The Root Causes of Siting Failures in Nuclear Waste Management - 15652

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ABSTRACT

For many decades, the global nuclear industry and associated governments have attempted to establish new facilities for the storage and disposal of nuclear wastes. Success has been rare (France, Sweden and Finland being the examples) and remains elusive for many programs despite attempts to change the selection process in some cases. Success has been aided by local and national consent in the few cases that are proceeding.

A small study of several countries lack of success is examined to determine the dominant reasons for such failures. The goal of the study is to inform the planning process for efforts to site new facilities by feeding back some lessons learned from past failed efforts.

This limited review of international experience indicates that there is no simple approach available for siting deep geologic disposal or even centralized storage facilities. A number of countries have tried multiple times to find an acceptable site. Two studies [1, 2] clearly indicate that there must be adequate assurance of social as well as technical acceptability for successfully siting such facilities.

It is evident that even though the technology and science may be proven, it is the politics and public engagement in siting processes that dominate the failures. However, the detailed reasons within each effort present a richer set of lessons.

This paper will summarize the findings and present them such that they can be used to inform future siting efforts by a nation.

United States

The Yucca Mountain Repository was designated by the U.S. government as the deep geologic repository for spent nuclear fuel under the Nuclear Waste Policy Act amendments of 1987. It is located in Nevada about 100 miles northwest of Las Vegas. Consistent with the Act it was approved by the U.S. Congress in 2002. However it has been highly contested by many environmental groups and most importantly by the State of Nevada.

Funding for the development of the project was terminated by the Obama Administration in 2011. The administration terminated the project as unworkable. No technical reasons were documented for its termination. In fact recently the NRC has issued a series for Safety Evolution Reports that have concluded that the application meets safety requirements contained in NRC regulations. Overriding public opposition without considering suitable alternatives focuses opponents and in this case they have been successful in stopping this major project.

In 1987 prior to the Nuclear Waste Policy Act amendments, the Department of Energy was engaged in a deliberative process to site both repositories and centralized facilities for the storage of spent fuel. While it is not possible to identify the precise reasons for the legislative actions, it was clear that the siting of such facilities was unpopular throughout the US. Congress opted to select Yucca Mountain without reference to public opinion or to the scientific work ongoing throughout the US.

The legacy of the US repository program is in stark contrast to the US success in siting, developing and operating the Waste Isolation Pilot Plant in southeastern New Mexico. This facility was developed to dispose of US long-lived wastes, excluding high-level waste and spent fuel, from US government

operations. This program's success stems largely from the broad consensus that was achieved in the host state and local communities, underpinned by sound scientific support.

Clearly, the structure of governance that exists in the US is different from that which exists in other countries. While the Federal government has some abilities to force the acceptance of facilities, this power depends upon the existence of the political will to do so. In the normal course of affairs, the abilities of a broad range of parties to judicially intervene in such projects coupled with the need for political consensus which must be supported by popular view creates a very high bar to success.

United Kingdom

The search for a deep disposal facility in the UK for high-level waste (vitrified HLW from reprocessing operations) goes back to the late 1970s. The United Kingdom Atomic Energy Authority, UKAEA, identified eight sites for detailed investigation. Eventually, permission was sought to carry out investigations at three sites, two in Scotland and one in Northumbria in a National Park.

A public inquiry in 1980 for one of the Scottish sites, in South West Scotland, saw much public opposition and the application was rejected. However, an application in Caithness, where the Dounreay nuclear site is located, was successful and investigations carried out in 1978-79. Several other areas in the UK were also to be investigated, but again there was much local opposition. The Northumbria National Park public inquiry was also successful, but in December 1981 the Government announced that the site selection programme would be abandoned.

In 1982 the Government said that the more urgent problem was the intermediate level waste arising from spent fuel reprocessing and that in any case the vitrified high-level waste was to be stored for 50 years to allow it to cool [3].

In October 1983, NIREX, the UK body responsible for site selection, announced it would investigate a site at Elstow in Bedfordshire, about 55 miles to the North of London, and a disused anhydrite mine in the North East of England. There was considerable local concern in both areas. Three further sites were to be investigated, but again there was considerable public opposition. These were classic examples of the "Decide Announce Defend" approach to site selection.

In March 1986 the House of Commons Select Committee on the Environment, under the chairmanship of Sir Hugh Rossi, published what became known as "The Rossi Report" [4]. The report concluded that the UK lagged behind other nations in work on geological disposal of radioactive waste and that near surface disposal facilities are only acceptable for short-lived low-level wastes.

The Government in July 1986 [5] announced its commitment to developing a deep facility and that all intermediate level waste should go into that facility.

The Secretary of State for the Environment instructed Nirex to identify a "suitable location for a deep multi-purpose facility" for both ILW and LLW. Nirex recommended that locations near to the nuclear facilities of Dounreay and Sellafield undergo detailed geological investigations. In July 1991, Nirex reviewed the preliminary investigation results from both sites and proposed that only Sellafield continue to be investigated. This decision was based on transport cost grounds as most of the waste for disposal within the repository arose at Sellafield.

Nirex in July 1994 submitted a planning application for a Rock Characterisation Facility which would help gather further geological information to develop a safety case for a repository. The application was refused by the local government, Cumbria County Council and so Nirex appealed against this decision triggering a Public Inquiry which was held between 1995 and 1996. However, the Secretary of State in March 1997 refused Nirex's appeal. One reason for this decision was the lack of transparency in the site selection process. The programme was thus "stopped dead in its tracks" in the words of the March 1999 House of Lords Select Committee on Science and Technology [6.

In 2001, the UK Government initiated the Managing Radioactive Waste Safely programme [7], with the aim of finding a practical long-term management solution for the UK's higher activity radioactive waste that:

- Achieved long-term protection of people and the environment;
- Did this in an open and transparent way that inspired public confidence;
- Was based on sound science;
- Ensured the effective use of public monies.

In March 2003, the Government set up the Committee on Radioactive Waste Management (CoRWM) to consider how to manage the UK's higher activity radioactive waste in the long term. They undertook a series of stakeholder engagements and studied all the options for managing radioactive waste. In July 2006 they recommended to Government that geological disposal is the best long-term solution which should be supported by safe and secure interim storage until a disposal facility was available. The Government accepted these recommendations and gave the task of implementing the policy to the Nuclear Decommissioning Authority (NDA) and in April 2007, Nirex was subsumed into the NDA.

In June 2007, the Government published a consultation document *Managing Radioactive Waste Safely* [8]. The Government invited communities to open, without commitment, discussions about the possible future hosting of a geological disposal facility based on a voluntarist process. The communities of Allerdale and Copeland, near to the Sellafield site, "expressed an interest" in talking to Government about hosting a facility. The Borough Councils of the two communities, together with Cumbria County Council formed a partnership [9] and met over three years. It ran a public consultation between November 2011 and 2012 to obtain stakeholder views before it sent its final reports to the councils for them to take the decision on proceeding to the next stage of the MRWS process.

In January 2013, Allerdale and Copeland Borough Councils voted in favour of remaining in the process, but Cumbria County Council voted to withdraw.

As a result of this, the Government again consulted on the way forward and in July 2014 issued a new White Paper: Implementing Geological Disposal [10].

The new framework establishes an upfront process of national geological screening. In terms of working with communities, it will decide on an approach to community representation and community investment in relation to engagement in the process and a decision to host a geological disposal facility. Formal discussions with interested communities will not begin until the initial actions set out in the White Paper have been completed, in around 2016. This new siting process will provide more information to communities before they are asked to get involved. With greater clarity on issues like geology and development impacts, community investment and community representation, communities will be able to engage with more confidence in the process to deliver this nationally significant infrastructure project.

Canada

In a 1978 the Canadian government directed the Atomic Energy of Canada Limited (AECL) to develop concepts for deep geological disposal. A subsequent statement by the governments of Canada and Ontario in 1981 established that disposal site selection would not begin until after a full federal public hearing and approval of the concept by both governments.

In September 1988, the federal Minister of Energy, Mines and Resources referred the concept for public review. In October, 1989, the federal Minister of the Environment appointed an independent environmental assessment panel to conduct the review.

The Panel [2] conducted its review in Saskatchewan, Manitoba, Ontario, Quebec and New Brunswick. The Panel held scoping meetings in 14 communities. It also held a workshop on Aboriginal issues. The

Panel prepared draft guidelines, for public comment in June 1991, and issued them in final form on March 1992.

On October 26, 1994, AECL submitted an EIS, for public review. Public hearings were held in 16 communities beginning March 11, 1996 and ending March 27, 1997. The panel focused on broad societal issues related to managing nuclear fuel wastes; the safety of the AECL concept; and on the public's opinions of the safety and acceptability of the concept.

The Panel concluded that broad public support is necessary in Canada to ensure the acceptability of a concept for managing nuclear fuel wastes. The Panel also concluded that safety is a key part, but only one part, of acceptability. Safety must be viewed from two complementary perspectives: technical and social.

To be considered acceptable, the concept must have broad public support; be safe from both a technical and a social perspective; have been developed within a sound ethical and social assessment framework; have the support of Aboriginal people; be selected after comparison with the risks, costs and benefits of other options; and be advanced by a stable and trustworthy proponent and overseen by a trustworthy regulator.

After applying these criteria to the AECL disposal concept, the Panel arrived at the key conclusions. From a technical perspective, safety of the AECL concept was adequately demonstrated, but from a social perspective, it was not. The AECL concept for deep geological disposal did not demonstrate broad public support. The concept did not have the required level of acceptability to be adopted as Canada's approach for managing nuclear fuel wastes.

The Panel considered the steps that must be taken to ensure the safe and acceptable long-term management of nuclear fuel wastes in Canada. Key recommendations included: the need for issuing a policy statement on managing nuclear fuel wastes; initiating an Aboriginal participation process; creating a nuclear fuel waste management agency; conducting a public review of regulatory documents using a more effective consultation process; developing a comprehensive public participation plan; developing an ethical and social assessment framework; and developing and comparing options for managing nuclear fuel wastes.

The Panel concluded search for a specific site should not proceed until these steps have been completed and broad public acceptance of a nuclear fuel waste management approach has been achieved.

Subsequent to the Panel report The Nuclear Waste Management Organization (NWMO) was established in 2002 to investigate approaches for managing Canada’s used nuclear fuel.

The NWMO was required to submit approaches for the management of used nuclear fuel, and a recommended approach. The NWMO conducted its study over three years and presented its report and recommended approach to the Minister of Natural Resources Canada in November 2005. In June 2007, the government selected Adaptive Phased Management (APM), the approach recommended by the NWMO.

Separately a LILW project is being run by Ontario Power Generation (OPG), which is responsible for management and disposal of utility generated low level waste produced by its nuclear reactors. OPG manages and stores radioactive waste at it Western Waste Management Facility located at the Bruce site on Lake Huron. NWMO is conducting the investigation for OPG.

In 2001, the Municipality of Kincardine expressed an interest in discussing with Ontario Power

Generation (OPG) long-term plans for the management of LLW stored at the Western Waste Management Facility. In 2002, a Memorandum of Understanding (MOU) was signed by the Kincardine and OPG, to assess the feasibility of long-term management LILW at the WWMF located on the Bruce site. OPG conducted an Independent Assessment Study to evaluate alternatives.

The work plan included a review of the technical feasibility, as well as the potential environmental, social and economic effects. The study [11] looked at three alternatives: 1) enhanced processing and storage on site; 2) surface concrete vaults; and 3) deep rock vaults. No alternative sites were considered. Following this review, the Kincardine Council passed a motion, in 2004, to support a deep geological repository.

Recent concerns and complaints were expressed during a public hearing by both Canadian groups and U.S. officials about a proposed underground nuclear waste repository in Ontario, less than a mile from the shores of Lake Huron. Opponents questioned siting a nuclear waste disposal site next to the Great Lakes; from which millions of Canadian and U.S. residents get drinking water.

In a letter [12] dated August 7, 2013, OPG has committed to the Saugeen Ojibway Nations (SON) that OPG will not move forward with the construction of a deep geologic repository for low and intermediate level nuclear waste until the SON community is supportive of the project. The SON-OPG Commitment is a necessary mechanism to ensure that SON and its members can fully understand and assess the potential impacts of the Project on their Rights and interests, identify and implement mechanisms to address those impacts, and determine how the Project could contribute to the resolution of the broader nuclear waste management issues within the SON territory. This commitment is essentially a latent veto right that was not effectively addressed earlier in the site selection and decision process.

Recently, the Canadian Nuclear Safety Commission CEO Michael Binder said during a presentation at the University of Calgary in October we "cannot be expected to reject a safe project due to lack of social acceptability." It is hard to reconcile how this statement fits within the government selected Adaptive Phased Management (APM), the approach recommended by the NWMO for selection of a deep geologic repository.

Japan

Japan started it efforts to establish a geological disposal program in 1976. Japan published a technical reliability report in 2000. The Final Disposal Act in June 2000 established the Nuclear Waste Management Organization (NUMO) in October of that year. NUMO, the waste management organization in Japan, has been undertaking a volunteer site selection process since December 2002. NUMO volunteer approach is based on maintaining harmony with broad regional development and coordination with local plans. Information packages were sent to all municipalities in Japan. The outreach efforts included interaction between NUMO and volunteer communities. Technical reports were provided to support the scientific and technical basis for the project.

The regional plans included government subsidies to promote siting. The local mayor and governor can register an objection during the siting stage to end the process. Ten local municipalities expressed interest. In 2007, the Mayor of one community (Toyo town) officially applied to host a candidate site [ref 13]. However, the prefecture governor and neighboring communities were not happy with the Mayor's decision. Later that year during a mayoral election, a candidate who was opposing the project was elected. The new mayor made an announcement calling for the project to be stopped immediately. Causes of this failure included; poor communication with the town and affected stakeholders, lack of a local action plan and lack of town policy advisors.

NUMO stopped the preparation of the solicitation for Toyo Town and developed enhanced measures for the HLW disposal program. Enhancements included: providing preliminary geological information; greater commitment of the government; and better coordination between the national government, the implementer and waste producers.

The accident at Fukushima Dai-Ichi led to significant concern about issues related to radioactive waste management. The safety of geologic disposal was questioned emphasizing the impact of earthquakes. In December 2012, Japan published a policy statement with renewed approaches to implementing geologic

disposal. The approaches included; an improved site selection process; structure for building local consensus; and measures to support sustainable local development. NUMO is preparing necessary actions to support this renewed approach.

Australia

In 1997, Pangea Resources Pty Ltd was formed with the objective of establishing an international repository for the disposal of spent fuel, HLW and ILW. Pangea was the creation of three groups – Golder Associates (an international engineering company), British Nuclear Fuels Ltd and NAGRA, the Swiss organization charged with managing that country's spent fuel and HLW. Pangea's efforts were centered on technical studies done that established that many parts of Australia contain geology that is superior for the safe management of long-lived wastes. Pangea's efforts never moved to a region or site specific stage of siting. Its work was done in a corporate environment in order to establish a broad program. In late 1998, the work of Pangea became known to the Australian public. By the end of 1999, the effort had effectively collapsed in the face of overwhelming public opposition coupled with legislative prohibitions.

Quite separately, the Australian Federal government has been seeking to site and develop a disposal facility for its LLW. Efforts focused, in the 1990's on a location in South Australia and more recently in the Northern Territory. The most recent effort is effectively stalled because of opposition from Aborigine groups in the area whose objections have been validated by the Courts.

SUMMARY

A limited review of international experience indicates that there is no simple approach available for siting deep geologic disposal or even centralized storage facilities. A number of countries have tried multiple times to find an acceptable site. Two studies [BRC and Seaborg] clearly indicate that there must be adequate assurance of social as well as technical acceptability for successfully siting such facilities. A number of examples have been provided in this paper that document failures are principally based on lack of social acceptance.

A number of causes can be identified that contributed to these unsuccessful attempts to site such facilities. Lack of clarity about the project and the projected inventory was a key concern for many of the examples examined. Poor information exchange with affected stallholders was cited as a weakness in many cases. The definition of a host community or multiple communities, and how consent will be determined is a key factor and concern. Determination of when withdrawal must be exercised must be clarified early on in the process. Lack of transparency in the site selection process contributed to a number of unsuccessful programs.

Broad public support and trustworthy regulatory process are necessary components to a successful siting process.

CONCLUSIONS

The nuclear industry has a large number of failures when attempting to site storage and disposal facilities for radioactive wastes. A number of these failures, and mention of rare successes, have been reviewed in this paper.

Nuclear managers frequently find these failures difficult to understand, offering comments such as:

- We talked to everyone. Why did it fail?

- I don't understand how they could turn down the jobs.
- This is crazy. These materials are so less hazardous than other risks already present in this community.

These sorts of comments are short sighted, as evident by the miserable experience in siting such facilities. For whatever reasons, the public associates "nuclear" with a special risk category. Specialists can argue endlessly that, for example, the trains full of oil coming from the oil shale areas are hundreds of time more hazardous to a community. Managers can offer jobs, impact funds and royalties. But there is an "allergy" that exists when nuclear is mentioned.

There is no simple approach for successful siting of deep geologic repositories. A number of failed attempts have been examined to provide insight for future efforts to site such facilities. It is clear that a very deliberative process that focuses on social acceptance as well as technical suitability is needed. Key factors that will increase the likelihood of success include the following:

- A national governance plan and suitable funding to support a consent based approach for siting
- A strong independent regulatory system
- Designation of a government organization responsible for key decisions
- A clearly laid out and deliberative process for achieving consent from local, state, tribal and national authorities.

REFERENCES

[1] Blue Ribbon Commission on America's Nuclear Future, January 2012
[2] Environmental Assessment Panel Report (Seaborn Panel Report), © Minister of Public Works and Government Services Canada, Catalogue No.: EN-106-30/1-1998E, ISBN: 0-662-26470-3, 1998
[3] UK Government White Paper: Radioactive Waste Management, Cmnd. 8607. July 1982
[4] House of Commons Select Committee on the Environment, First Report from the Environment Committee Session 1985-86 Radioactive Waste.
[5] Radioactive Waste - The Government's Response to the Environment Committee's Report, Cmnd. 9852, July 1986
[6] The Way Forward - A Discussion Document. UK Nirex Ltd, Nov. 1987
[7] "Management of Nuclear Waste", report of the House of Lords' Select Committee on Science and Technology; London: The Stationery Office HL Paper 41.
[8] Managing Radioactive Waste Safely: Proposals for Developing a Policy for Managing Solid Radioactive Waste in the UK, September 2001
[9] http://www.westcumbriamrws.org.uk/
[10] Department of Energy and Climate Change, Implementing Geological Disposal. A Framework for the long-term management of higher activity radioactive waste. July 2014.
[11] Golder Associates, "Independent Assessment Study at OPG's Western Waste Management Facility," February 2004
[12] Ontario Power Generation letter to Saugeen Ojibway Nation dated August 7, 2013
[13] Mayor of one community (Toyo town) officially applied