for providing a valuable disposal service. In the multinational approach, it is crucial to be clear about the extent of the commitment being made by partner countries upon joining a shared repository and then throughout the long process. Siting could then proceed under these series of guidelines and assumptions:

Potential host sites result from voluntary expressions of interest at the community level. The potential host country's national government would, at a minimum, have to agree not to block or forbid local community interest in volunteering. In practice, encouragement and political support by the national government would be not only helpful but necessary.

Potential host countries need to establish a clear selection process and corresponding mechanisms. One approach to beginning the siting work would be to establish agreed upon technical and nontechnical exclusion criteria for clearly unsuitable land areas and then to request volunteer locations in non-excluded land areas from partner countries.

Partners should be allowed to enter the project at different stages. Since a sensible estimate of the implementation costs and the scale of benefits and impacts to the host country and community can be assessed only after the scope of the project is known, the project should allow partners to join throughout the formative stages of the process.

Partners that already have developed national siting programs should be able to pool their knowledge. These partners also will have to decide how to interact with sites and communities that already are being considered as possible national repository locations.

Currently, the most intensive work on a regional or multinational partner-based repository is being done in Europe. A project named Strategic Action Plan for Implementing European Regional Repositories, or SAPIERR, concentrates on the feasibility of establishing one or more regional repositories serving several European countries. This project and its earlier pilot project were both funded by the European Commission.

The goal of SAPIERR was to facilitate debate on establishing a modestly sized, self-sufficient European repository development

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organization that can work in parallel with national nuclear waste agencies. It was responsible for performing specific studies on the economics, design, public and political attitudes, safety, and security of shared storage and disposal facilities, and for achieving a consensus from a number of nations on a preferred way to establish

such a repository. After SAPIERR's findings were published at the end of 2008, it was realized that further progress required support from interested countries at the political level.

Accordingly, contacts were made to more than a dozen European Union states at the ministerial level, which led to the establishment of a working group on a European Repository Development Organization (ERDO). Over the next two years, the participants will discuss the aspects of the organization (such as size, structure, work program, and financing mechanisms) that need to be agreed on before it is possible to create the formal regional repository implementation body. At the second meeting of the ERDO Working Group in Prague in September, more than 10 countries were represented. Notably, narrowing down the candidates for potential siting regions and countries will not take place until well after ERDO begins its operations.

The concept being developed by SAPIERR also is applicable elsewhere in the world where small nuclear programs exist or new nuclear programs are being proposed. Additional bodies could be established in the following regions:

Asia. Taiwan and South Korea have challenging geological environments and have had considerable problems in siting national disposal facilities, even for low-level waste. Considering these challenges and their substantial nuclear programs, Taiwan and South Korea would be clear candidates to partner with other countries in the region now considering initiating nuclear programs (e.g., Vietnam, Malaysia, or Indonesia).

Middle East. The Gulf States already have established a cooperative effort to introduce nuclear power. The United Arab Emirates and Kuwait are developing comprehensive plans to build a domestic nuclear infrastructure. Jordan also has expressed its wish to do the same and has supported regional disposal concepts. Other Arab countries such as Algeria and Egypt are possible candidates as well.

Central and South America. Mexico, Brazil, and Argentina each have nuclear power plants and need disposal solutions. The latter two countries already have initiated close cooperation in the

fuel-cycle area. Chile and Peru also are considering future nuclear power programs and could be likely participants.

Africa. South Africa has great nuclear ambitions (in addition to the two nuclear power plants it operates today) and currently is pursuing a national strategy rather than a regional one. It also has large swathes of territory where safe geological repositories could be implemented (for itself or for regional partners). Ghana, Nigeria, and Namibia, all of which are reportedly interested in nuclear power and potentially would need access to repository services, could be good customers.

In each of the possible partnerships, it is important to note that—as in the European case—there should be no rush to try to identify sites at an early stage. Experience in national programs has shown that there are many preparatory steps needed for a successful siting effort, steps involving both technical studies and societal measures to enhance trust and confidence in the implementing organization.

In the interest of all states. Providing safe and secure disposal options, particularly to small and new nuclear states, is a powerful incentive for them to voluntarily forego their right to implement a peaceful nuclear fuel-cycle program. It would certainly increase global nuclear security, in part by reducing stocks of spent fuel in countries that will otherwise have to wait for decades to implement geological repository plans. It is in the interest of the global nuclear community to encourage any initiatives that can help provide access to state-of-the-art disposal facilities. The large countries that are close to implementing national repositories show no interest in accepting spent fuel or HLW from others. Thus, partnering programs between small and new nuclear countries appears to be the most promising approach. The value of multinational shared repositories has been recognized by numerous small European nations, as many of them have agreed to collaborate in the next ERDO Working Group planning stage. Unfortunately, a few have been so badly affected by the current economic crisis that they are having problems raising even the modest funding required for this next stage. Given the global significance that progress made in this area would mean, direct support for such countries from large national nuclear programs or from international agencies would represent a valuable contribution toward a safer nuclear world. ■

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