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Time to Rethink Nuclear Waste Storage

*The government
must enlist the public
as an ally
in its efforts to find a
permanent repository.*

The 35-year effort to find a permanent repository for the nation's high-level radioactive nuclear waste is on the verge of collapse. Although most scientific experts are convinced that such a facility—sited for a site deep in Yucca Mountain, Nevada, about 90 miles north of Las Vegas—would pose little risk to public health or the environment, vehement public opposition has blocked any significant progress.

Most experts have always believed that the many complex technical problems of permanent nuclear waste storage—formidable as they are—could eventually be solved. The major backers of a repository—

the nuclear power industry—have pressed for a solution, not only because they are eager to get rid of the wastes piling up next to their reactors but also because they believe that the future of nuclear power is

grim without an effective management program. Meanwhile, U.S. officials, in particular the Department of Energy (DOE), the repository developer, have plunged ahead, slighting uncertainties and putting technical, scheduling, and cost considerations above all others.

But neither federal nor nuclear-industry officials have ever adequately understood or dealt with the fundamental cause of the current impasse: the depth of public concern about the siting of a nuclear waste repository. These concerns have been heightened by pervasive distrust of both Congress and DOE, built up during three decades of ill-fated attempts to dictate a solution.

Although large amounts of money have been poured into the scientific and engineering aspects of high-level radioactive waste disposal, virtually nothing has been done to actively enlist the public in the siting process or to collaborate with the public in forging a solution. Social acceptability has always taken a back seat to technical concerns. But until both are put

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on an equal footing, no solution will be possible. Indeed, given the levels of public opposition and distrust, Congress should scrap the current program and reconsider the options.

No compelling reason currently exists for siting a permanent repository at an early date. Technology developed in the past decade, especially dry-cask storage, provides assurance that wastes from commercial reactors can be stored safely for a lengthy period at current sites. In the longer term, reprocessing may reduce the volume of high-level wastes; storage elsewhere than in a geological repository may prove attractive; and experimental techniques such as transmutation—aimed at radically reducing the amount of time that wastes remain highly radioactive—could help solve the problem.

In the meantime, the United States must begin a long-term effort to engage the public in a process of active collaboration. In doing so, the United States has much to learn from other countries, where innovative approaches and techniques have begun to establish public confidence.

The scope of the hazard

High-level radioactive waste includes two major components: spent fuel from reactors at nuclear power plants and the various byproducts of nuclear weapons production. Although spent fuel accounts for less than one percent of the volume of all the high- and low-level radioactive wastes generated in the United States, it produces 95 percent of the radioactivity. Some of its radioisotopes pose grave dangers for hundreds, even thousands of years. For instance, the half-life (the time required for half the original radioactivity to decay) of plutonium-239 is 24,400 years.

The amount of spent fuel is growing rapidly. The nation's 110 commercial nuclear reactors, located at 72 sites mostly east of the Mississippi River, will have produced about 40,000 metric tons of high-level waste by the year 2000 and a combined total of about 105,000 metric tons during their operating lives. (If it could be consolidated, 40,000 metric tons of waste would fit in a 15-foot-high warehouse the size of a football field.)

Currently, most of this spent fuel is being stored at reactor sites in specially designed cooling ponds, which have been in operation at some plants for 30

years or more and have proved safe. DOE eventually wants to ship this waste to a centralized storage depot called a monitored retrievable storage (MRS) facility. DOE argues that, among other things, an MRS facility is needed to consolidate the wastes for greater efficiency in handling, storage, transportation, and eventual permanent disposal. Site selection for such a facility faces the same intense public scrutiny as the proposed Yucca Mountain repository. In 1987, DOE was forced to abandon a proposed MRS site in Oak Ridge, Tennessee, after strong public opposition and concern among state officials over potential adverse economic effects.

The problems of handling spent fuel pale in comparison with the waste problems at nuclear weapons production facilities. DOE has been embarrassed by huge leaks of radioactive wastes and other difficulties at its plants at Hanford, Washington; Rocky Flats, Colorado; and elsewhere. The storage and cleanup problems are considered so difficult and expensive that some experts have argued that certain areas of facilities such as Hanford should be permanently cordoned off. Mismanagement of the waste situation at the weapons plants has done much to discredit DOE's role in siting a permanent civilian repository.

Whatever the difficulties posed by temporary storage, they are dwarfed by the immense challenges involved in siting a permanent repository. The U.S. Environmental Protection Agency, charged by Congress with setting performance standards, has told DOE that it must provide assurances that human and environmental exposure to radioactive elements will not exceed stringent standards for 10,000 years. This long period—twice that of recorded human history—creates serious uncertainties in every area of scientific study. If a 10,000-year warranty is necessary, no wonder the public has grave doubts about the reliability of a permanent repository.

The public's nuclear dread

Although it is hardly news that the public is opposed to the siting of radioactive waste dumps, what is startling is the depth of public fear and revulsion. The public's visceral horror of all things nuclear has never been adequately understood by the government or the nuclear power industry, which have tended to dismiss such concerns as irrational and rooted in misperception and misinformation.

The extent of these fears can be seen in a study (in which two of the authors of this article were involved) that asked people to provide the words, thoughts, or images that came to mind when they heard the phrase, "underground nuclear waste repository." The four most frequent single associations were dangerous, danger, death, and pollution. In addition, there were a large number of images referring to war, annihilation, weapons, and things military. In short, the responses revealed pervasive dread, revulsion, and anger.

Other perception problems exist as well. For instance, surveys of residents of southern California, Nevada, and the nation as a whole found that people believe that the state where a repository is sited could be stigmatized as a "nuclear dump state," deterring others from moving to the state, visiting as tourists or convention-goers, or investing money there. For Nevada in particular, which is almost wholly dependent upon tourism for its economic wellbeing, the prospect of stigmatization is a serious concern.

Two further examples illustrate the public's extreme sensitivity to the siting of a nuclear waste facility. In 1986, DOE and Congress, after selecting seven states for preliminary siting studies, were forced to abandon work on a possible second permanent repository, to be built in the eastern United States after the first repository was filled. Even the remote possibility that their communities might be selected several decades in the future led unhappy residents to protest. Second, in March of 1991, residents in sparsely populated Grant County, North Dakota, voted all three county commissioners out of office in a recall election after officials applied for a \$100,000 grant to study the possibility of hosting an MRS facility. The public was not mollified by the fact that acceptance of the money did not in any way entail future obligation.

The rocky road to stalemate

More than three decades of ill-fated DOE efforts to find a repository site have engendered a huge amount of public distrust. A highly publicized attempt to investigate an abandoned salt mine in Lyons, Kansas, as a permanent site ended in embarrassment for DOE in

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1973, and efforts since then to examine possible sites in a dozen other states never got beyond the preliminary screening stage.

DOE's failure to make any significant progress led Congress to pass the Nuclear Waste Policy Act of 1982, signed into law by President Reagan on January 7, 1983. Among other things, the act called for the investigation of multiple possible sites and, for the first time,

extensive public participation in the siting process.

Congress and the nuclear industry, however, soon lost patience with the inevitable delays involved in such an open process. In late December 1987, in a curious miscalculation intended to resurrect the failing waste-disposal effort, Congress approved major amendments to the Nuclear Waste Policy Act. Without formal hearing, discussion, or debate—the revisions were attached to an appropriations bill—Congress named Yucca Mountain as the sole site to be investigated, even though only rudimentary studies had been completed.

Technical, economic, and political reasons were cited for choosing Nevada. Congress considered the barren, remote Yucca Mountain site technically acceptable and cheaper to develop than sites being considered in Texas and Washington. In addition, it would be less expensive to study only one site. Moreover, Congress wanted to put the project back on a fast-track schedule to appease the nuclear industry. Most naively, Congress thought that opposition in Nevada might be less than elsewhere.

Nevadans, of course, reacted to the subverting of the integrity of the siting process with outrage—an anger and opposition that has continued to build since the 1987 decision. Six major surveys of Nevada residents between 1987 and 1991 have recorded a consistent level of 75 to 80 percent opposition to the project. Nevadans are particularly irate because the state does not have a commercial nuclear reactor and because it already hosts a low-level waste facility and a site for testing nuclear weapons.

Since the 1987 decision to select Yucca Mountain, DOE has continued to stumble in its management of the high-level nuclear waste program. The agency's overall approach—its excessive concern with techni-

cal considerations, scheduling, and cost—was severely criticized in a 1990 report by the Board on Radioactive Waste Management of the National Research Council (NRC). The board chastised DOE for its insistence on a rigid schedule, for trying to write detailed regulations before all data are in, and for its “scientifically unsound” use of geophysical computer models to assess long-term isolation of nuclear wastes. “DOE managers,” the board said, “tend to feel compelled to do things perfectly the first time, rather than to make changes in concept and design as unexpected geological features are encountered and as scientific understanding develops.” This approach, the board said, was particularly perilous given the 10,000-year safety requirement, adding that, “a policy that promises to anticipate every conceivable problem or assumes that science will shortly provide all the answers is bound to fail.” The board recommended a flexible approach based on the established principle, used in commercial mining and underground construction, of “design (and improve the design) as you go.”

The NRC board also assailed DOE for failing to recognize that “safety is in part a social judgment, not just a technical one.” Technical analyses can help provide answers to the question of how safe is safe enough, but since safety cannot be 100 percent guaranteed, citizens must ultimately make the decision. Instead of trying to provide absolute guarantees, the board said, DOE must find ways “to assure the public that the likelihood of serious unforeseen events (serious enough to cause catastrophic failure in the long term) is minimal, and that the consequences of such events will be limited. These assurances rest on the credible application of general principles, rather than a reliance on detailed predictions.” Unfortunately, DOE has not adequately responded to this advice, and, given its regulatory requirements for permitting and licensing, may not be able to.

Lessons from abroad

Difficulties in siting a high-level waste repository are not, of course, restricted to the United States. In Europe, Canada, and Japan, there has often been fierce public opposition. Yet all are making efforts to defuse public anger, and Sweden has even managed to build a certain level of public confidence.

The Europeans in particular are making progress because they have done two things differently than the

United States. They have rejected a strategy of early permanent waste disposal, and they have placed considerations of equity, fairness, and social acceptability on an equal footing with technical goals.

In Sweden, the successful siting and development of a central interim storage facility has provided long-term storage capacity for spent fuel, enabling the search for a permanent disposal site to proceed deliberately and with more time for resolving technical uncertainties and addressing social and political issues. The Swedes have located the interim facility adjacent to an existing reactor, in recognition that communities with the experience of hosting a nuclear plant tend to be more willing to accept waste storage facilities.

None of the European countries is in a hurry to find a permanent disposal site. Sweden expects to keep its spent fuel in temporary storage for at least 40 years and will not choose a repository site until 2003–2006. France intends to spend at least 15 years studying the suitability of various sites before making a recommendation. Germany and Great Britain also envision lengthy storage of wastes before emplacement in a repository. Even Canada, which lacks a centralized interim storage facility, does not intend to recommend a site until the public has accepted the disposal concept.

In responding to the difficult social acceptability issues, Congress and DOE could learn much from the experiences of France and Sweden. For a long time, France, with 51 nuclear plants providing about 70 percent of the nation’s electricity, pursued a hardball strategy in which safety was considered to be a “problem of techniques” and site selection a matter for experts. The government fiercely resisted public opposition. But as public concern mounted, the government, finally recognizing that any solution ultimately must be politically sound and workable, put a moratorium on disposal and restricted the number of sites that would be considered. Although a national debate promised by President Mitterand has yet to take place, a nuclear waste negotiator has been appointed to work with potential host communities and find prospective sites for the construction of two underground testing laboratories. Only after lengthy characterization and assessment will one of the sites be recommended to the French parliament, which will then make a broad-based political decision on disposal and legislate the key features of repository design.

Sweden, with 45 to 50 percent of its electricity

generated by 12 nuclear power plants, has made an aggressive effort from the beginning to involve the public and critics through the well-established Swedish "remiss process." This process involves the wide dissemination of a proposed public policy to diverse stakeholders in Swedish society who evaluate and comment on the proposal in writing. The sponsors are then responsible for responding in writing to all the comments and often make modifications designed to shape a broad national consensus. In nuclear policy matters, the public is regarded as the ultimate judge. In addition, the radioactive waste program has been subjected to a special review process involving experts from around the world. The Swedish approach reflects a determination to accommodate rather than override local concerns and to fashion a national consensus on nuclear waste disposal within which siting efforts can proceed.

Perhaps most important in the Swedish approach is its strong sensitivity to issues involving not only the current generation but the wellbeing of future ones as well. For instance, the Swedes have decided that the repository should be designed so that surveillance and maintenance will not be required to ensure safety, yet changes can be made if more suitable methods of waste disposal become available. They have also elevated safety concerns above cost cutting. Such steps have helped build public support. Indeed, recent opinion polls indicate overwhelming support for radioactive waste disposal within Sweden rather than export abroad. There even appears to be considerable support for siting a repository in one's own region.

Other countries also are experimenting with new approaches to building social acceptance. In Germany, the public can tour the site of the proposed waste repository at Gorleben and read any document relating to the project. France plans extensive negotiations with prospective host communities to resolve siting conflicts and will offer an "image loss" tax subsidy of \$11 million⁴ per year to communities accepting even the underground test facilities. Substantial economic incentives, such as preferential hiring and purchasing and regional development assistance, also will be offered. Canada has committed itself to negotiation and

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voluntary acceptance by the host province of a repository; specifically, the government has determined that it will not attempt to override a federal-provincial deadlock.

The European experience demonstrates that the United States is becoming increasingly isolated in its attempt to override, rather than respond to, state and local concerns.

To have any prospect of success, the United States must develop approaches that are socially acceptable as well as technically sound, collaborative rather than preemptive, and predicated on persuasion and negotiation rather than coercion.

Toward a new beginning

The current U.S. repository siting program does not begin to satisfy these basic principles; indeed, it is often in conflict with them. The level of trust needed to conduct a siting process free of coercion does not exist. Scientists disagree about the suitability of the Yucca Mountain site and about the appropriate criteria for licensing and constructing a repository. DOE denies that stigmatization is a possibility in Nevada and believes—along with the nuclear industry—that such fears are irrational. No current avenues exist to resolve these disagreements, except through court suits.

The United States must take dramatic action to establish a workable process for siting nuclear waste repositories. Such a process can be built on the experience of other countries and on the work of a group of researchers and practitioners (including the authors of this article) who have developed a "facility siting credo"—a set of principles aimed at overcoming negative reactions and developing greater trust. Though many elements are needed to establish a process that works, three are particularly crucial:

Rethink the waste solution. Congress should place a moratorium on the existing program and begin work on new legislation. The current deadline of 2010 for beginning operation of a repository should be removed. The legal requirement that an interim storage facility cannot be licensed until a permanent repository is developed should be rescinded. In this way a search for temporary facilities can proceed

while technical studies of the problems involved in developing a permanent repository continue.

Scientific studies should, of course, be continued. Alternative technologies, such as transmutation and seabed disposal, should be evaluated. Serious efforts should be devoted to development of engineered multibarrier systems. More studies of various media for deep geological disposal, such as salt, clay, or rock, should be conducted in order to better understand the comparative advantages and shortcomings of these options. Additional technical cooperation with other countries in these areas and others should be emphasized and an international review of U.S. approaches should be considered.

Use a voluntary siting process. It is unwise to attempt to locate either a temporary or permanent facility for radioactive wastes without the support of the host community and state. Indeed, Congress should mandate that no community be forced to accept a repository against its will and then establish a broad-based participatory process as a means of developing greater trust. The public and representatives of all affected parties should participate in all stages of the siting and development process. Where direct participation is impractical, public views can be solicited through interviews, surveys, or special advisory committees. Interested and affected parties should have a full opportunity, supported with resources provided by the federal government, to review site selection criteria, identify research issues and data collection needs, and critique the findings and criteria on which siting decisions are based.

A compensation package could be negotiated to address potential stigma effects, perhaps by funding local facilities, projects, and improvements that would offset any potential adverse impacts. Procedures to make sure that the facility meets safety, health, and environmental standards must be acceptable to communities and states as well as to the facility developers and their licensing agencies. Beyond this, mitigation for unexpected problems and accidents, such as a repository failure, should be provided. Different compensation and mitigation packages should apply to each potential site. For example, in areas dependent on tourism, such as Nevada, the potential for stigmatization needs particular attention.

A homegrown model can be found in the siting

process for a monitored retrievable storage facility, which is being designed under the assumption that a repository will be built at Yucca Mountain. David Leroy, appointed as the first U.S. Nuclear Waste Negotiator in August 1990, and charged with finding an MRS site, has taken a number of steps designed to establish an open and credible dialogue between interested communities and the federal government. His office has produced a set of materials that explain the relevant technical and scientific issues in a format that is accessible and comprehensible to a general audience.

Leroy, a former attorney general and lieutenant governor of Idaho, is setting a new standard for siting waste disposal facilities by following two basic principles that enable the public to play an active role in the process. First, he maintains that there are no irrelevant issues. Anything that concerns citizens is important. Second, all items of a siting proposal are negotiable, including the choice of technology, how a facility is operated and controlled and by whom, and the size and scope of any compensation or benefits package.

Leroy's new strategy is already bearing some fruit. As of May 1992, planning grants of \$100,000 had been made to 19 communities or Indian tribes that expressed a serious interest in exploring the possibility of hosting a MRS facility. These funds are for feasibility studies, public information efforts, and other kinds of public outreach activities. Leroy has made it clear that acceptance of a grant does not imply a commitment to accept an MRS facility; the prospective host can terminate the process at any time, as five of the communities have done. One Indian tribe, however, has completed the initial planning activities and is now undertaking a more detailed evaluation of the proposed MRS facility.

The encouraging response to the nuclear waste negotiator's new strategy indicates that a voluntary siting process has some promise. But it is too early to draw any conclusions and a number of important questions must be answered. What process should be followed if an MRS site is not found using a voluntary approach? How will the government choose if more than one community, region, or Indian tribe decides that it wants to host the MRS? How much authority and control will host communities and states be allowed? What limits will the federal government want to place on liability, compensation, and mitigation ef-

forts? Can the federal government provide assurances as to just how temporary a MRS facility will be? Will a negotiated process be given the time and support needed to provide a fair test of the voluntary option?

Keep multiple options open. It is not a good idea to have just one possible location for a permanent facility, even at the final stage of the selection process. Cultivating several options is particularly crucial in the case of a first-ever repository with its great uncertainties and potential for public opposition. Rather than trying to force compliance, future efforts should seek volunteers from several different regions. Competition between potential host communities will moderate benefit demands. At the same time, it will tell the facility developers what the range of costs will really be for a volunteer community and state. Only when the affected public feels that there is more to lose by not having the facility than by becoming the host location will an acceptable solution be at hand.

New legislation is needed to get the national waste program on track. In addition to requiring that the siting process be completely voluntary, Congress should take two major steps. First, the management of military wastes should be separated from the spent fuel and civilian wastes program. DOE's problems at the nuclear weapons production plants have severely compromised its credibility and its efforts to solve the civilian waste problem. In addition, the tasks involved in cleaning up existing contaminated sites are vastly different from those of managing a complicated siting and development process for storing wastes. Given DOE's record of management failures, it is unlikely that it will ever be able to gain public support for a civilian waste program. This argues strongly for the second major step: Congress should establish a new agency or organization to operate the civilian waste program.

The U.S. Nuclear Waste Negotiator could play an important role in assisting a new federal effort. An honest, objective broker is badly needed to help federal program managers communicate and negotiate with communities and states. The independence that David Leroy has established would provide a valuable contribution to a new start on solving the storage problems.

Obviously, there is no simple solution to the prob-

lem of permanent disposal of high-level radioactive waste. In order to gain public approval, however, a fair and equitable siting process is absolutely essential. Only through a long-term process of building public trust and deeply engaging potentially affected communities in the planning process will we be able to create a viable program and achieve satisfactory solutions.

Recommended reading

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