



**UNITED STATES  
NUCLEAR WASTE TECHNICAL REVIEW BOARD**  
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September 16, 2013

The Honorable Rodney P. Frelinghuysen  
Chairman  
Subcommittee on Energy and Water Development  
Committee on Appropriations  
2362B RHOB  
U.S. House of Representatives  
Washington, DC 20515

Dear Chairman Frelinghuysen:

I want to thank you again for the opportunity to testify before the Subcommittee on Energy and Water Development on April 11, 2013. One of the questions I was asked to address at the hearing is “What do international and U.S. experiences tell us about consent-based siting?” In light of recent developments, with this letter I provide additional comments that I believe are relevant to the question posed by the Subcommittee on the experience gained through Board interactions with disposal programs for high-level radioactive waste (HLW) and spent nuclear fuel (SNF) in Sweden and France.\*

In February 2010, the Administration announced, among other things, that it intended to disband the Office of Civilian Radioactive Waste Management (OCRWM) and transfer its responsibilities to other units within the Department of Energy (DOE). On October 1, 2010, OCRWM ceased to exist. The Blue Ribbon Commission on America’s Nuclear Future (BRC) recommended that a new single-purpose organization be created outside of DOE to replace OCRWM. But, regardless of whether a deep-mined geologic repository for HLW and SNF is developed at Yucca Mountain or legislation is passed that changes the direction of the country’s approach to nuclear waste management, a new implementing organization for the repository program will likely have to be established.

What kind of implementing organization should be created in this case is a matter for decision-makers in Congress and the Administration to determine; only policy-makers can balance the competing objectives that are inevitably associated with the creation of a new institutional form. Importantly, both the BRC’s final report and the Administration’s “Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste”

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\* Copies of this letter also will be forwarded to the Senate Committee on Energy and Natural Resources as follow-up to previous Board comments on the Committee’s nuclear waste legislation and to the Senate Committee on Public Works, Subcommittee on Clean Air and Nuclear Safety, to follow up on comments made by Board Senior Professional Staff member, Daniel Metlay, at a hearing held by the Subcommittee in July 2012.

recognize that institutional issues and choices can affect technical activities.<sup>1</sup> That link between institutional design and scientific and engineering execution prompts this letter.

Since its establishment, the Board has followed closely the work of other national waste management programs to learn how they have addressed the same set of challenges and issues that the program in the United States necessarily must confront. Over the years, delegations from the Board have visited Sweden and France and met with personnel from each country's implementing organization (SKB in Sweden and ANDRA in France) as well as with other parties such as radioactive waste producers, regulators, overseers, and leaders of communities that are potential hosts to a deep-mined geologic repository. What follows are observations derived, not only from those interactions, but also from Board evaluations and reports.

- Successful waste-management programs are being implemented by private, hybrid, and public organizations.
- Successful implementing organizations emphasize a single-minded commitment to long-term safety, including, but not limited to, complying with the requirements of the regulatory authorities.
- Successful implementing organizations place a high value on sustaining public trust and confidence and accord a high priority on doing so in their everyday choices.
- Successful implementing organizations establish processes by which they respond to new information and circumstances.
- Successful implementing organizations appreciate that disposing of HLW and SNF presents operational challenges and, therefore, develop prototypes and techniques to address ahead of time those challenges.

The basis for these observations is elaborated upon in the remainder of this letter.

### **How an organization functions is more important than its structure**

Debates over whether the implementer of a high-level radioactive waste management program should be a public agency, a public-private hybrid, or a private company cannot escape the fact that all of those institutional forms have been effective in at least one country. Which approach is best for the United States will continue to be contested because claims are based largely on impressionistic evidence, "expert" judgments, and anecdotes—not on systematic analyses.

However, the weight of evidence and experience supports the proposition that, all other things being equal, an implementer focused on a single purpose is more effective than one that has multiple objectives. In the 1982 Nuclear Waste Policy Act (NWPA), Congress established OCRWM as a single-purpose office in DOE with the aim of elevating the importance of the disposal program within the multipurpose agency. However, embedding OCRWM in DOE only

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<sup>1</sup> Among other things, the BRC expected that its recommended new organization would be able to "achieve and sustain high standards of technical" performance. BRC, *Report to the Secretary*, (Washington, 2013) p. 62. Department of Energy, "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," (Washington, 2013).

partially reversed the low priority previously accorded to waste management; OCRWM had to compete with other DOE units for resources and attention, and OCRWM could not escape criticisms directed at the parent agency. The Board and many others have noted that this situation complicated OCRWM's technical efforts.

Almost universally, other nations have taken a different tack.<sup>2</sup> By the mid-1970s, Sweden and Finland had created single-purpose implementing organizations. The French Parliament in 1991 completely separated ANDRA from the larger Commissariat à l'énergie atomique (CEA). Since then, more than a half-dozen countries, including Belgium, Canada, Hungary, Japan, Spain, and Switzerland, have opted to give to single-purpose organizations the responsibility for the long-term management of HLW and SNF.<sup>3</sup>

Yet, as implicitly recognized in a recent RAND study<sup>4</sup> commissioned by DOE's Office of Nuclear Energy, what counts most is not organizational anatomy (how the pieces are structured and tied together) but organizational physiology (how the pieces behave, interact, and function).<sup>5</sup> From the Board's perspective, the two key "physiological" elements are (1) the impact of organizational culture on technical work and (2) how the organization responsible for implementing a nation's waste management program addresses critical scientific and engineering issues. Because both the Swedish and French programs are so advanced, examining how SKB and ANDRA function may suggest important lessons for any new implementing organization.

### **Organizational culture drives organizational behavior**

SKB leaders have remarked on a number of occasions and SKB managers have repeatedly maintained that the organization's mission could be summarized simply: (1) demonstrate long-term safety and (2) sustain public acceptance. ANDRA's personnel have not characterized their mission as succinctly but, like the Swedes, they have made clear that other objectives, such as schedule and cost, are subordinated to safety and acceptance.

The language used by the implementers in both nations differs substantially from comparable expressions used by OCRWM in the past. The emphasis in Sweden and France is on advancing a clear and persuasive safety case and then carrying out a focused research *and* development program designed to address key scientific and engineering questions. Although both implementers are unavoidably concerned about obtaining permission from the authorities to construct a deep-mined geologic repository, only rarely do they describe their work as directed toward satisfying regulatory requirements. Obtaining fundamental scientific understanding and

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<sup>2</sup> The implementer in the United Kingdom (NDA) is not a single-purpose organization; but plans have been announced to split off a separate single-purpose unit to develop a deep-mined geologic repository. The new implementing organization that is expected to be created in Germany is likely to have a single purpose.

<sup>3</sup> It may be coincidental, but three of the most vigorous nuclear waste management programs are run by dedicated utility-owned organizations (Canada, Finland, and Sweden).

<sup>4</sup> T. LaTourrette et al., *Managing Spent Nuclear Fuel: Strategy Alternatives and Policy Implications*, (RAND: Santa Monica, CA, 2013).

<sup>5</sup> There does not appear to a strong connection between organizational anatomy and physiology.

demonstrating engineering practicability, not compliance, seem to be the predominant motivations.

This single-minded focus on long-term safety lends credence to three messages that these implementers convey to the general public as well as to interested and affected parties. First, the long-term management of nuclear waste is a pressing societal and environmental problem that has to be addressed regardless of the long-term prospects for nuclear energy production. Community leaders from both Östhammar and Oskarshamn, the Swedish municipalities ultimately evaluated as potential repository sites, explicitly mentioned that their engagement with SKB is influenced by a desire to advance a larger national interest.

Second, considerable attention is being paid to framing nuclear waste management as an issue strongly affecting intergenerational equity. In Sweden, for example, the Board's sister agency, now called the National Council for Nuclear Waste, sponsored a public seminar on ethics and nuclear waste management in 1987. The following year, the Swedish authorities published a report that focused on the question of intergenerational equity.<sup>6</sup> It appears that SKB and ANDRA officials have internalized this concern.

Third, both implementers, but especially the French, recognize that the process for developing a deep-mined geologic repository must be stepwise and adaptive.<sup>7</sup> ANDRA published a book-length study that explores both the technical and institutional matters that need to be considered in implementing such a process, which must repeatedly assess whether the course being undertaken should be continued, revised, or abandoned.<sup>8</sup>

For SKB and ANDRA, public acceptance requires a dynamic and sustained effort to engage interested and affected parties. Each implementer has established a strong and long-standing local presence in the communities that might host a repository.<sup>9</sup> Although education is an important component of their engagement activities, listening respectfully, responding to all questions, soliciting the residents' opinions and values, and adopting at least some suggestions

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<sup>6</sup> National Swedish Board of Spent Fuel, *Ethical Aspects of Nuclear Waste*, SKN Report 29, (Stockholm, 1988). See also, Special Advisor for Nuclear Waste Disposal, *Responsibility, Equity, and Credibility—Ethical Dilemmas Relating to Nuclear Waste*, Ministry of the Environment, (Stockholm, 2001).

<sup>7</sup> The case for adopting such a process has been set forth best by the Nuclear Energy Agency of the Organization for Economic Cooperation and Development, *Stepwise Approach to Decision Making for Long-Term Radioactive Waste Management: Experience, Issues, and Guiding Principles*, (Paris, 2004). See also, National Research Council, *One Step at a Time*, (National Academy of Sciences: Washington, 2003). The BRC also makes this point. The Canadian program is probably the gold standard when it comes to implementing a stepwise, adaptive repository development process.

<sup>8</sup> L. Aparicio, *Making Nuclear Waste Governable: Deep Underground Disposal and the Challenge of Reversibility*, (Springer: Paris, 2010). Although reversibility may be easily achievable at the first stages of repository development, it is likely to be harder to accomplish at later stages. Important challenges having to do with detecting the need for and implementing adjustments will have to be addressed.

<sup>9</sup> In the case of Sweden, the nuclear-utility owners of SKB have a long and positive history operating power plants in both Östhammar and Oskarshamn.

are at the core of their interactions. Among the many dividends derived from these engagement efforts is that a deep reservoir of trust appears, by all indications, to have been created.<sup>10</sup> This trust means that technical issues can be debated without rancor and that the implementer is given the benefit of doubt as it proceeds to plan for the repository's development.

Both implementers realize that trust needs to be assiduously built and constantly maintained through openness, engagement, and transparency.<sup>11</sup> Unlike OCRWM, the Swedish and French implementers seem to have learned from experience and have taken to heart what are, in effect, the major findings and recommendations put together by task forces commissioned by three different Secretaries of Energy.<sup>12</sup> In particular, the Board has been struck by how often SKB and ANDRA personnel, without being prompted, offer observations that make the following general points:

- Trust must be gained over a long period but it can be lost almost instantaneously.
- Public trust and confidence is not a luxury. The implementer has an obligation to earn it but also a compelling need to do so.
- Lack of public trust and confidence is an obstacle to programmatic progress.
- Efforts to restore and sustain public trust and confidence cannot simply be appended to on-going activities. Senior officials and managers must recognize that most organizational choices have consequences for institutional trustworthiness. Leaders need to seriously weigh those consequences when key decisions are made.

These observations do not appear to be empty platitudes. Both implementers make readily available technical information as well as internal emails. SKB executives reward individuals with proven track-records for building public trust and confidence, and they seem to understand that, for the public, a feeling of safety is based on trust in politicians, industry, regulators, and the process. ANDRA officials have decided to defer to local views about the placement of the proposed repository's surface facilities *because* such deference would enhance trust. And in Sweden, the implementer had established such a reservoir of trust that no one seriously questioned the technical rationale that underlay the choice of the Östhammar repository site over the apparent front-runner, Oskarshamn.<sup>13</sup>

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<sup>10</sup> That the regulatory authorities are apparently well-trusted probably affects the implementers' attitudes about creating and maintaining public trust and confidence.

<sup>11</sup> The actions of SKB and ANDRA from the early 1990s on stand in sharp contrast with their earlier actions to identify potential sites for a repository. Then, both implementers proceeded without engaging or gaining the trust of the communities involved. Moreover, the two implementers are not necessarily trusted by all interested and affected parties, including those who oppose the repository projects. Rather, the Board has been struck by how widespread the trust is and how central its maintenance was for the implementers.

<sup>12</sup> Secretary of Energy Advisory Board (SEAB), *Earning Public Trust and Confidence: Requisites for Managing Radioactive Waste*, (Washington, 1994); SEAB II, *Responsible Openness: An Imperative for the Department of Energy*, (Washington, 1997); SEAB III, *Relations between DOE Facilities and their Host Communities: A Pilot Review*, (Washington, 2000).

<sup>13</sup> SKB, *Site selection—siting a final repository for spent nuclear fuel*, R-11-07, (Stockholm, 2011).

In sum, due in large part to their own approaches and efforts to build trust, SKB and ANDRA operate within a relatively stable political environment. Consequently, the technical cores of those organizations appear to be mostly walled off from disruptive external pressures. Work can be directed at well-specified scientific and engineering problems, and that work is carried out in an atmosphere that encourages candid exchanges, not only with the international technical community, but also with a wide range of individuals and organizations at home.

### **How an organization addresses technical issues is important for repository development**

From its interactions with the two implementers, the Board has come to appreciate what “ingredients” might be necessary (although probably not sufficient) to carry out a technically sound repository development process. Three appear worthy of note: (1) steady availability of resources; (2) adaptability; and (3) attention to the details of deployment.

One consequence of operating within a relatively stable political environment is that there is broadly based support for work to address long-term safety questions. This continuity is crucial because establishing the case for a repository is a decades-long and sometimes tedious process. For example, the Swedish safety case relies on the integrity of a bentonite barrier that surrounds the waste packages, minimizing water flow past them and absorbing radionuclides that might be released. The French safety case relies on the very slow movement of water through argillite (clay-rich rock) formations. Demonstrating the capabilities of these barriers requires investigations that have to be conducted over substantial periods of time. Experience in Sweden and France indicates that long-term, multi-year, assured budgets provided a number of benefits, including more efficient planning and implementation of an integrated research program and the retention of key personnel.

A stepwise and adaptive repository development process is premised on the likelihood that new technical information or shifts in policy might demand mid-course modifications. Both implementers have demonstrated a capacity—albeit sometimes imperfectly—to make adjustments in a technically credible and publicly transparent manner.

Another element of the Swedish safety case is the assertion that waste canisters fabricated from elemental copper will not corrode in the anoxic groundwater to which they will be exposed. That proposition appeared for many years to be supported by fundamental principles of thermodynamics. Experiments conducted at the Swedish Royal Institute of Technology (KTH), however, called that claim into question. The regulatory authorities expressed considerable interest in this new information.<sup>14</sup> SKB’s response has been two-fold. It supported a pair of independent investigations to see if the KTH results could be replicated and sponsored the creation of a formal “reference group” of interested and affected parties to monitor the progress

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<sup>14</sup> For an independent review of the copper corrosion issue, see National Council for Nuclear Waste, *Mechanisms for Copper Corrosion in Aqueous Environments*, Report 2009:4e, (Stockholm, 2009). Two former Board members were key participants in the National Council’s scientific workshop devoted to this issue.

of those studies.<sup>15</sup> SKB also performed additional safety assessments to determine the consequences for public health *if* the KTH findings were substantiated.

The French implementer also faced challenges to its approach. A public debate held in 2005 revealed a strong preference for a disposal concept that permits reversibility for perhaps as much as 100 years. That public demand was incorporated into legislation the following year. Since then, ANDRA has been working on alternative repository designs that would satisfy the law's requirements. These have been the subject of technical conferences and have been opened up to international peer review.<sup>16</sup> ANDRA will need to choose one design when it submits a license application to the regulatory authorities, an event projected to occur sometime in 2015.

SKB and ANDRA understand better than OCRWM did that their responsibilities extend beyond articulating a safety case and supporting it before the public and the regulators. Both SKB and ANDRA are looking ahead to determine what it will take to operate a deep-mined geologic repository in a manner that will not endanger the reservoir of trust that the organizations have built up over the years. For that reason, both implementers constructed underground research laboratories in rock formations and depths virtually identical to those where a repository might be developed. They also concluded that it is essential to develop full-scale prototypes of critical systems before a license application was submitted and to test the performance of those systems *in situ*. Neither SKB nor ANDRA are prepared to claim that the technologies required could be taken off the shelf or would somehow become available at a later stage.<sup>17</sup>

One of the greatest challenges that all implementers will face is the emplacement of waste packages and engineered barrier systems (EBS) within the host rock. This operation, which typically will have to be performed in a high-radiation, low-visibility environment, will need to be executed remotely. Should the EBS be misaligned or incorrectly emplaced, the long-term safety of the repository could be degraded and, perhaps, jeopardized.

The Swedish disposal concept specifies that, before a waste package is lowered into the host rock, highly compacted bentonite blocks and rings have to be placed into the vertical disposition holes. The tolerances are extraordinarily tight. To determine whether the emplacement requirements could be met, SKB constructed prototype machines for installing the bentonite and for depositing the waste package. These systems have been repeatedly tested (in a non-radiological but underground environment) using fully automated navigation and positioning systems.<sup>18</sup>

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<sup>15</sup> The role of the reference group is to keep the interested and affected parties and the public fully and currently informed about the progress of the replication experiments and to allow its members to suggest modifications to the planned experiments.

<sup>16</sup> See, for example, Nuclear Energy Agency, *Reversibility and Retrievability in Planning for Geologic Disposal of Radioactive Waste*, NEA 6993, (Paris, 2012).

<sup>17</sup> The Board has commented on this issue in the past. See, for example, its *Report to the U.S. Congress and the Secretary of Energy: January 1, 2005 to February 28, 2006*, (Washington, 2006), pp. 18-20.

<sup>18</sup> SKB, *RD&D Programme 2010*, TR-10-63, (Stockholm, 2010).

In the French disposal concept, the EBS relies heavily on the waste package. However, because of the reversibility requirement enacted by Parliament, ANDRA has had to determine not only how to emplace the packages inside horizontal holes bored in the repository tunnels' walls but also how to extract the packages if so required. Several full-scale prototypes were developed, and preliminary tests have been conducted. Although final design requirements have not been set, ANDRA seems to have a basis for feeling confident that it can develop the technologies needed to implement the reversible emplacement of waste.

### **Some final thoughts on national differences**

The Board well understands that recipes for developing a deep-mined geologic repository cannot be imported from abroad.<sup>19</sup> Some aspects of implementing a waste management program will strongly depend on a country's particular governance structure. For instance, how is power distributed between the central government on the one hand and regional/state/local governments on the other? Further, some aspects may likely depend on a country's political culture. For example, in both Sweden and France, individuals observed that having the "ground rules" for a consent-based siting process clearly specified in advance was an important condition for participating. In the United States, at least in the view of the BRC, these details are best left to individual negotiations.

National laws and political cultures seem to be less constraining when it comes to questions associated with organizational physiology. Certainly private and public organizations in the United States have track-records of focused problem-solving. Institutional trustworthiness is not unheard of in the United States. The Board believes that, while challenging, designing and operating a nuclear waste management organization that is both effective and merits public confidence is a practicable and attainable undertaking. The Board also believes that much can be learned from programs in other countries. We provide this summary of observations as a contribution to the development of any new implementing organization in the United States.

Sincerely yours,

{signed by}

Rodney C. Ewing  
Chairman

cc: Ranking Member Marcy Kaptur

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<sup>19</sup> U.S. Nuclear Waste Technical Review Board, *Experience Gained From Programs to Manage High-Level Radioactive Waste and Spent Nuclear Fuel in the United States and Other Countries*, (Washington, 2011).