Radioactive Waste Management

NDA Report no. NDA/RWM/157

Geological Disposal

Overview of international siting processes 2017

November 2017

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Acknowledgements

We are very grateful to our overseas organisations and colleagues for their contributions to this assessment of national approaches to siting processes for deep geological disposal of intermediate or higher activity radioactive waste or spent fuel.

Abstract

Internationally, there are a range of approaches to siting processes for the disposal of radioactive waste. This report focuses on:

- how each country undertook, or is undertaking, the siting process for disposal facilities, including geological disposal facilities (GDFs)
- the roles of local decision making bodies, national governments and the body responsible (the developer) for implementing a disposal facility
- the level and timing of payment of any community investment to local communities.

Executive Summary

Radioactive Waste Management Limited (RWM) has been established as the delivery organisation responsible for the implementation of a safe, sustainable and publicly acceptable programme for geological disposal of the UK's higher activity radioactive waste. A geological disposal facility (GDF) will be a highly-engineered facility, located deep underground, where the waste will be isolated within a multi-barrier system of engineered and natural barriers designed to prevent the release of harmful quantities of radioactivity to the surface environment. To identify potentially suitable sites where a GDF could be located, the Government is developing a voluntarism approach based on working with interested communities that are willing to participate in the siting process. Development of the siting process is ongoing and no site has yet been identified for a GDF.

RWM, a wholly owned subsidiary of the Nuclear Decommissioning Authority (NDA), has updated this report, first produced in 2013, to review different national approaches to siting processes for the disposal of low level, intermediate level, high level radioactive waste and/or spent fuel. This report focuses on:

- how each country undertook, or is undertaking, the siting process for disposal facilities, including geological disposal facilities (GDFs)
- the roles of local decision making bodies, national governments and the body responsible (the developer) for implementing a disposal facility
- the level and timing of community investment to local communities, if applicable.

The countries covered in this report have defined waste management processes for disposal of low level waste, including deep GDF's for the disposal of intermediate, high level radioactive waste and /or spent fuel. The experiences of different countries show a range of approaches to finding sites and seeking the involvement of local communities.

Information is provided with regard to the repository siting processes in some 19 countries, although greater detail is provided with regard to the siting processes in the following countries:

- Canada – GDF for spent fuel
- Canada – low and intermediate level waste disposal in the Municipality of Kincardine
- Finland – GDF for spent fuel
- France – underground research laboratory and GDF for long lived high level and intermediate level wastes
- Japan – geological disposal of high level waste and some types of transuranic waste
- Sweden – GDF for spent fuel
- Switzerland – GDF for high level, low level and intermediate level waste
- US – the Waste Isolation Pilot Plant (WIPP); a GDF for defence-related waste containing long-lived radionuclides
- US – Yucca Mountain; a GDF for spent fuel and high level waste.

Information is also provided for the programmes in the following countries, albeit in less detail:

- Australia – low level waste disposal and storage of intermediate level waste
- Bulgaria – low level waste disposal and a GDF for high level waste and spent fuel
- Czech Republic – GDF for spent fuel
- Germany – low level waste disposal and GDF for high level waste and spent fuel
- Hungary – low level waste disposal and GDF for spent fuel
- Italy – low level waste disposal and storage of intermediate level waste
- Lithuania – low level waste disposal, interim storage of spent fuel with deep disposal in the future.
- Netherlands – storage of low level waste
- Romania – low level waste disposal and GDF for spent fuel
- Slovakia – GDF for spent fuel
- Slovenia – GDF for spent fuel
- Spain – storage of high level waste and spent fuel

The experiences described in this report encompass a spectrum of approaches to identifying suitable sites for hosting a disposal facility.

RWM has gathered the information in this report in cooperation with the waste management organisations (WMOs) in each country, and it has been checked for accuracy with each WMO.

The main messages from the report are that, in the examples reviewed:

- the programmes in each country reflect the political, social and cultural circumstances of that country
- some siting processes faced setbacks in the early stages; before then proceeding with a revised process
- local government has always been involved as one of the representatives of the community and, with the exception of Switzerland, has a decision making role in the process
- the elected representatives of the community closest to where the disposal facility is proposed to be built (the local municipality) tend to be the local decision makers in the siting process
- engagement with and understanding of the issues, along with support for the siting process is often higher at a local level than it is at a regional or national level
- the community investment associated with a GDF, which are made available to potential host communities, vary from country to country in their approach, scope, amount and when they become available. In a number of countries, the community investment is scheduled to be made available in advance of the facility being constructed.

List of Contents

List of acronyms and abbreviations

ANDRA	Agence Nationale pour la gestion des déchets radioactifs, French National Radioactive Waste Management Agency
APM	Adaptive Phased Management
AVP	Added Value Programme
BRC	Blue Ribbon Commission on America's Nuclear Future
CLA	Construction Licence Application
CLI	Local Information Committee (France)
DGR	Deep Geological Repository
DIAs	Detailed Investigation Areas
DiP	Decision in Principle
DNLEU	Depleted, Natural and Low Enriched Uranium
DOE	US Department of Energy
DSS	Disposal System Specification
DSSC	Disposal System Safety Case
EDRAM	International Association for Environmentally Safe Disposal of Radioactive Materials
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ENSI	Swiss safety authority
GDF	Geological Disposal Facility
GIP	Groupement d'Interêt Public (Public Interest Group France)
HEU	Highly Enriched Uranium
HHGW	High Heat Generating Waste
HLW	High Level Waste
IAEA	International Atomic Energy Agency
ILW	Intermediate Level Waste
ILW-LL	Intermediate Level Waste – Long Lived
ILW-SL	Intermediate Level Waste – Short Lived
JRP	Joint Review Panel
LHGW	Low Heat Generating Waste
LLW	Low Level Waste
LWA	Land Withdrawal Act
MOU	Memorandum of Understanding
Nagra	(Swiss) National Cooperative for the Disposal of Radioactive Waste
NDA	Nuclear Decommissioning Authority

NEA	Nuclear Energy Agency
NNB	New Nuclear Build
NRD RAW	National Repository for Disposal of Radioactive Waste -
NUMO	Nuclear Waste Management Organization of Japan
NWMO	Canadian Nuclear Waste Management Organisation
NWAA	Nuclear Waste Administration Act (US)
NWPA	Nuclear Waste Policy Act (US)
OECD	Organisation for Economic Cooperation and Development
OPG	Ontario Power Generation
ORCF	ONKALO Rock Characterisation Facility
PIAs	Preliminary Investigation Areas
Pu	Plutonium
PURAM	Hungarian national waste management organisation
RCF	Rock Characterisation Facility
RD&D	Research, Development and Demonstration
R&D	Research and Development
RSILW	Robust Shielded Intermediate Level Waste
RWM	Radioactive Waste Management Ltd
SILW	Shielded Intermediate Level Waste
SF	Spent Fuel
SFOE	Swiss Federal Office of Energy
SKB	Svensk Kärnbränslehantering AB, (Swedish Nuclear Fuel and Waste Management Company)
SSM	Swedish nuclear regulator
STUK	Finnish nuclear safety regulator
TRU	long-lived transuranic wastes
TVO	Teollisuuden Voima Oyj, operator of Olkiluoto nuclear power reactors (Finland)
U	Uranium
UILW	Unshielded Intermediate Level Waste
URL	Underground Research Laboratory
VLLW	Very Low Level Waste
WIPP	Waste Isolation Pilot Plant
WMOs	Waste Management Organisations
YMP	Yucca Mountain Project

1 Introduction

Radioactive Waste Management Limited (RWM) has been established as the delivery organisation responsible for the implementation of a safe, sustainable and publicly acceptable programme for geological disposal of the UK's higher activity radioactive waste. A geological disposal facility (GDF) will be a highly-engineered facility, located deep underground, where the waste will be isolated within a multi-barrier system of engineered and natural barriers designed to prevent the release of harmful quantities of radioactivity to the surface environment. To identify potentially suitable sites where a GDF could be located, the Government is developing a consent-based approach based on working with interested communities that are willing to participate in the siting process [[1]]. Development of the siting process is ongoing and no site has yet been identified for a GDF.

Radioactive Waste Management Limited (RWM), a wholly owned subsidiary of the Nuclear Decommissioning Authority (NDA), has prepared this report to help to review different national approaches to siting processes for the geological disposal of intermediate level, high level radioactive waste and/or spent fuel.

The countries covered in this report either have, or are planning to have, facilities for the disposal of low, intermediate and high level radioactive waste and /or spent fuel. The experiences described in this report encompass a spectrum of approaches to identifying suitable sites for hosting a disposal facility. The approaches in each country depend on the political and cultural circumstances and the geology.

Section 2 provides information about the repository siting processes and community investment available in 19 countries. For nine countries, a more detailed narrative is provided, considering:

- the siting process
- local decision making
- the role of government
- the role of the developer
- the use of community investment
- steps in the process

Section 3 provides an analysis of the key themes across each of the countries considered.

Section 4 considers the conclusions that can be drawn from the experiences in the different countries.

1 Department of Energy and Climate Change, *Implementing Geological Disposal - A framework for the long term management of higher activity waste*, URN 14D/235, July 2014.

2 Summary of international experiences

This section provides information about the repository siting processes in 19 countries, although greater detail is provided with regard to the siting processes in the following countries:

- Canada – GDF for spent fuel
- Canada – low and intermediate level waste disposal at a site in the Municipality of Kincardine
- Finland – GDF for spent fuel
- France – underground research laboratory and geological disposal facility for long lived high level and intermediate level wastes
- Japan – geological disposal of high level waste and some types of transuranic waste
- Sweden – GDF for spent fuel
- Switzerland – GDF for high level waste and low and intermediate level waste
- US – the Waste Isolation Pilot Plant (WIPP); a geological disposal facility for defence-related wastes containing long-lived radionuclides
- US – Yucca Mountain, GDF for spent fuel and high level waste.

A summary of key information for these countries can be found in Appendix A.

This section also provides information on the current state of waste management and facility siting in 12 additional countries, albeit in less detail:

- Australia – low level waste disposal and storage of intermediate level waste
- Bulgaria – low level waste disposal and a GDF for high level waste and spent fuel
- Czech Republic – GDF for spent fuel
- Germany – low level waste disposal and GDF for high level waste and spent fuel
- Hungary – low level waste disposal and GDF for spent fuel
- Italy – low level waste disposal and storage of intermediate level waste
- Lithuania – low level waste disposal interim storage of spent fuel with deep disposal in the future.
- Netherlands – storage of low level waste
- Romania – low level waste disposal and GDF for spent fuel
- Slovakia – GDF for spent fuel
- Slovenia – GDF for spent fuel
- Spain – storage of high level waste and spent fuel

References are provided at the end of each subsection.

The values of actual or proposed community investment are shown as Sterling equivalents using exchange rates as of 5th October 2017

2.1 Canada – Geological disposal of spent fuel

Siting process

The Canadian Nuclear Waste Management Organization (NWMO) was established in 2002 by Canada's nuclear utilities, according to the Canadian Nuclear Fuel Waste Act of 2000 (Ref 1). Between 2002 and 2005 NWMO engaged in extensive consultation with communities across Canada and reviewed information about Canadian geology and its suitability for development of a GDF. In November 2005 NWMO published its plan for a siting process referred to as 'Adaptive Phased Management' (APM), designed to focus future studies on areas where communities have expressed interest (Ref 2).

At the beginning of the 9-step APM process, NWMO invited expressions of interest from communities that wished to learn more about the project. 22 communities did so and were assessed using a number of technical screening criteria. In those communities where no obvious conditions were found that prevented further consideration, social, economic and cultural studies were carried out involving communities in the surrounding area, including the First Nations and if appropriate Inuit or Métis (collectively known as Aboriginal peoples). The siting process includes respect for rights of Aboriginal peoples, supporting Aboriginal engagement and including Aboriginal traditional knowledge to be shared with the NWMO.

By mid-2017, some 7 communities in 4 general areas remained in the process, currently Phase 2 of Step 3. This involves field studies such as airborne surveys, geophysical and environmental mapping particularly in crystalline rock areas. As studies continue, deep borehole studies will be conducted to examine sub-surface geology at sites that might be considered for a repository. NWMO is working to identify a single location with safe geology in an area with a willing and informed host by 2023. Detailed site characterisation studies will then be conducted on this preferred site to confirm suitability and initiate the regulatory review process (Ref 3).

Steps in the process

Date	Event [2]
Getting Ready	The NWMO publishes the finalised siting process, having briefed the relevant levels of government, Aboriginal organisations and regulatory agencies. These briefings will continue throughout the siting process
Step 1	The NWMO initiates the siting process with a broad programme to build awareness and answer questions which will be ongoing throughout the siting process
Step 2	Communities identify their interest in learning more, and the NWMO provides detailed briefing. At the request of the community initial screening is carried out
Step 3	For interested communities, a preliminary assessment of potential suitability is conducted
Step 4	The NWMO will work collaboratively with interested communities, Aboriginal and provincial government to engage potentially affected surrounding communities. Detailed site evaluations are completed

[2] See nwmo.ca/sitingprocess_thesteps for a detailed account of activities.

Step 5	Communities with confirmed suitable sites decide whether they are willing to accept the project and propose the terms and conditions on which they would want the project to proceed
Step 6	The NWMO and the community with the preferred site enter into a formal agreement to host the project. The NWMO selects the preferred site, and the NWMO and community ratify a formal agreement
Step 7	Regulatory authorities review the safety of the project through an independent, formal and public process and, if all requirements are satisfied, give their approval to proceed
Step 8	Construction and operation of an underground demonstration facility proceeds
Step 9	Construction and operation of the facility with NWMO continuing to work in partnership with the host community throughout the entire lifetime of the project

Local decision making

Decisions are taken at a local level by the municipal council. This is the local council authority, which also provides local services, facilities, safety and infrastructure for the community. Commitment is also made to involving surrounding communities and Aboriginal communities in decision-making as the site selection process advances.

Community Liaison Committees have been established by the councils in all interested communities, and although there is no direct funding to them, any costs incurred are covered by NWMO. These have included up to:

- C$125,000 (~£76,000) per year to cover administrative expenses,
- C$40,000 (~£24,000) per year to cover planning activities,
- C$10,000 (~£6,000) to cover the cost of attending conferences,
- C$15,000 (~£9,000) for youth related initiatives,
- C$200,000 (~£121,000) to support capacity building, regional outreach and planning.

Comparable programs are available to First Nation and Métis communities in an area, with some additions that are specific to their unique needs and requirements. Neighbouring communities are also eligible for funding, although at a lesser level.

Role of Government

Government approval is required as part of the regulatory review process. Regulatory review will formally, independently and publicly assess and confirm that the project can be safely implemented at the site. The review process will take place over a number of successive steps, from site preparation and construction, to operation and then closure. The safety of the project will be assessed and confirmed at each step. NWMO works with provincial governments and the federal government.

Role of developer

NWMO facilitates the siting process by engaging communities and surrounding areas to understand their objectives. It works with the interested community to conduct the

assessment, involve community members in learning and involve neighbours in the process. It also identifies and selects the specific preferred site.

NWMO is responsible for providing information on its activities and briefing the public at large, provincial governments, the Government of Canada, national and provincial Aboriginal organisations, and regulatory agencies. NWMO is also responsible for preparing the material required for the regulatory review process and for ratifying a formal agreement with a community.

Community Investment

NWMO provides support for engagement activities within the potential host communities as detailed above, but there is no provision of investment in community projects during the siting process, although recently, and in preparation for the future implementation of the project in an area, programmes have been introduced to support the development of transferrable skills in an area. These programmes have relatively small funding levels associated with them.

Discussions of the longer-term community investment from repository development have focused on jobs and wealth creation as contributions to community and area well-being. At the end of the initial studies, assessment reports were produced examining the potential to foster well-being through the implementation of the project in an area, in light of the long-term vision people in the area have. In assessing the potential to foster well-being, a number of sustainable livelihoods or assets were examined beyond jobs and strictly economic effects. Those reports were shared with the community and published on the NWMO website. They are available for each of the community areas that are being examined in Stage 3 of the siting process. Ref 4 is cited as an example of the reports.

NWMO commissioned an independent report in 2009 that provided a discussion on possible economic community investment to generic communities within generic economic regions within a host province (Ref 5). Building on this, estimates of economic effects, focussed on jobs, have been published for each of the siting areas.

References

1. Government of Canada, '*The Nuclear Fuel Waste Act'*, June 13th, 2002
2. Nuclear Waste Management Organisation, '*Choosing a Way Forward The Future Management of Canada's Used Nuclear Fuel (Final Study)*'. November 2005
3. Nuclear Waste Management Organisation, *'Advancing the Site Selection Process: Identifying Areas for Sub-Surface Studies'.* June 2017
4. Nuclear Waste Management Organisation, '*Community Well-Being Assessment: Town of Blind River, Ontario*'. APM-REP-06144-0096
5. AECOM Canada Ltd, '*Summary of Economic Community investment Linked to Adaptive Phased Management at an Economic Region Level'*. NWMO SR-2009-03, April 2009

Additional information from Jo-Ann Facella (NWMO)

2.2 Canada - Low and intermediate level waste deep geologic Repository in the Municipality of Kincardine

Siting process

In 2001, the Municipality of Kincardine approached Ontario Power Generation (OPG) to jointly look at developing options for a long-term disposal facility for low level waste (LLW) and intermediate level waste (ILW) at the Western Waste Management Facility located on the Bruce site. In 2002, a Memorandum of Understanding (MOU) between OPG and the Municipality of Kincardine was signed setting out the terms to develop a plan.

Following an independent assessment, including geotechnical feasibility and safety analyses, Kincardine Council passed a resolution (in April 2004) indicating that it preferred a deep geologic repository (DGR) because:

- it provides the highest level of safety of any option
- is consistent with best international practice
- there will be a rigorous environmental assessment and the regulatory process includes opportunities for public input before construction is approved
- a DGR (referred to as a GDF in the UK) will permanently isolate the low and intermediate level waste stream, much of which is already stored on site
- it provides significant economic benefit to the residents of the municipality
- no high level waste or used nuclear fuel would be allowed in the facility.

A detailed four-year multi-phase “Geoscientific Site Characterisation Program” was completed in July 2010 and verified the suitability of the geology beneath the Bruce nuclear site to safely host a DGR.

Steps in the process

Date	Event
2001	The Kincardine Municipality expressed interest in discussing long-term plans for the management of low and intermediate level waste
2002	Memorandum of Understanding signed by community and OPG
2002 – 2004	Independent assessment to jointly review options for the long-term management of low and intermediate level waste
Apr 2004	Kincardine Council passed a resolution that requested OPG to pursue the deep geologic repository (DGR) option at the Bruce site
Oct 2004	OPG and Kincardine entered into a hosting agreement. Agreement includes confirmation of support of Kincardine residents
Jan – Feb 2005	Telephone poll conducted to determine community support for the project. 60 per cent were in favour of the development
Nov 2005	OPG filed a project description with the Canadian Nuclear Safety Commission, which initiated the Environmental Assessment (EA) process under the Nuclear Safety Control Act and the Canadian Environment

	Assessment (EA) Act.
2006	EA scoping hearing & site investigations initiated
2007	EA track approved
2009	EA Guidelines issued January 2009
2011	Environmental Impact Study, Preliminary Safety Report and supporting licensing documents submitted to Regulatory Body
2012	Joint Review Panel appointed and public comment period
2013-2014	33 public hearing days by a Joint Review Panel (JRP)
May 2015	JRP EA report submitted to Federal Minister of Environment and Climate Change (Ref 2)
Feb 2016-May 2017	Additional information requested by Federal Minister of Environment and Climate Change and the Canadian Environmental Assessment Agency and responses provided by OPG (Ref 3)

Local decision making

In October 2004, the municipality of Kincardine, the local decision making body, signed the DGR Hosting Agreement with OPG saying it would support development of the facility (Ref 1). The hosting agreement also references four adjacent municipalities from which OPG received letters of support for the proposed DGR at the Bruce site. They are the Corporation of the Town of Saugeen Shores, the Corporation of the Township of Huron-Kinloss, the Corporation of the Municipality of Arran-Elderslie and the Municipality of Brockton.

Kincardine Council determined that they would seek formal endorsement of the hosting agreement from Kincardine residents through a community poll. This was included as a requirement in the hosting agreement. A poll of all Kincardine residents aged 18 and over was completed either by telephone or by mail if no telephone contact could be made, with seasonal residents being mailed a copy of the question and asked to respond by mail. The poll results indicated 60% support for the project.

Role of Government

Under the Nuclear Safety and Control Act, OPG will require licences from the Canadian Nuclear Safety Commission (CNSC) for activities to be undertaken with respect to the DGR project. Before the CNSC can make licensing decisions for the proposed facility, an Environmental Assessment (EA) of the proposal must be conducted in compliance with the Canadian Environmental Assessment Act. The purpose of an EA is to identify the possible environmental effects of a proposed project, and determine whether these effects can be mitigated before the project is allowed to proceed. A Joint Review Panel (JRP) appointed by CNSC held public hearings in 2013-2014, and its report was submitted in May 2015 (Ref 2).The final decision on whether to proceed with the project once the licence is obtained is with OPG.

Role of developer

OPG is a provincially-owned electricity utility that owns 20 nuclear reactors, eight of which are currently leased to Bruce Power. OPG owns the DGR project and only Low Level Waste and Intermediate Level Waste from OPG-owned nuclear generating stations in Ontario will be accepted in the facility.

The Nuclear Waste Management Organization (NWMO) assists OPG by providing technical support and other services in seeking regulatory approval for site preparation and construction of the DGR. OPG has also contracted with NWMO to manage the construction of the DGR if a site preparation and construction licence is obtained.

OPG negotiated the hosting agreement and community investment package with the Municipality of Kincardine. Following the JRP hearings and report, additional information was requested by the Federal Minister of Environment and Climate Change and the Canadian Environmental Assessment Agency and responses were provided by OPG (Ref 3). This has delayed the expected date for granting of licence approvals.

Community Investment

The financial terms of the hosting agreement provide a CAN$35 million package (around £21 million) indexed to inflation, to Kincardine and the four adjacent municipalities. This is split into lump sum and annual payments over 30 years and is subject to meeting key milestones.

The local municipalities and First Nations and Métis organisations also receive additional funds to conduct peer reviews and for community engagement activities.

If required, a property value protection plan will compensate owners of property that loses value as a consequence of building the DGR. This covers an 8-km radius from the centre of the DGR.

The DGR hosting agreement also provides support aimed at making Kincardine and the adjacent municipalities, a centre of energy excellence including trades and vocational schools and international educational tours of the DGR facility. Kincardine is already well established as a centre of nuclear power development.

One-off payments associated with the Kincardine DGR development (at 2017 conversion rates).

Date	**Milestone**	**Community**				
		Kincardine	**Saugeen Shores**	**Huron-Kinloss**	**Arran-Elderslie**	**Brockton**
2005	Community support established	$1.3m ~£790k	$500k ~£303k	$140k ~£85k	$80k ~£49k	$80k ~£49k
~2018	DGR construction licence granted	$1.3m ~£790k	$500k ~£303k	$140k ~£85k	$80k ~£49k	$80k ~£49k

Annual payments (adjusted for inflation) will also be made to the municipalities between 2005 and 2034 as follows:

Community				
Kincardine	**Saugeen Shores**	**Huron-Kinloss**	**Arran-Elderslie**	**Brockton**
$650k ~£395k	$250k ~£152k	$70k ~£42k	$40k ~£24k	$40k ~£24k

These payments become part of the relevant municipality's budget, with no direction regarding how they are spent. However, as they are subject to achievement of agreed project deadlines in accordance with the 2004 Agreement, the delays that have occurred since 2016, mean that the payments are currently in holding accounts that cannot be accessed.

References

1. *DGR Hosting Agreement Between Ontario Power Generation And Municipality of Kincardine.* October 2004

2. Joint Review Panel Environmental Assessment Report. *Deep Geologic Repository for Low and Intermediate Level Radioactive Waste Project* CEAA Reference No. 17520

3. OPG, *OPG response to request for further studies from Minister of Environment and Climate Change*, January 2017

Additional information from Donna Pawlowski (OPG)

2.3 Finland - Spent fuel geological disposal facility

Siting process

In 1983 Teollisuuden Voima Oyj (TVO), operator of the Olkiluoto nuclear power reactors, drew up a list of 101 potential sites for hosting a GDF and undertook a consultation process with the affected communities. This resulted in TVO's identification in 1987 of five potential sites for more detailed investigations.

In 1992, TVO announced that further investigations would only be carried out at Romuvaara in Kuhmo, Kivetty in Äanekoski and Eurajoki (near to the Olkiluoto nuclear site,) where two of the country's four nuclear power reactors are located. In 1995 a joint company, Posiva Oy, was established jointly by TVO and Fortum Power and Heat, operator of the other Finnish nuclear reactors at Loviisa, to be responsible for siting, constructing and operating the GDF. Interim reports on the four sites were produced at the end of 1996 and an additional site close to the Loviisa power plant which had been added to the list in 1994. Assessment of the sites (Ref 1) concluded that the only significant difference between them was in terms of social acceptance. Eurajoki was the most supportive, linking this to a guarantee that Posiva would cease examination of the site at Loviisa. The decision to site the GDF at the Olkiluoto site in Eurajoki Municipality was announced in 2000. Over a decade of surface-based investigation and construction of an underground rock characterisation facility, known as ONKALO^{TM}, was followed by an application for a construction licence in 2012. This was granted in 2015, with construction beginning in December 2016. An application for an operating licence is expected in 2021.

The plans for Posiva's GDF include disposal of spent fuel from its owners, i.e. the four nuclear reactors in operation by TVO and Fortum Power and Heat, and from the fifth reactor under construction in Eurajoki.

In 2010 Fennovoima Oy received a favorable Decision-in-Principle (DiP) to develop a pressurized water reactor (VVER-1200) in the Hanhikivi headland area, in Pyhäjoki Municipality in northern Finland. Following an EIA process, approved by government in 2014, Fennovoima applied for a construction licence in 2015. Subject to regulatory approval, construction is scheduled for 2019 and operation in 2024. Under the terms of the 2010 approval, Fennovoima is responsible for final disposal of spent fuel from the reactor. Fennovoima's primary objective is to achieve long term cooperation with Posiva and the parties liable for nuclear waste management. Fennovoima and Posiva's subsidiary, Posiva Solutions Oy, have signed a ten year service agreement. The agreement will enable Posiva's expertise to be utilized in Fennovoima's final disposal of spent nuclear fuel. Preliminary studies will be undertaken in Eurajoki and Pyhäjoki municipalities, but a final location will not be selected until the 2040s and disposal will not begin until the 2090s.

Steps in the process

Date	Event
1983 to 1985	Screening study of Finland
1986 to 1992	Preliminary site investigations
1993 to 2000	Detailed site investigations and an environmental impact assessment (EIA) was carried out for sites in Romuvaara in Kuhmo, Kivetty in

	Äänekoski, and Olkiluoto in Eurajoki and Hästholmen in Loviisa (added in 1994).
1997	Posiva organised several open discussion events in all candidate municipalities as part of the EIA programme and for informing the public.
1997 to 1999	Posiva completed an environmental impact assessment for the disposal of spent nuclear fuel
1999	Posiva decided to apply for a Decision in Principle for the Olkiluoto site in Eurajoki
2000	Eurajoki Council gave a favourable statement to the responsible ministry for hosting the GDF facility. The Government also made a favourable DiP for the Olkiluoto site.
May 2001	Parliament ratified the Government's favourable DiP
2002 – 2012	Site specific investigations to confirm suitability of the Olkiluoto site by starting the construction of ONKALO™ in 2004. Disposal depth in ONKALO™ was reached in 2010. Positive site investigations at Olkiluoto, construction of ONKALO™
December 2012	Posiva submitted its Construction Licence Application (CLA) for a GDF for Spent Nuclear Fuel to the Government
November 2015	The Government granted a Construction Licence the Olkiluoto encapsulation plant and disposal facility (GDF)
December 2016	Government confirmed that the conditions for the start of the construction as in the license (CLA) have been met and GDF construction can begin
Early 2020s	Final disposal should be able to begin Disposal is scheduled to begin after the government has granted an operating license to Posiva

Local decision making

The municipal council in each potential siting community, representing the local level of administration, had to express its willingness to participate in the site selection process. The councils of the potential sites had the right of veto and to decide whether to support the development of the GDF. Prior to a licence application for repository development, the Finnish Nuclear Energy Act requires a 'Decision in Principle' (DiP) to be taken by the Government (that is then taken to a vote in Parliament for its ratification), following a similar positive Decision by the relevant local municipality, after which an ability to withdraw from the process within the scope of the DiP ceases.

Eurajoki Council took its final decision after Posiva had submitted an application for a DiP to the Government. This happened before the construction of the ONKALO™ facility at Olkiluoto.

The agreement to construct the Hanhikivi 1 Nuclear Power Plant in Pyhäjoki was also subject to the DiP process, and the government required that Fennovoima presented its detailed plans for managing its spent nuclear fuel within 6 years of the DiP (by 2016).

Role of Government

The Ministry of Economic Affairs and Employment (MEAE) is responsible for granting licences and preparing the legislation, advised by STUK, the radiation and nuclear safety authority, which is also responsible for the oversight of nuclear facilities.

The final requirement of the site selection process is the ratification by the Finnish Parliament of the Government's DiP, and (for Posiva) this took place in 2001, following the earlier approval by the government (Ref 2). Prior to the DiP an Environmental Impact Assessment (EIA) needs to be carried out. The developer is responsible for the EIA programme and the government is responsible for the process (MEAE acts as the co-ordinating authority, receiving statements from other authorities, non-governmental organisations and the general public). After the EIA process, the MEAE received a preliminary safety assessment for the proposed facility from STUK.

Role of the developer

Posiva, together with its two owners, is solely responsible for assessing and choosing its preferred site, and for construction and operation. As stated, Posiva was responsible for planning and then conducting the EIA programme, required as part of the DiP process. The EIA procedure is an open process in which all residents and other stakeholders can participate. One of the key goals with this interaction is to gather the views of different interested parties and utilize them during the EIA procedure. Posiva held public meetings to allow the public in the local area to understand what was being proposed.

Related to its own disposal option, Fennovoima submitted an EIA (Ref 3) for its GDF in June 2016 as required by the 2010 DiP, and entered into the 10-year service agreement with Posiva.

Community Investment

No incentives or compensation are paid directly in relation to the GDF or nuclear. In Finland, private and industrial real estate pay a real estate tax to the municipality at a rate that varies on average from 0.4 to 1.0 per cent of the value of the real estate (land and buildings). However, nuclear facilities pay the real estate tax at the highest percentage rate, i.e. 2.85 per cent. This real estate tax is seen as the most obvious benefit for the hosting municipalities. The tax money goes straight to the municipality with no restrictions on its use. Changes to the amount of tax that a facility pays can therefore have an impact on the revenue of a municipality.

Following the selection of the Olkiluoto site, and under the terms of the Vuojoki Agreement signed between Posiva and the Eurajoki Municipality, Posiva granted a loan of €6.9 million (£6.2 million) to Eurajoki to help with the construction of a new, purpose-built home for elderly people who had previously occupied an historic mansion in the municipality (Ref 4). The Agreement was developed through a series of discussions between a working group consisting of Posiva and elected local representatives. Posiva financed a major part of the restoration of the mansion, along with the municipality and the European Union. The historic building is now open to the public and houses a restaurant, visitor attraction and conference venue. The activities at the mansion are run by the Vuojoki foundation, together with other

organisations. Posiva will rent the mansion for 40 years but has agreed to pay all the rent over the first 20 years. The municipality covers the costs of paying back its loan from this rental income.

Fennovoima intends to carry out analyses of the current socioeconomic status and structure of the alternative GDF locations for the spent fuel from the Hanhikivi 1 reactor, in order to study the project's socioeconomic impact. Ways to promote positive socioeconomic impacts will also be sought during the impact assessment.

References

1. Posiva Oy, '*The site selection process for a spent fuel repository in Finland – Summary report',* Posiva 2000-15, December 2000
2. Government of Finland, '*The decision in principle by the Government on 21 December 2000 concerning Posiva Oy's application for the construction of a final disposal facility for spent nuclear fuel produced in Finland*'. Unofficial translation dated September 2001
3. Fennovoima, *Environmental Impact Assessment Program for Spent Nuclear Fuel Encapsulation Plant and Final Disposal Facility,* fennovoima.fi/userData/fennovoima/publications/Fennovoima-EIA-Program-of-Spent-Nuclear-fuel-2016.pdf, June 2016
4. Kojo M, *Compensation as Means for Local Acceptance. The Case of the Final Disposal of Spent Nuclear Fuel in Eurajoki, Finland*, Waste Management 2008, February 24-28 2008, Phoenix AZ, US

Additional information from Susan Pietilä (TVO) and Tiina Rytky (Fennovoima)

2.4 France - Underground research laboratory and Cigéo – geological disposal facility

Siting process

Following a failed site selection process in the 1980s that did not involve or consult local communities, the 1991 Bataille Act on nuclear waste research and development established a clear political decision-making process, incorporating a 15-year research & development phase before any decision about long-term management of high level waste (HLW) and intermediate level long-lived waste (ILLW) (Ref 1). Andra, the National Radioactive Waste Management Agency, was also established through this Act.

Christian Bataille, a Member of Parliament, established three objectives: information provision to the public, open dialogue, and decision facilitation.

The Bataille Act provided for the creation of Underground Research Laboratories (URLs) to study waste disposal in different deep geological formations. At the end of 1992 Bataille, acting as a mediator, and assisted by Andra, launched a consultation to find sites that could host these URLs. 30 districts initially showed interest, but only 10 were deemed to be geologically suitable and three potentially favourable areas were identified in 1996 for more detailed consideration.

As Bataille recommended, the process required the districts to vote in favour of preliminary surface investigations before being included in a list of potential sites submitted to the government. Local government bodies, citizen groups, trades unions and a range of community groups were all involved in local hearings where they were allowed to express their opinion.

Andra and the Bureau de Recherches Géologiques et Minières (BRGM), the French geological survey, reviewed the geological data for communities that had expressed an interest in involvement in the project.

Another report by Bataille in December 1993 (Ref 2), confirmed by the Minister for Industry, also repeated the contents of the 1991 Act:

- supporting an organised debate by establishing a local information committee (CLI), with a budget of €150,000 (£133,500), in each district
- establishment of an economic development scheme (Public Interest Group or GIP) in each district with an annual budget of €900,000
- underground research laboratories (URL's) should work with local universities and R&D organisations in the districts on related scientific and technological projects.

In May 1996, Andra identified three possible sites for further investigation, granite below sedimentary cover at La Chapelle-Baton, in the Vienne district; in marl at Bure, in the Haute-Marne district and at Chusclan, in the Gard district, near Marcoule, also in marl (Ref 3). Andra was authorised by Ministers to file applications for the installation and operation of URLs at these sites, and public hearings were held in each from January to May 1997. Following considerable delay, in December 1998 the government authorised Andra to develop an underground laboratory in the clay beneath Bure. However, at the same time it rejected the sites in the Gard and Vienne as geologically unsuitable (Ref 4). In addition, the government called for investigation of a granite site at a location to be confirmed. However, subsequent research into the granite environment has only been carried out at international underground

research laboratories in granite, supported by existing bibliographic geological data available in France.

The Bure site, which straddles the border of the Meuse and Haute-Marne districts was subsequently selected as Andra's underground research facility. It is used to:

- study the feasibility of the reversible geological disposal of high level and long lived intermediate level radioactive waste.
- carry out experiments on technical demonstrations, such as drilling and lining a 100m borehole for horizontal disposal of high level vitrified waste.

Following several years of research in the URL, Andra concluded in 2005 that it would be both feasible and safe to construct a deep geological repository within a 250km^2 "Transposition Zone" on the Meuse / Haute Marne border (Ref 5). The following year, after review of Andra's proposed solution, and both public and parliamentary debate, the 2006 Waste and Planning Act (Ref 6) was enacted. It revised the 1991 original act and enacted the adoption by the French government of reversible (for at least 100 years) deep geological disposal at Bure as the solution for the long-term management of HLW and ILW.

In 2010, and following extensive stakeholder engagement, the government approved the underground location for development of a deep repository. In 2012, Andra successfully drilled and lined a 100-metre demonstration borehole for horizontal disposal of vitrified high level waste. An environmental monitoring and data/sample bank facility has been built on the Bure site and was commissioned in 2013.

In 2013 a public debate was held on the siting process, as legally mandated in the 2006 Act, based on the solution Andra had developed that included an identified and located single site for the waste receipt and transfer facility and two possible options for the shaft site (Ref 7). A number of public meetings were scheduled nationally but disruption from opposition groups led to the first two meetings being abandoned. A revised schedule was then developed, replacing the public meetings with both on-line debates and more targeted meetings with invited stakeholder groups (the "Citizens Conference" with seventeen invited members of the public).

Steps in the URL and Cigéo Geological Disposal Facility process

Date	Event
1991	Andra established
1992	Work on GDF design and identification of knowledge to be acquired
1993	30 volunteer sites identified
1994-96	Geological survey work on two clay sites (Meuse/Haute-Marne and Gard) and one granite site (Vienne)
1998	Government selection of Meuse/Haute-Marne site. URL experimental programme defined including selection of a range of technical solutions
1999-2001	Start of laboratory shaft sinking
2000	The underground research laboratory (URL) built in Bure comprising surface installations (administrative offices, workshops, laboratories,

Date	Event
	reception building) and more than one kilometre of underground tunnels excavated in the Callovo-Oxfordian marl at a depth of 445 to 490 metres
2002	Revision of scientific programme for 2002-2005 and selection of GDF concepts (waste packages and disposal cells)
2003-2004	Borehole drilling on and around the laboratory site
2004/5	Further drift experimentation
2006	2006 Planning Act passed containing the objectives and time-scales for disposal of radioactive waste
2007	Perennial Observatory of the Environment (OPE) created to investigate the environment around the future site of the Industrial Centre for Geological Disposal (Cigéo) to identify any long-term changes
2011	The Industrial Committee: a new Andra advisory body created to focus on Cigéo
December 2011	Andra granted the licence to operate its URL and to continue its research activities at the Meuse/Haute-Marne facility until 31 December 2030
2013	Public consultation, followed by Government site selection/confirmation
2019	Filing of the licence application for Cigéo
2019 - 2020	Public consultation
2019 - 2022	Review of the Cigéo licence application (ASN)
2022	GDF licence is granted - Cigéo construction begins
2025-2035	Commissioning (pilot phase then disposal of the first waste package)

Local decision making

France was, at the time of the siting process, divided into 22 regions, that comprised 100 districts and 36000 “communes”. The main local decision makers are the “communes” directly concerned by the project and the district.

Consultative votes involving elected officials at all local and regional levels of government were part of the licensing process for the URL, and the same will happen for the repository, which is now referred to as the Cigéo project (Centre Industriel de Stockage Géologique). Although only “consultative”, gaining local support with these votes was considered essential for the government to progress. There was no direct public involvement in the way that had occurred during the initial site selection process carried out by Christian Bataille between 1991 and 1996.

During the URL licensing process in 1997, as well as the districts, the 33 communes (similar to a parish) within 10km of the URL's main shaft were also entitled to vote as were the two regional councils.

Role of Government

France has a centralised and complex political administrative system. Decision-making on radioactive waste management is organised so that national, regional and local levels can be appropriately involved.

A public inquiry process results in government decrees which direct Andra to undertake particular work. The Government has a decision making role throughout.

Role of developer

Andra, as national disposal agency, is responsible for all radioactive waste in France and mandated to conduct studies on the deep disposal of HLW and ILLW. As described. this led to the creation of the URL and to scientific experiments and technological tests to demonstrate the feasibility of deep disposal at Bure. In 2005, Andra had reported that deep disposal was feasible for HLW and ILLW (Ref 5), resulting in the 2006 Planning Act, which confirmed that deep geological disposal is the preferred solution for these wastes in France (Ref 6).

In response to issues raised during the truncated public debate in 2013 Andra have included an "industrial pilot phase" in their revised implementation plans, in order to test the performance of the disposal system once a construction license has been granted. A Masterplan for construction and operation of the Cigéo project, which will be subject to regular review, has also been developed, and was published in 2016. In addition, improved plans for the involvement of civil society in the project are being put in place (Ref 8).

Community Investment

Since the Waste Planning Act in 2006 (Ref 6), some 312 communities in the Bure area within a defined 'proximity zone' have received increased community investment relative to those laid down in the original 1991 Act, associated with operation of the URL. The Public Interest Groups (GIP or Groupement d'Interêt Public) proposed in the 1991 Act and established in 2000 in both Meuse and Haute-Marne, each received €9.1 million (~£8.1 million) a year up until 2006 for the financing of local projects. As from 2007 each Public Interest Group received up to €20 million (£17.8 million), now increased to around €30 million (£27 million). The Act also specifies that the benefit budget should be managed by the GIPs and devoted to promoting the local economy and employment. The benefit budget should be invested mainly in the communes closest to the Bure site.

The GIPs were set up according to a 'Convention' or 'Terms of Reference' which had to be approved and published by the national government as an 'arrête' or Ministerial Order. This outlines the participation activities of the group members and the conditions under which they shall be held responsible for the group's debts. It also specifies the conditions under which the group members may provide the group with the services of their own paid staff.

The Meuse GIP, for example, is administered by a Board of Directors, answerable to a General Assembly, which alone can alter the GIP structure or terminate its activities. The Board consists of 3 members of the Conseil Général de la Meuse; 1 member representing the French Government; 1 member representing the group of local governments from the immediate surrounding communities; 1 member representing the group of adjacent community governments in the Upper Meuse Valley; 1 member representing the 15

communities within 10Km of the URL; 1 member from the Conseil Régional de Lorraine and 1 member representing ANDRA. The General Assembly consists of around 250 members, representing, in addition to the groups and organisations above, EdF, Areva, CEA and relevant local Chambers of Commerce, Trades and Crafts and Agriculture.

The GIPs manage the benefit budget, within strict rules governing how it can be spent. Each community receiving funding has to provide 50 per cent matched funding for any proposed project. This means that the allocation of funds around the Bure site is assessed in terms of the "leverage" (as well as direct impact) that a project or activity can bring to the area in terms of jobs created, number of businesses affected or other socio-economic community investment. Those requesting support from the GIP must submit detailed project outlines prior to commencement of any activity. The GIPs publish a list of eligibility criteria. For example, the GIP Meuse Objectif requires projects to match an agreed list:

- Economic development and employment;
- Communication and transport infrastructure;
- Developing a tourist economy;
- Training, R & D, technology transfer;
- Habitat and Urban Planning;
- Services to the population; and
- Sustainable development and environment.

The GIP assesses the project applications and then prepares an annual programme showing the projects to be supported. In the case of the GIP Haute-Marne, these are grouped in terms of Energy and the Environment; Companies and Technologies; Tourism and Attractiveness; Equipment and Services and Infrastructure (Ref 9). The GIP Objectif-Meuse groups them in terms of Economic Development and Employment; Communication and Transport Infrastructure; Developing a Tourist Economy; Training, Research and Development and Technology Transfer; Habitat and Town Planning; Services to the Population and Sustainable Development and the Environment (Ref 10).

In order to undertake these activities, each receives funding from taxes levied on other so-called 'basic nuclear installations' (reactors, storage sites, fuel fabrication plants, reprocessing plants etc.). The GIP receives funds through a sub-set of this tax referred to as the "taxe d'accompagnement". Prior to 2017, a second tax was also levied, referred to as the "technological diffusion tax". This is described in detail in the 2006 law (Ref 6).

The €30 million (£27 million) that the GIPs manage is paid directly to the GIP by the national government. No decision has yet been made about when these payments will cease, although this is expected to be linked to the licencing of the DGR (target date 2025). Once the DGR has been licensed to operate, the expectation is that Andra will pay the "Installation Nucléaire de Base" tax for the facility.

Additional community investment focuses on the creation of new infrastructure and resources in the Bure area by large waste producers, for example at EdF's national archive centre. The nuclear industry has also supported local businesses by helping them to develop projects and apply for grants from the Public Interest Groups (GIP's).

The GIPs have to pay charges to the municipal budgets of those communities within 10km of the URL. In 2012, for example, these appropriations paid by the Haute-Marne GIP amounted to €1,308,114 (£1,167,000) divided among 18 municipalities in proportion to their population.

The 2006 Planning Act originally specified that a licence application should be submitted in 2014-15 with a decision expected in 2018-19, but the licence submission is now planned by 2019, and has been preceded by the submission of a “Safety Options Dossier” to the French Nuclear Safety Authority. The NSA then in turn asked for this document to be reviewed by the International Atomic Energy Authority (Ref. 10).

When the final licence decision is made to construct a GDF, the facility will be classed as a "basic nuclear installation" and will be subject to the special tax system for the relevant type of facility. According to the 2006 Planning Act, the ‘Presumptive Assessment’ of the tax due for a final repository will be some €2.1 million per year, which is similar to the amount assessed for a single operating reactor unit, and will be levied throughout the operational lifetime of the repository.

References

1. Text of Law No. 91-1381 of December 30 1991 (In French)
2. Battaille C 1994; ‘*Mission de Médiation sur l'implantation de Laboratoires de Recherche Souterrains’*. (Report to the Prime Minister, In French)
3. ANDRA 1996; ‘*Pour des Laborataire Bien Intégrés*: *Les procédures administratives préalables à l’implantation des laborataires de recherche souterrain’s.* October 1996
4. Sugier N and P Lebon 1999; ‘*Underground Research Laboratories in France Results of the Reconnaissance Phase and Research Programs’*. In: ICEM'99; 7th International Conference on Radioactive Waste Management and Environmental Remediation. Nagoya, Japan. September 26-30, 1999
5. Andra, 2005. Dossier Argile: ‘*Synthesis: Evaluation of the feasibility of a geological repository in an argillaceous formation, Meuse/Haute-Marne Site’.* December 2015
6. ‘*Radioactive materials and waste Planning Act of 28 June 2006’*. Consolidated version established by Andra
7. Andra, 2013. ‘*The Cigeo project – Meuse / Haute-Marne reversible geological disposal facility for radioactive waste’*, 504VA – DCOM/13-0271, July 2013
8. A*ndra Board Minutes May 2014*
9. GIP Haute-Marne, Programme d’activité 2017. 19 décembre 2016 (in French)
10. GIP Objectif-Meuse, Rapport d’activités 2016.
11. IAEA, 2016. ‘*International Peer Review on the “Safety Options Dossier” of the Project of Disposal of Radioactive Waste in Deep Geological Formations: Cigéo’*. November 2016

Additional information from Richard Poisson (Andra)

2.5 Japan - High level waste and transuranic waste geological disposal

Siting process

The original site selection process had three stages as set out in 2000 in the "Final Disposal Act" (Ref. 1). The stages are; the selection of Preliminary Investigation Areas (PIAs), the selection of Detailed Investigation Areas (DIAs) and the selection of a GDF construction site.

The Nuclear Waste Management Organization of Japan (NUMO), the developer, sought volunteer municipalities so that it could use existing information to carry out a desk-based study for the selection of PIAs. After confirming that volcanic activity, active faults or other geological phenomena do not make the area unsuitable for siting a GDF, more detailed site investigation and selection was then planned. NUMO is considering a co-disposal of HLW and TRU waste (also known as long-lived intermediate level waste) as a reference repository concept.

In January 2007, Toyo town, in Kochi Prefecture, became the first and only municipality to agree to a desk-based study, but withdrew subsequently in April 2007. NUMO continued to work to attract other municipalities, but without success.

Given this lack of progress, in 2013 the Japanese Government established the "Inter-Ministerial Council for Final Disposal" to fundamentally review its policy on final disposal. As a result the policy was amended in May 2015 (Ref.2). The key revisions to the policy are:

- while making efforts based on the responsibility of the present generation so that future generations will not be subject to the burden, the government will ensure reversibility and retrievability and promote technological development for alternative options
- the government will ensure that the wider population demonstrates gratitude and respect to the areas contributing to the project
- the government will identify scientifically suitable areas and offer the opportunity for local governments to cooperate in the investigation
- the government will support consensus building and sustainable development in local communities
- the Japan Atomic Energy Commission will regularly evaluate progress in in activities carried out by the Government and relevant organisations for promoting geological disposal programme, which include technological development etc.

The third bullet has fundamentally changed NUMO's approach to siting. NUMO now has a "twin track" approach - while the call for volunteers remains open, the Japanese Government will pro-actively progress the siting process and identify suitable sites in a process referred to as 'Nationwide Scientific Screening'.

In December 2015, the governmental Geological Disposal Technology Working Group published an interim report outlining draft requirements and criteria for identification of scientifically preferable areas (Ref. 3). This included a recommendation that areas within a few Km of the coast should also be considered in the national screening exercise. However, a peer review of the new process by the Nuclear Energy Agency, published in 2016 (Ref. 4) pointed out that the new approach is intended to differentiate between "potentially less suitable areas"; "potentially suitable areas"; and "potentially more suitable areas" as a means to facilitate future site selection, and that this might cause some confusion amongst the public.

Following calls for public comment on the draft criteria, and a series of public seminars, a final version of the report was published in April 2017 (Ref. 5), with a change in emphasis in terms

of how the areas are described. This was followed by an explanatory 'scientific characteristics map' published on 28th July 2017, indicating 4 different areas on the Japanese mainland and islands:

1. Areas scientifically estimated to have unfavourable features in terms of long term underground stability, as well as those relevant to phenomena that could cause adverse impacts to the above-ground facility, e.g. pyroclastic flow
2. Areas scientifically estimated to have unfavourable features due to the potential of future human intrusion
3. Areas with potentially favourable features
4. Preferable areas with regard to logistical safety / transportation reasons

Steps in the process

Below are the steps in the process, in which the site selection and operation milestones are based on the government's final disposal plan:

Date	Event
2002	Open invitation began, known as "open solicitation"
2007	The mayor of Toyo Town officially applied to be part of a desk-based survey
April 2007	A new mayor takes office in Toyo Town, the application is withdrawn
May 2015	Revision of siting policy, with government taking over a leading role
April 2017	Publication of requirements and criteria for identifying potential siting areas
July 2017	Publication of a Scientific Characteristics Map showing potential siting areas
Mid-2020s	Selection of GDF site
Late 2030s	Start of GDF operation

Local decision making

As repeated in the revised process, when approving each stage of the site selection process, the opinions of the municipality mayors and the prefecture governors concerned must be taken into account. Following publication of the siting map, NUMO will open discussions with the local communities at the sites identified by the Nationwide Scientific Screening with a view to gaining their co-operation in the literature survey for selection of Preliminary Investigation Areas (PIAs). The municipality is the most local level of local government in Japan.

As before, where the prefecture or municipality opposes a disposal facility, the area will not be considered for siting studies.

Role of Government

Under the amended siting process, the Japanese government has led development of the nation-wide siting criteria and characteristics map. It has also established the Expert Group for Radioactive Waste Management, under which the Geological Disposal Technology Working

Group developed the screening requirements and criteria. The government remains the overall decision maker.

Role of developer

NUMO was established in 2000 to prepare for and implement geological disposal of "specified" radioactive waste – vitrified high level waste (HLW). Some types of transuranic waste resulting from the reprocessing of spent fuel from commercial nuclear power plants and the MOX fuel fabrication plant has been included by the amendment of the Final Disposal Act in 2007. NUMO will lead discussions with the local communities in the areas identified in 2017 as being potentially suitable for investigation.

Community Investment

According to the original siting process in 2002, up to ¥210 million (£1.4 million) per year per site would be paid to communities during the initial Literature Survey, expected to last for 4 years. This would be followed by up to ¥2 billion (£13.4 million) per year per site up to a maximum of ¥7 billion (£46.7 million) during the 'Preliminary Investigations' period, expected to last around 5 years. In 2007 the payment during the Literature Survey was increased to a possible ¥1 billion (£6.7 million) per year, although limited to a maximum of ¥2 billion (£13.4 million) in total. The level of payments during the 'Detailed Investigations' period have yet to be announced. The purpose of the payments, which will be made directly from government, are to support the following:

- Activities to promote understanding
- Examinations of regional promotion measures
- Activities to enhance welfare and promote regional industries.

As part of the revised siting process, it is intended to establish local 'dialogue platforms', although it is still undecided as to how their operation will be supported by NUMO and the government.

Expected socio-economic community investment associated with GDF construction and operation would include:

- transfer of the NUMO operational headquarters to the municipality
- promotion of regional employment and utilisation of regional industry, actively employing local workers and using related regional industry
- creation of business opportunities and supporting local companies, such as buying local materials/services for the construction and operation of the GDF
- development of regional industries with the transfer of GDF operational and management know-how to the municipality.

References

1. Government of Japan, *Final Disposal Act*. 2000
2. Ministry of Economy, Trade and Industry, *'Basic Policy on the Final Disposal of Designated Radioactive Wastes amended*'. Press release May 22nd 2015
3. Geological Disposal Technology WG, '*Interim report on the requirements and criteria for identification of scientifically preferable area'* (in Japanese). December 2015

4. Nuclear Energy Agency, *Japan's Siting Process for the Geological Disposal of High-level Radioactive Waste: An International Peer Review*. NEA No. 7331, 2016
5. Geological Disposal Technology WG, *'Summary of Requirement and Criteria for Nationwide Map of Scientific Features for Geological Disposal'* (in Japanese). April 2017 (see METI Press Release: meti.go.jp/english/press/2017/0417_001.html)

Additional information from Hiroyuki Umeki (NUMO)

2.6 Sweden - Spent fuel geological disposal facility

Siting process

Sweden's national policy is to dispose of radioactive waste in crystalline bedrock. One task in the initial phase of the siting process was to acquire good knowledge of the Swedish bedrock and what properties the rock must have to ensure safe final disposal of spent fuel.

SKB, the implementer, drilled at 10 sites across Sweden to identify suitable areas. The studies showed that most of Sweden probably has suitable bedrock for a GDF. However, the early investigations had met with considerable local opposition, and SKB saw little point in progressing siting work in a hostile community environment, recognising that local support is needed to implement geological disposal.

Consequently, in October 1992, SKB wrote to all 286 municipalities in Sweden to introduce the work of managing and disposing of nuclear waste. SKB sought interest from municipalities that wanted to know more about nuclear waste management or that would allow it to carry out a feasibility study. The letter pointed out that showing interest would not mean a future commitment. It also pointed out that communities could opt out of the process if they did not want to proceed.

Following discussions with around 20 municipalities, two municipalities in the north of Sweden agreed to begin discussions and to conduct feasibility studies. However, local referenda in both areas showed the local population did not support continuation of the siting process. After this SKB decided to focus on existing nuclear communities (for example, where a nuclear facility, like a power station, already exists) in the south of the country. They therefore approached municipalities near nuclear facilities to see if they were prepared to allow feasibility studies to be carried out. SKB stated that it would not carry out studies in areas where the community objected.

In the event, five more feasibility studies were carried out, in Ősthammar (adjacent to the Forsmark reactor site), Nyköping (site of the Studsvik facility), Simpevarp and Laxemar (adjacent to the Oskarshamn reactor site), Tierp (neighbouring Ősthammar) and Hultsfred immediately west of Oskarshamn. In light of these, three areas were prioritised for site investigations: Forsmark, an area in the northern part of the municipality of Tierp, the Simpevarp area and Laxemar. The municipality councils in Östhammar and Oskarshamn consented to further investigations, while Tierp said no. In 2009 Östhammar was chosen as the preferred site, and in 2011 SKB applied for permission to develop a GDF at Forsmark and an encapsulation plant (known as Clink) at Simpevarp, adjacent to the Clab interim storage facility (Ref 1). This was endorsed in June 2016 by SSM, the Swedish nuclear regulator, and will be the subject of planned hearings by the Swedish Land and Environment Court starting in September 2017 (Ref 2). SKB are hoping to commence construction work in the early 2020s and start emplacing spent fuel in the GDF some 10 years later.

Steps in the process

Date	Event
1992	SKB sends invitation seeking volunteers to all municipalities
1993	Storuman and Malå agree to host feasibility studies

1995 - 1997	1995 Storuman decided to withdraw from the process, 1997 Malå decided to withdraw from the process - the decisions were based on referenda
1995	SKB focuses on existing nuclear communities and seeks volunteers
1995 - 1999	Communities agree to participate in the feasibility studies (Östhammar took 4 weeks and Oskarshamn took 17 months to decide to volunteer). Some communities were invited to volunteer later in the process (Tierp joined the process in 1998 as did Älvkarleby at the beginning of 1999). Other communities investigated were Nyköping and Hultsfred
1993 - 2000	Feasibility studies at eight sites (including Storuman and Malå), the studies took between two and four years, depending on when the sites entered the volunteer process
Nov 2000	SKB publicly announce the choice of sites for detailed investigation (Oskarshamn, Östhammar and Tierp)
Dec 2001	Östhammar accepts the site investigations
March 2002	Oskarshamn accepts the site investigations
April 2002	Tierp rejects the site investigations
2002 - ~2009	Detailed investigations at two sites (Oskarshamn and Östhammar)
2009	Östhammar chosen as GDF host
2011	Application for GDF development submitted
2011 - ~2019	Review of applications and granting of permissions
~2020s	Construction begins
~2030s	Emplacement of spent fuel

Local decision making

The municipal council and the Swedish Government are responsible for decision making. The municipal councils had the opportunity to object to the initial feasibility studies and voted on whether to allow detailed site investigations. Opinion polls have been conducted regularly in both Östhammar and Oskarshamn municipalities The recent polls showed that around 80% of people are in favour of the encapsulation plant and the final repository.

After the regulatory reviews are completed, and if the Government agrees with SKB's proposals, the Östhammar municipality will be asked if the community accepts SKB's suggested solution. The municipal council is considering how it will make that decision and on what basis. It is expected that there will be a vote in the council. It has been decided to hold a local referendum in March 2018 to gauge the opinion of citizens in the municipality.

Role of Government

The Swedish Government is responsible for developing relevant legislation. Subject to positive reviews and recommendations from SSM and the Land and Environment Court, the Government will issue a construction licence under the Nuclear Activities Act and permission under the Environment Code. SSM will then authorise the start of construction, the start of trial operations, the start of routine operations, and the decommissioning of the facility. A Government decision is again needed for de-licensing and the exemption from responsibilities. SSM will review the application to ensure that all obligations and licensing conditions have been fulfilled.

Role of developer (implementer)

SKB is owned by the nuclear utilities and has the task of managing and disposing of spent nuclear fuel from Swedish nuclear power plants. It is responsible for site investigations, the choice of site and implementing a solution. It was also responsible for negotiating the details of the Added Value Programme (AVP) as detailed below.

Community Investment

Funding for the municipalities' involvement in the siting process has been paid through the Nuclear Waste Fund, into which the nuclear operators have contributed for the purposes of radioactive waste management and decommissioning. Since 2005, non-profit organisations can also receive money from the fund to participate in the process and undertake research.

During the feasibility studies, which ran for about four years, each of the eight municipalities involved received up to two million SEK per year (around £187,000). These grants were sourced directly from the Swedish Waste Fund on application by the Reference Groups that were established in the municipalities, and distributed by SKI, the Swedish nuclear regulator at the time. The payments were made available following a Government Decision in 1995 (Ref 3) .During the detailed site investigation studies, Oskarshamn and Östhammar, the two municipalities involved, received 4 million SEK per year (around £375,000). As Oskarshamn was also being considered as host for the encapsulation plant it received an additional 1.5 million SEK a year (£141,000), making a total of 5.5 million SEK (around £515,000). The communities were accountable for the funds and subject to an annual audit to ensure that the money was spent only on activities designed to enable involvement in the debate about long-term radioactive waste management. In Östhammar the Reference Group consisted of only 8 people, each of which was a representative of the various political parties on the municipal board, although the permanent secretary to the group was a municipal official. By way of contrast, the Reference Group in Oskarshamn consisted of the whole municipal council, with as many as 6 working groups concentrating on monitoring the various aspects of the investigation. Although these too primarily consisted of elected representatives, they had full autonomy in terms of using external consultants and advisors when required (Ref 4).

In 2007 a letter was sent to SKB, signed by the municipality mayors of Östhammar and Oskarshamn stating that there should be some recognition of their roles in addressing a serious national issue. In addition, a condition of any negotiation regarding community community investment was that an agreement should be signed before SKB announced the preferred site for the repository (Ref 5). The agreement that was signed, known as the AVP, is unique in that it specifies that whilst both communities will benefit from the 1.5 to 2 billion SEK (£140 – 187 million) available in total, the community that was not selected actually receives 75% of the benefit. In addition, 20% of the available funds had to be allocated before 2013,

the date by which a construction licence was expected, although as outlined above, the licence has yet to be issued. The AVP is designed to deliver added value to the communities through projects funded directly by SKB´s owners, the waste producers, and not by the Nuclear Waste Fund. A project will be assessed in terms of its added value to the community. This will include such things as whether the project will generate local income, whether third party funding is available that would otherwise not be and the value of additional jobs generated through the project etc. The Board will take all these into account when evaluating proposals and requires a majority of at least 4-1 for approval.

Under the terms of the AVP, Oskarshamn and Östhammar municipality each receive around 1.5 million SEK (£141,000) to maintain an organisation that administers the local activities associated with its operation (Ref 6). This is payable until 2020, under the current agreement.

Applications for projects that deliver added value are made to the programme committee, which consists of the Mayors of Oskarshamn and Östhammar, SKB and others (Ref 6). Until the GDF is built, the communities can draw up to 20 per cent of this value. There is some flexibility built into the percentage and timescale to allow for variances in the timing of the siting process.

In Östhammar the Added Value Programme is funding or supporting a college of technology and energy, the business incubator in Uppsala, a pre study on a hotel and a pre study on the business harbour. A special company, SKB Business Development, guarantees bank loans and helps local companies with business development. The programme has also helped to advance the building by the Swedish Transport Administration of a road between Östhammar and Uppsala. In Oskarshamn, some of the operations within the Added Value Programme include support to the business incubator, the creation of the nuclear engineering education organisation (Nova), and various activities in the Äspö laboratory, etc (Ref 5).

References

1. SKB, '*Site selection – siting of the final repository for spent nuclear fuel*', R-11-07, March 2011
2. SKB, *'Environmental licensing of the Spent Fuel Repository this autumn'*, July 03, 2017 skb.com/news/environmental-licensing-this-autumn/
3. Sundqvist G, '*Constrained Deliberation: Public Involvement in Swedish Nuclear Waste Management*'. Discussion Paper 25, STAGE (Science, Technology and Governance in Europe), April 2004. EC Fifth Framework Programme (HPSE-CT2001-50003)
4. Richardson PJ, '*Public Involvement in the Siting of Contentious Facilities; Lessons from the radioactive waste repository siting programmes in Canada and the United States, with special reference to the Swedish Repository Siting Process'*. SSI Rapport 97-11
5. Nuclear Energy Agency, '*Actual Implementation of a Spent Nuclear Fuel Repository in Sweden: Seizing Opportunities. Synthesis of the FSC National Workshop and Community Visit*, *Östhammar, Sweden*', 4-6 May 2011
6. Setzman E, '*Preparing for Implementation, Construction and Public Support / the Added Value Programme'*. Waste Management 2014, March 2 – 6, 2014, Phoenix, Arizona, USA

Additional information from Monica Hammarström (SKB)

2.7 Switzerland - High level waste and low/intermediate level waste repositories

Siting process

A site selection process for the disposal of low level waste (LLW) and intermediate level waste (ILW) was initiated in the 1980's. It ended when the population of canton Nidwalden rejected the proposal for the excavation of an exploratory drift in 2002. In 1987, Nagra had submitted an application for an exploration permit for the Wellenberg site, in canton Nidwalden. In 1993, it came out top of the list of priority sites for LLW and ILW. This was after an initial list of 100 sites had been reduced to 20 and then three sites.

In 1994, the Wolfenschiessen siting community voted to begin discussions with the cooperative responsible for constructing and operating the GDF, Nuclear Waste Management Cooperative Wellenberg (GNW). However, authorisation from the canton (district) was necessary to use the underground. In 1995 and again in 2002, this authorisation was refused in a public referendum across the canton. It should be pointed out that in 1995, the cantonal government had granted the requested permit and the potential host community was also in favour of the project. An analysis of the negative vote showed that the safety of the project was not contested, but the GDF concept and the selection process needed substantial changes.

The new nuclear legislation, which came into force in 2005, specified that site selection should follow a process called a "sectoral plan", a land use planning tool implemented for large infrastructure projects such as the construction of an airport or a motorway. The siting regions should be involved at all stages of the decision-making process, but would not have a veto right. The sectoral plan process aims at identifying two repository sites, one for LLW/ILW and one for high level waste (HLW) and spent fuel (SF), using a stepwise approach. Note, that the option for both repositories at one site is also possible. The first stage of the new process (Ref 1), from 2008 to 2011, identified six broad regions that could be suitable for the construction of safe repositories, starting from a blank map of Switzerland. All six regions were considered potentially suitable for a GDF for LLW and ILW, three of them for HLW and SF. The second stage of the process, currently on-going, will lead to the selection of at least two sites each for the L/ILW and the HLW repository.

To implement the participation process, so-called "regional conferences" have been set up, involving a broad range of stakeholders. These have in particular contributed to defining the locations for the surface facilities. Furthermore, the siting regions had to be compared from the point of view of safety, according to specific provisions established by ENSI, the Swiss safety authority. Following these requirements, at the beginning of 2015, Nagra proposed retaining two regions, "Jura Ost" and "Zürich Nordost" for further investigation in Stage 3 and to place the other four regions in reserve (Ref 2). In the course of its review process, ENSI requested additional information showing whether construction at greater depth involves disadvantages in terms of safety and whether modifying the repository concept would be advantageous for such depths. The additional information was particularly relevant with respect to the Nördlich Lägern siting region that Nagra proposed to put in reserve. Reports submitted to ENSI in July 2016 support Nagra's earlier conclusions.

In a detailed review of Nagra's proposals, published in April 2017 (Ref 3), ENSI agreed that the Zürich Nordost and Jura Ost siting regions should be further investigated and accepted the proposed focus on Opalinus Clay as a host rock. However, it concluded that Nördlich Lägern should also be further investigated in Stage 3. The review documentation will be

subject to a broad public consultation at the end of 2017. Based on the reviews by the authorities and the results of the consultation, the Swiss Federal Office of Energy (SFOE) will issue a recommendation to the Federal Government. Stage 2 of the sectoral plan process is expected to be completed at the end of 2018. In Stage 3, starting in 2019, the remaining siting regions will be investigated at depth. Applications for deep drilling permits have already been submitted.

Steps in the process

Date	Event		
2008	Sectoral plan for GDF's – preparation of conceptual part 1	Approval by Federal Council	
	Sectoral plan for GDF's – Implementation	Procedure according to Spatial Planning Act and Ordinance	Procedure according to Nuclear Energy Act
2008-2011	**Stage 1:** Selection of geological siting areas	• Cooperation • Hearings and participation • Settlement • Decision	
2011 – 2018	**Stage 2:** Selection of at least two sites (~7 years)	• Cooperation • Hearings and participation • Settlement • Decision	
2019-2024	**Stage 3:** Site selection and general licence procedure (~5 years)	• Cooperation • Hearings and participation • Settlement	• Preparation and submission of general licence application • Review and approval procedure
By 2025	Decision of Federal Council	Approval	Granting of general licence
By 2026	Approval of general licence by government (1 year)	• Possible national referendum	

Local decision making

The local authorities do not have a decision-making role, but they represent regional interests. Together with SFOE they were responsible for setting up regional conferences in Stage 1. These are made up, amongst others, of delegated participants from the communes, representatives from interest groups and political parties.

The process aims to involve the regional cantons and local communes at the potential sites through various engagement mechanisms and formal engagement periods and hearings. A cantonal commission, which was established in 2008, will ensure cooperation between central government representatives, the siting cantons and affected neighbouring cantons and countries. An expert group also provides support and advice to the cantons on safety-related documentation.

Role of Government

The Swiss Federal Office of Energy (SFOE) is the lead authority. The new Nuclear Energy Act and Nuclear Energy Ordinance have been in force since February 2005, making federal government the final decision-maker. Cantonal licences or permits for site selection, construction and operation of the repository are no longer required. The federal government is responsible for the legal framework, while its various authorities are responsible for the supervision of nuclear power plants and the disposal of radioactive waste.

The general licence, similar to planning permission in the UK, will be sought when the preferred site(s) is/are identified. Once the government has granted the general licence, this decision has to be approved by Parliament. The decision is also subject to an optional referendum, which means that a national vote will take place if 50,000 signatures are collected from Swiss voters or eight cantons demand a referendum. This is expected to be the case.

Role of developer

Nagra's mission is to prepare and implement solutions for waste management and disposal that ensure the long-term safety of man and the environment. Nagra proposed six siting regions in 2008. The federal council confirmed this at the end of Stage 1 in November 2011.

In Stage 2, Nagra has proposed two sites each for the disposal of HLW as well as LLW and ILW, including the location for a surface facility in each siting region. In Stage 3, the remaining sites will be investigated in depth with a view to site selection and an application for a general licence. At the end of each stage, the responsible federal authorities are conducting a review followed by a three-month hearing before the federal council makes its decision.

Community Investment

There is no legal basis for the provision of community investment. Based on experience within Switzerland and in other countries it is expected that a siting region will receive some financial benefit. The sectoral plan specifies that decisions on any financial benefit should be transparent and not detached from the sectoral plan process. During Stage 2 the SFOE will develop a guideline for the corresponding negotiations between the siting cantons, siting regions and the waste producers. Note that the sectoral plan introduces two types of compensation measures: One can be thought of as compensation to a siting region for a service it performs to solve a national issue, the other is applied when the planning, construction or operation of a deep geological repository are found to have negative consequences for a region. Such negative consequences are assessed on the basis of independently conducted socio-economic and ecological studies. The compensation will be negotiated in Stage 3 and paid by the waste producers only when a valid general licence exists. The siting region will prepare proposals for the distribution and application of the compensation and submit these to the affected cantons and communes of the siting region.

Compensation measures, approved by the SFOE and financed by waste producers, will be developed in cooperation with the siting region and cantons.

References

1. Swiss Federal Office for Energy, *Sectoral Plan for Deep Geological Repositories – Conceptual Part*, April 2008
2. Nagra, *Siting regions for deep geological repositories – Nagra's proposals for Stage 3*, January 2015

Additional information from Stratis Vomvoris (Nagra)

2.8 US - Waste Isolation Pilot Plant transuranic wastes

Siting process

The Waste Isolation Pilot Plant (WIPP), originally intended for disposal of defence transuranic wastes and defence related high-level wastes at a pilot scale, was developed following a siting process involving considerable public concern at a number of other proposed sites. The US National Academy of Sciences had made a landmark recommendation on how to permanently isolate radioactive waste as early as 1957.

A committee of the national Academy of Sciences, primarily focused on high level waste (HLW), recommended disposal in salt as the most effective and cost efficient choice for deep geological disposal. A second choice recommended by that same committee was clay-rich shale. The first geological setting explored was rock salt.

Carlsbad, New Mexico, invited the Department of Energy to develop a facility in bedded salt (Over 600 metres thick) some 300 metres below the surface near to the town. In 1976, drill hole exploration began in the desert, southeast of Carlsbad.

WIPP, in accordance with United States federal law, namely Public Law 102-579, *The Waste Isolation Pilot Plant Land Withdrawal Act* (WIPP LWA, Ref 1), is mainly used for only defence-related wastes containing long-lived transuranic (TRU) wastes. The original idea of disposing of some quantities of defence related high level waste was dropped in response to state objections. However, in 1999, the New Mexico Environment Department approved the WIPP Hazardous Waste Facility Permit, authorizing the disposal of hazardous waste as part of the TRU waste, which is considered mixed (radioactive and hazardous) TRU waste.

The facility, when developed as per current plans, contains disposal rooms mined out of the salt rock approximately 650 metres underground. The disposal volume capacity of TRU waste for WIPP, established by the WIPP LWA, is 175,564 cubic metres of TRU waste. Each disposal room is over 90 metres in length. The plant is in its 18th year of operation and will continue accepting waste until the disposal volume capacity is reached.

In addition WIPP provides a suitable very low-dose environment for scientific experiments, including particle physics, GDF science, and studies of low radiation dose effects on organisms.

Steps in the process

Date	Event
1957	National Academy of Sciences recommends salt as a suitable geology for a GDF
1965	Oak Ridge National Laboratory looks at several salt sites
1975	Carlsbad approaches US Department of Energy (DOE) about hosting a GDF
1976	DOE begins studying sites for construction of the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico
1978	The New Mexico Environmental Evaluation Group (EEG) created to address growing public unrest concerning construction of the WIPP

Date	Event
1979	Congress authorises construction of the facility and the level of waste to be stored in the WIPP from high temperature to transuranic or low level waste
1991	A federal judge rules that Congress must approve WIPP before any waste, even for testing purposes, was sent to the facility
1994	Congress orders extensive evaluation of the facility against the standards set by the Environmental Protection Agency (EPA). Evaluation of the facility continues for four years, resulting in a cumulative total of 25 years of evaluation
1998	EPA concludes that there is “reasonable expectation” that the facility would contain the vast majority of the waste interred there
1999	Waste emplacement starts

Local decision making

Decisions were all taken by the mayor and the county without local referenda or other attempts to gauge support. There was intensive lobbying for the facility by the local mayor, with general support from the town as well as the county of which it is a part (Eddy County), and also neighbouring Lea County and its largest city, Hobbs. The County is the first-tier administrative division in a state. The powers assigned to counties arise from state law and so vary widely across the USA. Carlsbad did not have the power of veto. The state stepped in legally and secured a “consultation and cooperation agreement” that specified what would be allowed to be disposed of in the repository.

Role of Government

Congress is responsible for legislation on radioactive waste management and the President has the overall decision making role.

Role of developer

The US Department of Energy (DOE) was responsible for finding, constructing and now operating the GDF.

Community investment

Carlsbad has received social community investment from the WIPP programme, including:

- Carlsbad Environmental Monitoring & Research Center
- Advanced Manufacturing and Innovation Training Center
- environmental/hazardous materials education and training programmes
- grant writing courses, school equipment and curricula and a records centre project
- centre for hazardous waste management excellence
- community giving, with WIPP partners donating hundreds of hours to civic projects
- jobs – the largest economic impact for the area

- local procurement – the WIPP team is committed to using local suppliers as much as possible. It recruits local suppliers, helping them to understand and meet procurement requirements through seminars and training
- $20 million (£15 million) per year funding from the Land Withdrawal Act (1992) for 14 years (ceased 2011)
- WIPP acceleration funds - as designated by the U.S. Congress, the DOE has provided Carlsbad with approximately $3 million (~ £2.3 million) in funds per year (now stopped) designed to help offset the acceleration of waste disposal during the past few years, acceleration of waste disposal meant earlier termination of the positive local economic impact
- business development projects
- Technology Transfer Programme - WIPP developed organisational tools, training materials, and software that are available to more than 300 organisations in 50 communities throughout New Mexico (Ref 1).

Reference

Miner, A and Keeler, B., *Technology Transfer Innovation at the Waste Isolation Pilot Plant: using the Internet to Market and Transfer Soft Technology*, Proceedings of WM98, Tucson, Arizona, US

Additional information from Casey Gadbury (DOE)

2.9 US - Yucca Mountain spent fuel

Siting process

The Department of Energy (DOE) began studying sites including Yucca Mountain in 1978 as the USA's first long-term GDF for spent fuel. In 1987 Yucca Mountain was designated as the preferred site for a spent fuel GDF. The Nuclear Waste Policy Act (NWPA), as amended in 1987 (Ref 1), directed DOE to study only Yucca Mountain as the potential site for a deep mined geologic repository for the long-term disposal of spent fuel and HLW. As part of NWPA, as amended, the host state, Nevada, had a legal right of veto but the Federal Government could override the state. In 2002, Congress passed a law overriding Nevada's opposition that was signed by the President, confirming the site as the GDF location. Nye County, where the proposed facility would be situated, and other surrounding rural counties, supported continuation of the licensing process. In June 2008 - after more than two decades of site studies - DOE submitted a license application to the Nuclear Regulatory Commission (NRC) to construct a repository at Yucca Mountain.

In March 2009, the Energy Secretary stated that Yucca Mountain site was no longer considered a workable option. DOE discontinued Yucca Mountain license review activities in 2010 and Congress eliminated funding for Yucca Mountain activities in Fiscal Year 2011. In March 2010 the DOE proposed a motion to withdraw its license application from the Nuclear Regulatory Commission (NRC), which was denied by the NRC's administrative hearing board. In August 2013 a federal appellate court issued an order requiring NRC to continue review of the license application.

In January 2012, the Blue Ribbon Commission on America's Nuclear Future (BRC), established by the President in 2010, issued its final report (Ref 2) containing recommendations for legislative and administrative action to develop a new strategy to manage nuclear waste. In January 2013 the US Administration endorsed these recommendations to:

- deliver a new consent-based approach to siting nuclear waste management facilities
- establish a new organisation dedicated solely to implementing the waste management programme and given the authority and resources to succeed
- provide access to the funds from nuclear utility ratepayers for nuclear waste management
- prompt efforts to develop one or more GDFs
- prompt efforts to develop one or more consolidated storage facilities
- prompt efforts to prepare for the eventual large scale transport of spent nuclear fuel and high level waste to consolidated storage and disposal facilities when they become available
- continue support for US innovation in nuclear energy technology and for workforce development
- drive active US leadership in international efforts to address safety, waste management, non-proliferation, and security concerns.

In 2013, DOE endorsed the findings of the BRC and released a revised management and disposal strategy (Ref 3). During the period from 2011 through to 2017, the U.S. nuclear high-level waste programme was focused on generic research for repositories in a broader

range of geologic media, and conceptualizing and conducting preliminary designs for long-term spent fuel storage facilities.

Congress has recently endorsed a nuclear waste disposal plan introduced as the Nuclear Waste Administration Act of 2013 (NWAA). The Act would create a new and independent Nuclear Waste Administration to manage nuclear waste, construct an interim storage facility(s) and site a permanent GDF through a consent-based process as recommended by the BRC in 2012. All of this would be funded by ongoing fees collected from nuclear power ratepayers (the Nuclear Waste Fund). However, since 2013 Congress has considered the NWAA and other bills related to disposal, but none of the bills has been passed.

Following the change in the US Administration, the DOE is completing the work authorised by Congress in 2017 financial year. Although the President's Budget Proposal for 2018 financial year now requests funding for Yucca Mountain licensing, no decision has been made to re-open the Office of Civilian Radioactive Waste Management or resume Yucca Mountain licensing. It is however considered that moving forward with the licensing process would represent a significant step toward fulfilling the US federal government's legal obligation, safely managing the nation's nuclear waste, reducing taxpayer burden, and enhancing national security.

Steps in the process

The following chronology relates to the Yucca Mountain Project (YMP):

Date	Event
1983	Nine candidate sites identified (including Yucca Mountain)
1986	Five sites nominated by Secretary of Energy as suitable for characterisation of which three sites recommended to the President. Yucca Mountain, Nevada, Deaf Smith County, Texas and Hanford, Washington were selected *Note: investigations at 12 potential sites had been planned for a second GDF, but postponed for cost reasons*
1987	NWPA Amendments Act passed: only Yucca Mountain to be investigated Independent Nuclear Waste Technical Review Board (NWTRB) established
1993	Congressional dissatisfaction with the Yucca Mountain Project (YMP) in the intervening years resulted in a comprehensive reassessment of activities, stakeholder expectations, schedules and accomplishments
1994	YMP refocused and targets set: • evaluation by 1998 of Yucca Mountain technical suitability • statutory site recommendation and EIS to the President by 2000 • licence application to National Regulatory Commission (NRC) by 2001
1996	Programme funding cut by 40 per cent by Congress which required

Date	Event
	refocusing of programme, including deferment of 1994 targets. DOE issues Draft Revised Program Plan for YMP
1997	New milestone from plan The Viability Assessment by 1998 enacted in law
1998	DOE issue Program Plan Rev.2: • submit Yucca Mountain Viability Assessment to Congress in December 1998 • re-set the Secretary's site recommendation date for 2001 • submit licence application by 2002
1999	Draft Environmental Impact Statement (EIS) submitted
2001	Yucca Mountain Science & Engineering report • Supplement to Draft EIS / NAS Study • Preliminary site suitability evaluation
2002	Site selection review stage • Final EIS • Site recommendation from Secretary of Energy to President based on "sound science" and "compelling national interest" • President recommends Congressional approval that Yucca Mountain is qualified for a construction permit application • State of Nevada objects (vetoes) • Congress approves and overrides veto – puts decision on Yucca Mountain with NRC
2003	US$4.6bn (£3.5bn) spent to end of FY 03 (September) on YMP Other HLW related costs takes the amount to US$7.6bn (£5.8bn) YMP Budget for 2003. $350m (£266m)
2004	The total Office of Civilian Radioactive Waste Management (OCRWM) budget request for FY 04 is $590m (£450m) July – court decisions on YMP objections
2008	Licence application for operation submitted to Nuclear Regulatory Committee The Omnibus Spending Bill, the Yucca Mountain Project's budget was reduced to $390 million (£296m) although exploratory work continued

Date	Event
	Promise made in the presidential campaign to abandon the Yucca Mountain project
2009	Congress restricts funding to licence application work only Senate told that the Yucca Mountain site is no longer considered an option for storing reactor waste Congressional Research Service produces report on alternatives to Yucca Mountain
2012	Blue Ribbon Commission releases its final report. It expressed urgency to find a consolidated GDF, but also that any future facility should have input from the citizens around it, therefore, consideration is being given to the process for finding a site aligned to a volunteerism approach
2013	January 2013, US DOE publishes a revised Strategy for the management and disposal of used nuclear fuel and high-level radioactive waste
2013	The Nuclear Waste Administration Act of 2013 is introduced which would create a new and independent Nuclear Waste Administration to manage nuclear waste, construct an interim storage facility(s) and site a GDF through a consent-based process. The Act has yet to be passed by Congress
2017	Although the President's Budget Proposal requests funding for Yucca Mountain licensing, no decision has been made to re-open the Office of Civilian Radioactive Waste Management or resume Yucca Mountain licensing.

Local decision making

In the USA, a county is the first-tier administrative varying widely in size and powers. However, the state often has the final say on developments. The local mayor and county are likely to be the local decision-making body. However, their decisions would need to be in accord with the position taken by the state. Under the BRC's recommendations a consent-based process would have been followed requiring the developer to engage with states, tribes[3], local governments, key stakeholders and the public.

If a decision is made to return to the Yucca Mountain repository licensing process, the local decision-making activities under the NWPA, as amended, are considered to have been addressed. There is continued support locally from Nye County, Nevada, the location of the Yucca Mountain site, and opposition by the State of Nevada for the Yucca Mountain

[3] The relationship between federally recognised tribes and the United States is one between sovereigns, that is, between a government and a government. Furthermore, federally recognised tribes possess both the right and the authority to regulate activities on their lands independently from state government control.

Project. The State of Nevada objections were overridden by an act of US Congress in 2002.

Role of Government

Congress is responsible for legislation pertaining to radioactive waste management the President has the overall decision-making role as head of the Executive branch of the US Government.

Role of developer

The Department of Energy (DOE) is responsible for finding a site, construction and the operation of a GDF in accordance with the Nuclear Waste Policy Act (NWPA) of 1982.

Community investment

The 1987 Amended Nuclear Waste Policy Act (NWPA) contained provisions for community investment to be paid to host communities, at both a county and state level. However, in the case of Yucca Mountain the State of Nevada would not enter into negotiations, claiming that this would legitimise the siting decision, which it opposed.

Under the NWPA, the government charges utilities $0.001 for each kilowatt-hour of electricity sold from nuclear power plants in exchange for agreeing to accept and permanently dispose of used nuclear fuel. Fees collected total approximately $750 million per year (£570 million). This income is credited to the Nuclear Waste Fund. In addition, about 30% of the repository by volume, though only 10% per cent by (radio)activity is to be used for defence related wastes, for which the US government would pay. The current balance of the fund is estimated at $28 billion (£21 billion). In 2014, the collection of charges from the utilities were suspended following the lack of progress toward a viable spent fuel disposal programme.

Nye County received community investment from the DOE associated with the Yucca Mountain project. The county received various “payments equivalent to taxes” from the DOE, which supported road and infrastructure projects.

References

1. Nuclear Waste Policy Amendment Act, 1987
2. Blue Ribbon Commission on America’s Nuclear Future, *‘Report to the Secretary of Energy*’ , January 2012
3. US Department of Energy, ‘*Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste’*, 2013

Additional information from William Boyle (DOE)

2.10 Other National Programmes

Summary information is provided below on repository siting programmes in a number of other countries in order to provide additional insight and experience. The countries covered are:

- Australia – low level waste disposal and storage of intermediate level waste
- Bulgaria – low level waste disposal and a GDF for high level waste and spent fuel
- Czech Republic – GDF for spent fuel
- Germany – low level waste disposal and GDF for high level waste and spent fuel
- Hungary – low level waste disposal and GDF for spent fuel
- Italy – low level waste disposal and storage of intermediate level waste
- Lithuania – low level waste disposal
- Netherlands – storage of low level waste
- Romania – low level waste disposal and GDF for spent fuel
- Slovakia – GDF for spent fuel
- Slovenia – GDF for spent fuel
- Spain – storage of high level waste and spent fuel

2.10.1 Australia

Waste – disposal of LLW and interim storage of ILW

Process – voluntary nomination of potential site by landowner with approximately 100 hectares of eligible land. The nominator is asked to demonstrate local support for a nomination

Community investment – $A10 million Fund to be established for local development projects over the life of the Facility. A conservative estimate of 15 full time jobs over the life of the project.

The Australian Government is currently seeking a willing community to host the National Radioactive Waste Management Facility (NRWMF) for disposal of LLW and interim storage of ILW through a voluntary nomination by interested landowners. The Nomination Process opened in March 2015, with a shortlist of 6 candidate sites announced in November 2015. Following a 120 day public consultation period with each of the nominated communities, a sole preferred site at near Hawker in South Australia was progressed in April 2016. Cultural heritage and technical suitability studies are currently underway. Revised Nomination Guidelines were issued in November 2016 recommending prior evidence of public support. In February 2017, two local landowners near Kimba, in South Australia, nominated potential sites. These nominations were accepted by the Minister for Resources and Northern Australia and progressed into a 90 day community consultation period. In June 2017, a ballot was held at the end of this consultation period by the Australian Electoral Commission on behalf of the Kimba Local Council Region to determine public support. Following the results of the ballot and a number of other factors including neighbour‘s views the nominations were accepted by the Minister for Resources and Northern Australia to move to the next phase. These two sites are now in the same phase of the siting process as the Hawker site.

Under the National Radioactive Waste Management Act 2012 a National Repository Capital Contribution Fund will be established for the purposes of providing enhanced public services and/or infrastructure in the relevant State and Territory. This Fund must be credited with a minimum of $10 million (£5.9 million) by the Commonwealth in order for the facility to become operational. These Funds may be drawn upon once the facility is operational.

The Australian Government has committed to ensuring that there will be local jobs available for the hosting community. In 2016-17 the Hawker community also received $2 million (£1.2 million) to support projects that will provide a social or economic benefit to the communities within a reasonable proximity of the site. This money is being provided to recognise the community’s contribution to this national project and short-term disruption while detailed technical reviews will be conducted.

Information supplied by Australian Department of Industry, Innovation and Science

2.10.2 Bulgaria

Waste – L/ILW to be disposed of in a surface repository; Spent fuel and HLW

Process – A nationwide technical survey has identified 5 possible areas of suitable host rock for a GDF

Community investment – No details are currently available of plans for community investment associated with the L/ILW repository or the planned GDF

Bulgaria commissioned the first VVER-440 reactor at Kozloduy in 1974, and by 1991 there were a total of 6 in operation (two VVER-440 and four VVER-1000). As part of the conditions for joining the EC, Bulgaria agreed to decommission four of these, leaving two VVER-1000 reactors in operation. It is intended to construct a new reactor at Kozloduy in the future, after previous plans for a site at Belene were abandoned. An interim pool type spent fuel storage facility and a newly built dry spent fuel storage facility are also located at the Kozloduy site, as well as a disposal facility for LLW from reactor operations. Institutional wastes were disposed of in a facility at Novi Han between 1964 and 1994 and are currently stored on the reactor site. In 2005, the Council of Ministers resolved that a national near-surface L/ILW disposal facility (the National Repository for Disposal of Radioactive Waste - NRD RAW) should be constructed by the national waste management organisation, SE-RAW(established by government in 2004), with operation in 2015. A site at Radiana, in Kozloduy Municipality, has been selected for the facility (Ref 1) and In July 2016 SE-RAW signed a €72 million agreement with a commercial consortium to build the first phase of the facility to accept Kozloduy decommissioning wastes (Ref 2).

The principles for waste management in Bulgaria are described in the 'National Strategy for Nuclear Fuel and Radioactive Waste Management, 2004', which was further developed in the 'Strategy for Nuclear Fuel and Radioactive Waste Management' adopted by the Council of Ministers in January 2011. In the Strategy, specific policies and directions in a long-term plan until 2030 are outlined (Ref 3). Spent fuel from Kozloduy was previously sent to Russia for reprocessing, and the resultant HLW will ultimately be returned. As regards plans to develop a GDF for this HLW and non-reprocessed spent fuel, preliminary studies have indicated that up to 5 areas of clays and marls in the NW, N-central and East of the country could be suitable, including one in Kozloduy Municipality (Ref 4). No further work has been undertaken as regards specific site identification since around 2011.

There has been extensive stakeholder engagement associated with the development of the NRD RAW, as part of the EIA process prior to the agreement for construction (Ref 5) involving events in schools, public meetings and various specific activities.

References

1. SE-RAW, *Report on Environmental Impact Assessment /EIAR/ on investment proposal for Construction of National Repository for Low and Intermediate Level Radioactive Waste Disposal – NRRAW,* 2011.
2. World Nuclear Association, *Nuclear Power in Bulgaria,* April 2017.
3. Republic of Bulgaria, *First National Report under the Directive 2009/71/EURATOM*, 2014.

4. D. Karastanev, *Site Selection Approach to Geological Disposal of High-Level Waste in Bulgaria. Chapter 3* In: *International Approaches for Deep Geological Disposal of Nuclear Waste. Geological Challenges in Radioactive Waste Isolation – Fifth Worldwide Review*, 2016.
5. European Bank for Reconstruction and Development 2015*. Stakeholder Engagement Plan For The EIA Of The National Disposal Facility,* Ref. No.006/2015. March 06, 2015

2.10.3 Czech Republic

Waste – Spent fuel

Process – Initial process involved technical screening only, but this caused local opposition. The current situation is uncertain.

Community investment – According to legislation, all communities allowing investigations for the DGR will receive annual payments of around 600,000 CZK (£20,000), with the final host community receiving a larger lump sum (50 million CZK (around £2 million).

The National Policy for spent fuel in the Czech Republic was adopted in 2002, and updated in 2014. The Policy includes an intention that the public will be fully involved in the process to develop a deep geological repository (DGR) and will be invited to actively participate in the individual stages. The site selection process is planned to be based on a partnership between the implementing agency, SÚRAO, established by government in 1997, and the communities concerned (Ref 1). According to SÚRAO's current plan, construction of the DGR should begin in 2050 and be completed by 2065. An underground experimental facility has already been developed in a former uranium mine.

Following a comprehensive assessment of the whole of the Czech Republic in the 1990s, eleven potentially suitable disposal site areas were identified; seven in granite, three in metamorphic rock and one in sedimentary rock. Of these, six site areas, all in granite, were selected for further study. Discussions were carried out with local government bodies in 50 affected communities, but all work was suspended in late February 2004 following negative votes in ten referenda around three of the sites and work ceased. By 2009 SÚRAO had also examined conditions at a number of military sites. Another site adjacent to two former uranium mines was added to the list in October 2011 (Ref 2).

As part of the response to recommendations from the EC ARGONA project, the 'Working Group on Dialogue on the DGR' was established in 2010. This Working Group included representatives of local governments in the affected municipalities, and of local civic initiatives and national environmental organisations, together with representatives of relevant state authorities. However, when SÚRAO submitted a request to undertake work at a site on the list, causing concern in the local area, the Working Group suspended its activities. In 2014, the Working Group was transformed into an official body of the Government Council for Energy and Raw Materials Strategy, and began to finalise drafting the terms of legislation on community involvement in the site selection process. However, following continuing local opposition and formation of the 'Platform Against a Deep Repository' in 2017 by objecting municipalities, the way forward is currently unclear and the Working Group has been suspended.

The Atomic Act (Ref 3) contains details of annual payments of round 600,000 CZK (£21,000), that would be available to communities allowing investigations to take place, with the final host community receiving an additional lump sum of 50 million CZK (£1.7 million). These have however been rejected by the communities.

References

1. Government of the Czech Republic, *Notification to the European Commission in relation to Directive 2011/70/EURATOM on the responsible and safe management of spent fuel and radioactive waste*. June 2015
2. Svačina, K., and Konopásek, Z. (2012) *Identifying remaining socio-technical challenges at the national level: Czech Republic*. A draft InSOTEC Working Paper (WP 1 – MS 4)
3. ACT No. 263/2016 of Coll. Of 14th July 2016 (Amendment of 1997 Act)

Additional information supplied by Lucie Steinerova (SURAO)

2.10.4 Germany

Waste – Heat-generating wastes (spent fuel and HLW)

Process – Three-phase process to identify potential siting regions by 2023, ultimately aiming to find a site with the "*best possible safety*".

Community investment – Compensatory measures to be developed individually for each region.

German policy has always been deep disposal for all wastes, with differentiation between '*waste with negligible heat generation*' and '*heat generating waste*'. In 1977 the state government of Lower Saxony declared the salt dome at Gorleben to be the preferred location for a deep repository, although this was met with continuing local opposition. Underground investigations were halted in 1999 for up to 10 years, and the AkEnd Committee was established to develop a transparent, comparative site selection process. A proposal for a staged process based on scientific criteria and including public participation in cooperation with all stakeholder groups, under independent control by a supervisory board, was presented in 2002 (Ref 1). It failed to win political or industry support.

Prior to 2013 responsibility for radioactive waste disposal rested with the Federal Office for Radiation Protection (BfS), part of the Ministry for Environment, Nature Conservation, Building and Nuclear Safety (BMU). The 10-year Gorleben moratorium expired in 2010 and in July 2013 two new Acts were passed (Ref 2), the Repository Site Selection Act (StandAG) and another to establish a new Federal Office for the Regulation of Nuclear Waste Management (BfE) within BMU. The new Site Selection Act established a 33-member Commission in May 2014, tasked to develop 'basic principles' for site selection (Ref 3). The Commission included representatives from the parliament, academia, civil society organizations, industry, the environment and trade unions. The Commission's final report was submitted to the government in July 2016 (Ref 4), proposing a 3-phase site selection process accompanied by extensive public participation with bodies at regional, inter-regional and national level. The Site Selection Act was amended in 2017 to take account of these, with potentially suitable locations for surface exploration to be identified by the end of 2023 (Ref 2). A new Agency (Bundes-Gesellschaft für Endlagerung -BGE) was formed in July 2016 merging parts of the BfS, the Asse GmbH and a previously partially privately-owned company (DBE) to carry out the new siting process and operate a GDF.

The objective of the current German site selection procedure is to find a site for a geological repository, especially for high-level radioactive waste, in a science-based and transparent procedure. This site is to guarantee the "*best possible safety*" over a period of one million years. No specific details are provided in the Act or the Commission report as regards community investment to be available to potential host communities, although both recognise that any stigma that may result should be balanced by negotiation of suitable '*compensatory measures*' (Ref 3).

References

1. AkEnd, *Site Selection Procedure for Repository Sites.* December 2002

2. Federal Office for Radiation Protection (BfS), *The Repository Site Selection Act,* website
3. *Report of the German Commission on the Storage of High-Level Radioactive Waste*, July 2016, Drs. 18/9100). Official Translation by the Language Service of the German Bundestag

2.10.5 Hungary

Waste – Spent fuel and HLW

Process – Technical survey of Boda Claystone Formation (Mecsek Hills region) to identify a suitable host rock for a Geological Disposal Facility (GDF), with initial development of an Underground Research Laboratory (URL) to test the suitability of the host rock selected.

Community investment – 2013 Decree specifies payments available to Information Associations established around the L/ILW repositories, the spent fuel storage facility and the potential URL site.

An intermediate-depth repository at Bátaapáti for L/ILW from the Paks Nuclear Power Plant (NPP) has been operational since 2012, operated by the national waste management organisation PURAM, which was established by government in 1998. Institutional LLW is disposed of in the Püspökszilágy near-surface engineered repository, which has been operational since the 1970s. At the moment a deep geological repository (GDF) for HLW or spent fuel is not available in Hungary. Spent fuel from the current four Paks reactors is stored in a modular vault dry store that has been in operation on the site since 1997. Prior to this, according to an intergovernmental agreement concluded between the Soviet Union (later Russia) and Hungary in 1966, spent fuel was sent to Russia without any obligation to take back any resulting waste, but this was terminated in the 1990's.

An important feature of the Hungarian National Programme (Ref 1) is that it has not yet been considered necessary to make a final decision regarding the back-end of the fuel cycle, mainly because the option of future reprocessing of spent fuel is regarded as worth keeping open. The national policy requires a flexible (reversible) but active approach referred to as a "DO and SEE" policy. This means that an-going research programme for a GDF is required, based on a reference scenario, which is currently direct disposal of spent fuel in a Hungarian GDF, together with any HLW arising from operation and decommissioning of the NPP. The National Programme calls for a decision on the back-end policy by the early 2040s at the latest, concerning the feasibility of the reprocessing option, to be based on a detailed safety, technical and economic analysis (Ref 1).

A surface-based geological research programme for siting of a HLW repository began more than two decades ago and has already led to identification of an area of potentially suitable geological conditions in the Boda Claystone Formation at the south-western end of the Mecsek Hills. Two surface-based investigation phases have taken place, one beginning in 2005 and one in 2014, scheduled for completion in 2017. These have involved boreholes, seismic surveys and other geological-geophysical techniques. The goal of these investigations was to characterize the Boda Claystone Formation and to further reduce the investigation area to 10–15 km^2. The current geological investigation programme includes geological and geomorphological mapping, hydrogeological modelling, trenching, and the drilling of several deep boreholes and associated seismic profiling. PURAM intends to complete the site selection process by 2030, the planned end date of surface-based investigations, in order to identify the potential location for the surface and subsurface facilities as well as the URL. In

the reference scenario, a GDF is scheduled to operate from 2064 after an extended period of storage in the Paks facility (Ref 1).

During the siting process for the L/ILW repository at Bátaapáti, 'Information Associations' were established in communities around the potential sites, as previously developed around the Paks storage facility. The GDF investigation programme has been supported by the authorities in the adjacent nine municipalities and a similar Association has been established around the areas of the investigation activities. PURAM therefore currently has four Information Associations (around Bátaapáti, around the Paks interim storage facility, around the Boda investigations and around Püspökszilágy).

The Associations collect, distribute and communicate information from PURAM, with local government responsible for feeding back comments and concerns from the local citizens, and organising public hearings or public votes as necessary. Financing of over 1 billion HUF (around £3 million) a year is available for these activities, shared between the four Associations, and is provided by the National Budget from the Central Nuclear Financial Fund, in accordance with an formula published in a 2013 Decree (Ref 3).

References

1. Hungary's National Programme for the Treatment of Spent Fuels and Radioactive Waste. *Strategic Environmental Assessment*. December 2015
2. Government of Hungary: *National Report (Fifth Report) prepared within the framework of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*. 2014
3. Government Decree 214/2013 (VI.21)

Additional information supplied by Gabriella Honti (PURAM)

2.10.6 Italy

Waste - Disposal of VLLW, LLW and ILW-SL, interim storage of ILW-LL and HLW.

Process – development of a National Map of Suitable Areas through application of technical criteria and consultation; local authorities in suitable areas invited to volunteer.

Community investment – development of a Technology Park connected to the National Repository to encourage investment and job creation. In addition, financial community investment, yet to be quantified, will be available: 55% of the value to be paid to hosting municipality (or municipalities), 35% to be paid to municipalities within a 25 km radius of the facility, and 10% to hosting county (or counties).

In Italy, responsibility for decommissioning nuclear sites and for managing radioactive waste lies with Sogin, a state-owned company established in 1999.

In 2003, an attempt to identify a site in southern Italy (Scanzano Jonico) for centralising all radioactive waste, aiming at disposal of LLW and ILW-SL, and potentially (after site qualification) ILW-LL and HLW as well, came to nothing following intense local opposition. A working group was set up by government in 2008 to devise a new siting process. This led to a Decree in 2010 (Ref 1) charging Sogin with siting, designing, building and operating a National Repository for radioactive waste, together with an associated Technology Park, intended to benefit the local community through investment and job creation. This is in response to wording in the 2010 Decree that ‘‘in order to optimise the socio-economic, employment and cultural impact of the development of the technology park, the locality surrounding the site is entitled to a financial benefit in relation to the radioactive waste”.

The siting process is based on a so-called ‘mixed approach’ (technical/consultative). The first technical phase is aimed at identifying suitable areas by means of exclusion/investigation criteria, and the second phase is aimed at seeking communities that would be interested in hosting the facility on a voluntary basis.

In 2014, the Italian Nuclear Regulatory Body (ISPRA) published a Technical Guide on siting criteria for a near-surface disposal facility (Ref 2). Following this, Sogin developed a proposed National Map of Potentially Suitable Areas (Carta Nazionale delle Aree Potenzialamente Idonee – CNAPI) which was passed to ISPRA for review in January 2015, and then onto the national Government in April 2015 for additional review. Once authorised, Sogin will publish the draft Map together with the Preliminary Design and start a four month period of consultation on its proposals, including holding a National Seminar with all the interested stakeholders. The map will then be finalised and issued as the National Map of Suitable Areas (the CNAI). At this point, local authorities of the suitable areas will be invited to express an interest in hosting the facility, to be finalised in a formal agreement. The activities that take place as part of the siting process will also involve communication with, and participation of, the relevant local communities (Ref 3). Candidate sites will be identified and detailed technical investigations undertaken to underpin the final selection of the site, supervised by the Nuclear Regulatory Body. The realisation programme foresees the start of the facility construction in 2021, and first waste emplacement in 2025.

References

1. Republic of Italy, 2010. *Legislative Decree 15 Feb 2010*, n.31

2. ISPRA, Technical Guide N. 29, *Siting criteria for a near surface disposal facility for low and intermediate level radioactive waste*, 2014 isprambiente.gov.it/files/nucleare/TechnicalGuiden_29onsitingcriteria.pdf

3. Sogin, *The National Repository and Technology Park* - sogin.it/en/about-us/The-Technology-Park-and-The-National-Repository/Pages/the-technology-park-and-the-national-repository.aspx

Additional information supplied by Angelo Paratore (Sogin).

2.10.7 Lithuania

Waste – Near-surface disposal of L/ILW; interim storage of spent fuel with deep disposal in the future.

Process – Initial technical screening, with identification of suitable host rock characteristics.

Community investment – No specific community investment are available to the host community around the planned L/ILW repository; indeed, the site was chosen because of concerns expressed by the previously selected municipality regarding socio-economic impacts. Community investment associated with a GDF is a part of further project development.

There are two RBMK-1500 type reactors at Ignalina. Unit 1 was shut down in 2004 and Unit 2 in 2009, with decommissioning of both is underway. Spent fuel is to be stored on-site in both pools and interim dry storage facilities (ISFS). At the Ignalina NPP there are two ISFS facilities, one in operation since 1999 and now completely full. A second ISFS was approved for operation in May 2017 (Ref 1). Final commissioning of a new near-surface disposal facility for L/ILW, also on the Ignalina site, is underway, with operation expected in June 2018 (Ref 2). The first phase of a landfill-type facility for short-lived very low level waste was completed in 2013, with a second phase under construction, with completion expected by 2019.

An existing near-surface (RADON-type) disposal facility for institutional waste at Maisiagala operated from the early 1960's but was closed in 1989, after which wastes were stored in the Ignalina facility. The wastes previously emplaced will be retrieved and the area remediated. Site selection for the new near-surface repository for these and for L/ILW from Ignalina began in 2003 with publication of screening criteria in 2004. Following assessment of geological, tectonic and hydrogeological conditions three areas, comprising 9 potential sites, were selected in the vicinity of the Ignalina NPP where geological and geographical conditions were considered suitable. Following detailed studies and consultations with local communities, three potential sites were identified. The Ignalina municipality claimed that development of a repository would affect property values and tourism, with the result that In 2005 an alternative site was identified as the final location in the adjacent Visaginas municipality, at Stabatiškės.

In relation to spent fuel disposal, the waste management agency, RATA, established in 1999, began work around 2000 to develop a strategy for development of a GDF. Several geological formations were examined as possible host rocks (crystalline rock, clay formations, anhydrite and salt). Exploratory work was carried out between 2002 and 2005, supported by SKB, with a focus on crystalline rocks in southern Lithuania and two clay formations, primarily the Lower Triassic clay, and also the Lower Cambrian Baltic Group (Ref 3). In 2008, the 'Strategy for Radioactive Waste Management' was revised and subsequently the National Research Programme for 2008–2012 was developed and approved by the Lithuanian Government (Ref 4). EC Directive 2011/70/EURATOM requires member states to develop national programmes for spent fuel and radwaste management, and therefore the Government of the Republic of Lithuania approved a National Radioactive Waste Management Development Program (NRWMDP) in 2015 (Ref 5). Key GDF project phases and dates are set by the

NRWMDP, however the GDF development plan (prepared by RATA and LEI in 2016) proposes some internal adjustment regarding the timeline.

The current version is as follows: project planning and site selection for a representative investigation borehole (2016-2021); site selection for additional boreholes (2022-2030); site selection for an underground research laboratory (repository) (2031-2035); repository site confirmation (2036-2045); repository design development (2046-2055); repository construction and preparation for operation (2056-2065); repository operation (2066-2072); repository closure (2072-2077).

A site investigation programme was developed for the government by an independent company in 2010, but a 2010 IAEA Peer Review suggested that more stakeholder participation would be beneficial. This led to work in 2016 to develop an External Communication Strategy and Annual Plan intended to identify the relevant stakeholders and plans for involvement.

References

1. World Nuclear News: '*Ignalina storage facility set for commercial operation'*. 5 May 2017
2. P. Poskas et al. 2011. *'Progress of radioactive waste management in Lithuania'.* Progress in Nuclear Energy.
3. R. Kanopienė, S. Šliaupa et al. 2005. *Investigations of Possibilities to Dispose of Spent Nuclear Fuel in Lithuania: a Model Case. Volume 1: Suitability of Geological Environment in Lithuania for Disposal of Spent Nuclear Fuel* Ed. J. Satkūnas
4. P. Poskas et al 2015. '*Overview of the Lithuanian programme for disposal of RBMK-1500 spent nuclear fuel*'. Mineralogical Magazine, November 2015, Vol. 79(6), pp. 1581–1589
5. Government of Lithuania. 2015. *'National Radioactive Waste Development Programme*'. 23rd December 2015 (in Lithuanian) https://www.e-tar.lt/portal/lt/legalAct/6c3bf040af9a11e5b12fbb7dc920ee2c

Additional information supplied by Vaclovas Bajorinas (RATA)

2.10.8 Netherlands

Waste – L/ILW, spent fuel and HLW currently in storage for up to 100 years

Process – A number of technical research programmes have concluded that a GDF could be safely developed in either the Boom Clay or Domal Salt, although no siting process has been undertaken to date

Community investment – No details are currently available of any plans for community investment associated with a future GDF

The Netherlands currently operate only one PWR (Borssele). A BWR at Dodewaard ceased operation at the end of March 1997. In 1984 the Dutch Government and Parliament decided to store all existing wastes and future arisings in one central facility, pending final decisions on disposal methods and sites, with ultimate disposal of all wastes in a single repository. Spent fuel is reprocessed in France (in the past, the BWR SF was reprocessed in the UK). The capacity of the storage facility was to be large enough to allow interim storage for a period of 50 to 100 years. COVRA was founded the same year and made responsible for the management of all radioactive wastes in the Netherlands.

A central storage facility for L/ILW has been operational at Vlissingen, close to Borssele reactor site since 1992 and the HABOG storage facility for HLW and spent fuel since 2003. Government policy is to eventually dispose of L/ILW, spent fuel and HLW underground in a GDF and to move towards that goal in a way such that each step is reversible and the waste retrievable. In 1984 a long-term research programme into disposal options was agreed and a research commission was set up (OPLA - Commission for the Disposal on Land), under the direction of the ILONA Committee (Committee for Integrated National Research on Nuclear Waste). In 2001, the Government-sponsored Committee on Radioactive Waste Disposal (CORA) concluded that retrievable geological disposal is technically feasible in the Netherlands in either domal salt or clay formations. In September 2009, the third Research Programme for the Geological Disposal of Radioactive Waste (OPERA) 2011-2016, was initiated (Ref 1). The aim of the research programme is to evaluate the existing safety and feasibility studies from the earlier studies and develop an updated Safety Case for deep disposal and a roadmap (Ref 2) for development of a GDF in either salt or the Boom Clay (as also studied in Belgium) or in other clay formations.

As there has been no field research or siting exercise conducted for a repository, there has been little or no public involvement in the development of the research programme by COVRA. However, there was involvement during the siting process for the storage facility at Borsele, which was based on technical criteria. Initially 12 possible sites were identified, and a further selection was based on the consent/acceptance of the local communities. This reduced the number of available locations to two. From the two the Borsele location was selected on technical grounds. Although initial EIS studies tended to ignore participation and environmental impact, in favour of technical issues such as transport and design, local review identified concerns amongst the local population which eventually led to the selection of an alternative site to the one originally proposed by COVRA, further from the village, although both were located near to the NPP (Ref 3).

References

1. *COVRA website, accessed 28th June 2017*
2. *Verhoef, E and H Codée 2014. Radioactive waste management in The Netherlands. December 2014.* ft.dk/samling/20141/almdel/miu/bilag/102/1440569.pdf
3. *Codée,* H 2003. '*Give the Public Something, Something More Interesting Than Radioactive Waste*.'. In: Proceedings of WM'03 Conference, February 23-27,2003, Tucson, AZ

Additional information supplied by Ewoud Verhoef (COVRA)

2.10.9 Romania

Waste – LLW and spent fuel

Process – A technical siting process with no local communication identified a single site for the L/ILW repository in 1998. Since then there has been much local concern, with increased efforts by the authorities to gain support. The process for spent fuel has yet to be agreed, but is expected to involve an independent facilitator and community engagement.

Community investment – Although no formal agreement exists regarding community investment, it is anticipated that a Programme for Local Development will be established in the Saligny community when the LLW facility is developed. There are currently no details concerning spent fuel.

Currently, institutional low and intermediate level wastes (L/ILW) are disposed of in a facility at Baita Bihor, developed in a disused uranium mine. This is expected to be closed around 2040 (Ref 1). A siting process for an engineered near-surface repository (known as the DFDSMA) for these and L/ILW from the Cernavoda Nuclear Power Plant, began in the surrounding region in 1992, managed by the NPP owner. Around 37 potential locations were examined and in 1994 three of them were identified for more detailed investigations. These were Saligny (within the NPP exclusion zone) and two other sites, 3 km and 20 km away from the NPP. In 1998 Saligny was identified as the preferred location and detailed characterisation was undertaken until 2004, when a new national waste management agency, ANDRAD, was established by government and took over responsibility for the process. ANDRAD immediately began communication activities with the local community and the newly-created Saligny municipality, something which had not occurred throughout the previous process (Ref 1). A partial siting licence was granted by the regulator (CNCAN) in 2008 and in 2009 ANDRAD was merged with another agency to become ANDR. The siting licence was cancelled in 2012 by the national Court following an appeal by Greenpeace under the terms of the Aarhus Convention, claiming a lack of meaningful local participation.

As part of the EU-supported IPPA project, a series of focus groups were held in the Saligny community to explore stakeholder concerns, which were focused especially on issues associated with community investment. There is an expectation for the introduction of a Programme for Local Development, aimed at improving local infrastructure, creating jobs, increasing the quality of life, and contributing via taxes to the local budget (Ref 2).

The policy in Romania is for geological disposal of both spent CANDU fuel from the Cernavoda NPP and long-lived L/ILW. Spent fuel is currently stored on the NPP site in an interim Dry Storage Facility, with a design life of 50 years. Applying the recommendations of IPPA and other EU projects (COWAM2 and Cowam in Practice) to public engagement in the disposal programme has resulted in the formation of a Romanian Stakeholders Group. This involves representatives from industry, government, national agencies (including CNCAN and ANDR) and non-governmental organisations. The siting methodology has not yet been established and therefore no potential host communities are involved at this stage (Ref 1). It has been agreed that ANDR should propose a 'vision' for the public participation process; that

Romanian Stakeholders Group should debate the vision and produce recommendations for improvement to transform it into a strategy; that an independent facilitator should moderate the discussions on the strategy and that public engagement should follow once a siting programme begins, with a repository not required until around 2050 (Ref 1).

References

1. Government of Romania, *Notification to the European Commission in relation to Directive 2011/70/EURATOM on the responsible and safe management of spent fuel and radioactive waste*. June 2015
2. Constantin A, Constantin M and Diaconu D, *Investigation of the attitudes, needs, and expectations of the Saligny community*, Mineralogical Magazine, November 2015, Vol. 79(6), pp. 1573–1580

2.10.10 Slovakia

Waste – Spent fuel and HLW

Process –Technical survey to identify a suitable host rock for a Deep Geological Repository was realised from 1996 to 2001. In 2002 the process was slowed down. Restart was done in 2012 and will continue with examination of the two most promising locations. Watching brief on an international solution.

Community investment – Some community investment are associated with the Mochovce LLW repository in terms of real estate tax paid to the municipality. Other economic stimulus measures are planned in association with the GDF siting process, in accordance with the national strategy.

There are four WWER-440 reactors in operation in Slovakia, two at Jaslovské Bohunice, and two at Mochovce. Two WWER 440 reactors and one HWGCR reactor at Bohunice are being decommissioned. A near surface repository for both institutional and operational LLW has been in operation close to the Mochovce NPP site since 2001 and since 2016 a VLLW repository has also been in operation. Until 1999 some WWER 440 spent fuel and all HWGCR spent fuel were sent to Russia on the basis of an intergovernmental agreement. Since 1987 a pool-type interim storage facility for WWER-440 spent fuel has been in operation at Bohunice.

The National Policy and Programme for spent nuclear fuel and radioactive waste management were approved by Government Resolution No. 387/2015 on 8 July 2015. These promote a dual approach, namely disposal of spent fuel and HLW in a deep repository within Slovakia, and monitoring and support for plans to develop an international repository (Ref 1). A GDF siting programme, launched in 1996, had identified five potential localities in crystalline and sedimentary rocks, away from the reactor sites, in the early 2000s. Although surface investigations were carried out, work was slowed down and from 2001 only some geological research and investigation activities were continued by the State Geological Institute of Dionýz Štúr, financed from the budget of the Ministry of Environment, Directorate for Geology and Natural Resources realized (Ref.2).

At the end of 2010 the nuclear and decommissioning company – JAVYS, plc. was entrusted with performing all activities in the area of radioactive waste and spent fuel disposal and charged with the task of restarting the GDF development programme, which began again in 2012 (Ref 3).

The first stage of the restarted project was carried out during the period 2012-16 and consisted of:

- Comprehensive review of the work carried out in the deep geological repository development programme,
- Development of the national program of radioactive waste and spent fuel management according to European Council Directive 2011/70/Euratom
- Update of the Deep Geological Repository Feasibility Study in the Slovak Republic,
- Update of Criteria for GDF site selection and evaluation,
- Information and promotional materials about GDF development in Slovakia,

- Organisation of meetings with affected municipalities,
- Draft of legislation adjustments in order to stimulate affected municipalities during exploration activities and in the post-operational phase,
- Development of a Strategy for public involvement in the field of GDF development in the Slovak Republic,
- Detailed work plan for the years 2017- 2023 and the proposal for further spent fuel and HLW repository development in Slovakia,

In compliance with the document: "*Detailed work plan for the years 2017- 2023 and the proposal for further SNF and HLW DGR development in Slovakia*" the Slovak programme for deep geological repository development will continue in 2017 with the following tasks :

- A project for basic geological research and exploration for investigation in the two most prospective localities, one in crystalline and one in sedimentary host rocks
- A Framework Programme for research and development in the field of construction at depth, including the requirements for its implementation
- Creation of the implementation proposal of economic stimulus of localities affected by the development and operation of a deep geological repository.

Basic milestones of the GDF development in the Slovak Republic are:

- Final site selection 2030
- DGR operation 2065

The municipalities hosting the two nuclear reactor sites and the LLW repository have been able to levy a real estate tax. As regards the GDF, JAVYS ensures the provision of public information regarding waste management and ensure public participation in the decision-making process in accordance with applicable legislation. In addition, JAVYS will create and prepare the implementation of a system of economic stimulus for sites affected by the development and operation of repositories, in accordance with the 2015 Resolution.

References

1. Report of the Slovak Republic, compiled in terms of Article 14 par. 1 Council Directive 2011/70/Euratom, August 2015
2. Salzer P. et al. 2016. *Development of the Slovak Deep Repository Programme – Status in 2015. Chapter 16 in: International Approaches for Deep Geological Disposal of Nuclear Waste; Geological Challenges in Radioactive Waste Isolation*. Fifth Worldwide Review
3. JAVYS website: accessed 20th June 2017

Additional information supplied by Miroslav Bozik (JAVYS)

2.10.11 Slovenia

Waste – L/ILW and spent fuel

Process – Volunteer process for L/ILW repository. No siting process in existence for spent fuel.

Community investment – A series of Decrees have specified the amounts available to communities hosting nuclear facilities, including repositories. Funding was also provided to local partnerships during the siting process.

The Republic of Slovenia has a small nuclear programme, consisting of one operating nuclear power plant at Krško, jointly owned by Croatia. In 2003, Slovenia and Croatia reached an agreement on the ownership and use of the Krško Nuclear Power Plant. Under this agreement, both contracting parties are responsible for managing the resulting spent fuel. There is also one research reactor and a central storage facility for radioactive waste from small producers near the capital Ljubljana. Currently all wastes from the NPP are stored on the Krško site, with construction of a modular dry storage facility planned to begin in 2017 (Ref 1) and operate until 2065 (Ref 2). In 2009, a site near the village of Vrbina, in Krško municipality, was selected for development of a near-surface L/ILW repository incorporating two shallow silos. In July 2014, a feasibility study and implementation programme for the repository was approved by the Ministry of Infrastructure and Spatial Planning establishing an investment framework for development (Ref 3). Construction of the L/ILW repository is planned to begin in 2019, with operation in 2022 (Ref 1).

As stated in the 2016-2025 National Programme, the fact that there is such a small amount of spent fuel to be managed means that Slovenia will construct its own repository only if other solutions cannot be found internationally. Although no site investigations for a GDF have been carried out in Slovenia, and no specific data for geological disposal are available (Ref 2), ARAO, the national waste management organisation, is scheduled to identify sites for the GDF by 2035 and to propose the site by 2055 (Ref 3). The reference scenario, based on the Swedish KBS-3 disposal concept, assumes a generic location in a hard rock formation (Ref 2).

As part of the L/ILW repository voluntary siting process, local partnerships were established in three of the eight communities that initially expressed interest (but one community withdrew from the site selection procedure immediately after establishing a local partnership, so there were two left in the procedure), plus one associated with the site of a temporary storage facility for institutional wastes in the Dol pri Ljubljani municipality. The two local partnerships in the municipalities bidding for the location for LILW repository received financial support of some €96,000 (£86,000) for administration costs and €41,000 (£37,000) for supporting studies (Ref 4). Following selection of the site at Vrbina in 2009, these partnerships were disbanded, although the local community and others in Brežice and Krško continued to request its reinstatement (Ref 5).

At the end of 2003, a Decree on the '*Criteria for the Determination of the Compensatory Amount due to the Limited Use of the Environment in the Area of a Nuclear Facility*' was adopted, which outlined the financial compensation available to relevant local communities hosting a range of nuclear facilities, in addition to the partnership funding. The payments were scaled according to the type of facility, to be paid following the issue of a site licence. An amendment to the Decree was issued in 2008, altering the payment scaling system. The amount available for the repository was changed to two payments of 54% (i.e. 108% in total) of a revised base payment of €4.7 million (£4.2 million),further revised to €4.82 million (£4.3 million) in 2009, available to the 5 entitled neighbouring municipalities) after selection of the site. Most of this was paid to the hosting municipality (i.e. Krško where the Vrbina site is located), whilst a smaller amount was shared among other 4 neighbouring municipalities. The amendment specified that the funds must be used to improve local infrastructure. Payments began in January 2010.

References

1. World Nuclear Association. *Nuclear Power in Slovenia*. April 2017.
2. Tomaž Žagar, Leon Kegel, Matej Rupret 2016. '*Slovenian Approach to Strategy and Planning for High-level Waste and Spent Fuel Deep Geological Disposal*'*.* In: International Approaches for Deep Geological Disposal of Nuclear Waste Geological Challenges in Radioactive Waste Isolation – Fifth Worldwide Review.
3. Republic of Slovenia. '*The First Slovenian Report under Council Directive 2011/70/Euratom on safe management of spent fuel and radioactive waste*'. July 2015
4. Irena Daris, Nadja Železnik, Metka Kralj 2010. '*Integral Communication Activities as a Support to the Site Selection for LILW Repository*'. IAEA 4th Review Meeting, Paris.
5. Marko Polič, Drago Kos and Nadja Železnik, 2012. '*Review of public participation in radioactive waste siting process in Slovenia'.* Deliverable 2.11. of the EC IPPA Project, Contract Number: 269849. 2012.

Additional information and review supplied by Irena Daris (ARAO)

2.10.12 Spain

Waste – Interim storage of ILW, spent fuel and HLW for 60 years.

Process – Local communities invited to volunteer in 2009. Site selected in 2011.

Community investment – Annual payments are available to any storage or disposal facility according to a 1999 Government Decree, including a multiplier based on the volume of wastes, part of an overall calculation, which also considers local population levels. It is proposed to develop a Technological Centre and an associated Enterprise Park alongside the CTS, part funded by Enresa and through investments by various regional bodies.

Following cessation of a site selection process for a GDF in 1996, undertaken by the waste management organisation Enresa (established by government in 1984), due to strong local and national public opposition, the Spanish government issued the 6th General Radioactive Waste Plan (Ref 1), which repeated earlier calls for development of a Centralised Temporary Storage (CTS) facility for spent fuel and HLW and proposed a strategy for its implementation.

The facility is expected to operate for some 60 years while a permanent management solution for the waste is agreed and developed. An integral part of the project is an associated Technology Centre. An initial call for expressions of interest in 2009 (Ref. 2) generated responses from 14 interested communities. Eight of these were judged to be technically suitable, and the small village of Villar de Cañas was selected at the end of 2011 (Ref 3). The Spanish government noted the poor socio-economic situation in Villar de Cañas would be improved by the addition of new, highly skilled jobs from the storage site and accompanying Technology Centre.

Site and construction licenses were applied for in January 2014. Regulatory approval for the site license was obtained in 2015. Initially, Castilla La Mancha, the region where the hosting municipality is located, supported the development of the project; but in 2015 the regional Government changed. The new regional Government disagreed with the support previously given to the project, and consequently declared an extension of a special protection zone for birds, which now included the CTS site area. Additional reporting was undertaken to assess the impact of the facility on the special protection zone, which delayed the project by approximately 12-18 months.

In January 2017, the Spanish Supreme Court issued a cautionary finding stating the temporary cancellation of the decision of the regional government, as it could compromise the higher environmental protection objectives of the management of Spanish radioactive waste. A final decision, definitively confirming the outcome of litigation between central government and regional government, is yet to appear. In the meantime, the licensing process for the facility is progressing. The construction authorisation is currently being assessed by the nuclear regulatory authority, while the Environmental Impact Declaration has been delayed by the litigation proceedings.

References

1. Ministerio de Industria, Turismo Y Comercio, 2006. *Sixth General Radioactive Waste Plan* [6th GRWP]
2. Boletín Oficial Del Estado 21107 - *Resolución de 23 de diciembre de 2009, de la Secretaría de Estado de Energía, por la que se efectúa la convocatoria pública para la selección de los municipios candidatos a albergar el emplazamiento del Almacén Temporal Centralizado de combustible nuclear gastado y residuos radiactivos de alta actividad (ATC) y su centro tecnológico asociado.,* Núm. 313 Martes 29 de diciembre de 2009 Sec. III. Pág. 111431
3. Government of Spain, *Fifth Spanish National Report to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*. June 2014

Information and review supplied by Mariano Molina (Enresa)

3 Analysis

Whilst most of the observations and comments here refer to the search for suitable sites for development of a GDF, even siting a facility for disposal of L/ILW can be seen to be dependent on similar factors, namely suitable geological conditions and, equally important, a willing community. The exact approach adopted depends to a great extent on these two factors, as well as the proposed inventory for the site in question, and the country-specific regulatory requirements.

3.1 Siting process

Many of the countries reviewed have faced set-backs in their processes for siting disposal facilities, both for low-level and high-level wastes. This has included local, regional, and, in the US, national political opposition to potential disposal sites. Each country has modified its site selection process to various extents to enable progress. The approaches differ slightly depending on the particular national political and social situation, but a number of common threads can be observed, based on sharing of experiences amongst the responsible waste management organisations (WMOs) and relevant government departments. These include:

- Volunteer first processes, inviting communities to volunteer then evaluating their geological setting (Canada [GDF])
- A national consideration of geology to show that volunteers could be sought from across the country and then asking communities to volunteer (Germany [revised process], Italy, Japan [revised process], the current UK plan
- Identifying the preferred geology and then seeking volunteers (France, Netherlands [planned], Slovakia)
- National site identification based on geology followed by volunteerism (Finland, Sweden)
- National process to identify sites based on safety and geology with communities being consulted (Bulgaria, Czech Republic, Hungary), but not having a decision-making role (Lithuania, Switzerland)
- Communities approaching waste owners/WMO for consideration (Canada [Kincardine], US [WIPP])
- Individual landowners approaching WMO for consideration, subject to satisfactory levels of local support (Australia)
- Site selected by government through legislation (US [Yucca])
- Process to be decided (Romania, Slovenia, Spain)

The countries considered in this report are at different stages in their siting processes; however general trends in timescales can be detected (noting that many dates for 'start of construction' have been estimated):

- From the start of a siting process to site identification is expected to take around 10 – 20 years.
- From the start of a siting process to start of construction is expected to take around 20 – 30 years.

3.2 Local Decision Making

The local decision-makers in the siting process have usually been the elected representatives of the community closest to where the disposal facility will be built (the local municipality). Wider-area or regional levels of local government are also involved in the siting process through various engagement mechanisms, but do not usually have a decision-making role.

There is also an increasing tendency to establish representative local committees to assist in decision-making, although in many cases the final decision still lies with the elected bodies. In some cases these bodies plan to hold local plebiscites to gauge local acceptance levels prior to making a final decision (Sweden).

3.3 Role of National Government

In all the countries considered, the final decision on whether a facility should be built rests with the national government, albeit supported by the recommendation of the relevant nuclear regulator. In France and Switzerland, the parliament has to approve the site for a disposal facility. In other countries the government department responsible for geological disposal will make the final decision.

3.4 Role of the Developer

In the majority of the countries reviewed the national waste management organisation (WMO) is responsible for developing and implementing geological disposal including identifying and assessing the suitability of potential sites.

There are variations in the ownership and management of the WMO between the countries reviewed here. These include:

- Countries where the role of the WMO is carried out by a government department (Australia and the United States). In Germany recent changes mean that a new arms-length agency has been created within government to carry out and implement the revised siting process

- Countries where the WMO represents and is funded by the waste producers (Canada, Finland, Sweden, Switzerland)

- Countries where the WMO is an independent state-owned organisation, established by government for the sole purpose of implementing waste management and disposal (Czech Republic, Bulgaria, France, Hungary, Italy, Japan, Lithuania, Slovenia, Spain), sometimes taking over from the waste producer that had originally been responsible

(Romania). The government in Japan has recently assumed responsibility for the siting process, although assisted by the WMO, which remains responsible for GDF construction and operation

- Countries where a private company is responsible for implementation, financed through normal commercial practices and contracts (Netherlands, Slovakia)

3.5 Community Investment

The countries considered in this report exhibit a range of approaches to supporting local communities. Many have provided resources (similar to the engagement funding provided in the UK) to the communities considering hosting a disposal facility to enable them to participate in the siting process and to contribute their views. The various approaches identified include:

- A focus, in the early stages of the siting process, on the offer of jobs and improved infrastructure

- Discussion of more specific community investment to follow when shortlisted sites have been identified (Canada [GDF])

- Community Investment outlined in legislation (Czech Republic, France, Slovenia, Spain, US [Yucca], US [WIPP])

- Community Investment provided as part of site selection process (Australia, Hungary)

- Community Investment (likely to be) developed through local negotiation (Canada [Kincardine], Finland [limited to rental income and loans], Romania, Sweden, Switzerland)

- Community Investment (to be) specified by WMO without negotiation (Japan, Italy, Slovakia)

- No consideration of community investment to date (Bulgaria, Lithuania, Netherlands)

- No consideration of community investment but recognised as important for the future (Germany)

Where financial community investment has been identified, there appears to be a loose correlation between the population density of the country and the scale of the financial package proposed (see Appendix A).

4 Conclusions

The experiences described in this report encompass a spectrum of approaches to identifying suitable sites for hosting a geological disposal facility. The approaches in each country depend on the political and cultural circumstances and the geology. There are some common themes that can be drawn out across the countries. The main messages from the report are:

- The programmes in each country reflect the political, social and cultural circumstances of that country
- Some siting processes faced setbacks in the early stages; before then proceeding with a revised process
- Local government has always been involved as one of the representatives of the community and, with the exception of Switzerland, has a decision making role in the process
- The elected representatives of the community closest to where the disposal facility is proposed to be built (the local municipality) tend to be the local decision makers in the siting process
- Engagement with and understanding of the issues, along with support for the siting process is often higher at a local level than it is at a regional or national level
- The community investment associated with a GDF, which are made available to potential host communities, vary from country to country in their approach, scope, amount and when they become available
- In a number of countries, the community investment is scheduled to be made available in advance of the facility being constructed.

These common themes, often appearing particularly prevalent with those most successful in progressing their GDF processes, indicate that any successful volunteer process needs to take into account not only these elements but also its own political situation, community needs and decision making structures.

5 Appendix A

The following table shows key information for each of the 'major' countries covered in this report in terms of national approaches to the selection and siting of a geological disposal facility (GDF).

Country	Population	Volunteer community population	Waste	Process	Local decision maker	Local Veto	Community investment
Canada	**34.5 million** Density 3.4 per km²	Unknown - site not identified (though a number of potentially interested communities have come forward)	Spent fuel	Volunteer first. Nuclear Waste Management Organisation (NWMO) has determined that Canada has a range of suitable rock types. More detailed evaluation takes place after a community decides to participate in nine-step process.	Municipal Council - the most local level of Canadian government below federal and provincial. Plus a commitment to involve surrounding communities and representation of the "First Nations", Inuit and Métis peoples in the decision making process.	Yes	Socio-economic from jobs and impact on local supply chains. Any funding will come from NWMO - the developer but there is no funding for local projects during the siting process.

Country	Population	Volunteer community population	Waste	Process	Local decision maker	Local Veto	Community investment
Canada - Kincardine	**34.5 million** Density 3.4 per km²	Kincardine: 11,173 Density 20.8 per km²	Low and intermediate level waste	Community approached the developer asking it to undertake a high level study in 2003/2004 looking at options. Deep geological repository (DGR) regulatory process ongoing.	Municipal Council of Kincardine representing the most local level of government in Canada below federal and provincial.	No, but local support essential.	Total package - C$35 million (around £21 million) with an initial lump sum and then payments over 30 years, inflation linked. Funding from Ontario Power Generation (OPG).
Finland	**5.4 million** Density 17 per km²	Eurajoki: 5,900 Density 17.2 per km²	Spent fuel	Geology first. Much of Finland has suitable rock types. Final selection followed negotiation of formal agreement with host community about financial support.	Municipal council - representing the local level of administration in Finland.	Yes, up to the point of the Decision in Principle	Real estate tax that goes to the municipality with no restrictions on use. In addition, a loan has been provided for the provision of a care facility for older people. Posiva, the developer, is funded by its owners.

Country	Population	Volunteer community population	Waste	Process	Local decision maker	Local Veto	Community investment
France	**65 million** Density 120 per km²	Meuse: 192,198 Density 31 per km² Haute-Marne: 194,873 Density 31 per km²	Underground research laboratory (URL) and Cigéo - high level waste and long lived intermediate level waste	Districts with potentially suitable types of geologies were then consulted and decided whether to participate further. URL developed at Bure site, with final siting for GDF underway in the area.	Districts which are the local level of administration in France below national and prefectural/regional.	No, but local support essential	€10m (around £9 million) per year from 1999 to 2006 at both Meuse and Haute-Marne. Now €30 million per site per year (around £27 million). Match funding is required. Funding comes from waste producers through taxes on nuclear installations.
Japan	**128 million** Density 337 per km²	Unknown - site not identified	High level waste and some types of transuranic waste	New process begins with publication of map showing potentially suitable areas based on newly-developed criteria and requirements. Letter inviting participation sent to every municipality in potentially suitable areas. More detailed evaluation would take place after a community agrees to participate.	The municipality representing the most local level of administration in Japan below national and prefectural government.	Yes	Socio-economic from jobs and impact on local supply chains. Impact of move of NUMO - the developer's HQ to the area. Around ¥2.9 billion(around £19 million) of property tax revenue per year. Communities to receive ¥1 billion (~£6.7 million) during initial study, followed by ¥2 billion (£13.5 million) during site investigations.

Country	Population	Volunteer community population	Waste	Process	Local decision maker	Local Veto	Community investment
Sweden	**9.5 million** Density 20.6 per km²	Östhammar Municipality: 21,389 Density 6.1 per km² Oskarshamn Municipality: 26,235 Density 11 per km²	Spent fuel	Volunteer first. Geological studies showed much of Sweden to have suitable rock forms. 8 feasibility studies undertaken, majority in southern nuclear communities. Site selected in 2011 after detailed work at two locations.	Municipal council.	Yes	A 2 billon SEK (around £188 million) Added Value Programme. 75 per cent of which is available to the site not hosting the GDF. Of the remaining 25 per cent, 20 per cent is available from site selection to construction (2011-2020s). The remaining value is available once construction has begun. Funded directly by waste producers, not by Waste Fund.
Switzerland	**8 million** Density 189 per km²	Geologically suitable regions have been identified by Nagra. Specific sites in these regions will be identified later.	High level waste and spent fuel, intermediate and low level waste	Geology first. Site selected based on suitability of rock formations. Communities then consulted to identify a specific surface site.	Cantons and communes participate. Federal government makes a decision at the end of every stage and is leading the process.	No	A detailed package has yet to be confirmed. The Federal Council (government) will make this decision once planning permission is granted. Waste producers will fund through Nagra.

Country	Population	Volunteer community population	Waste	Process	Local decision maker	Local Veto	Community investment
US - WIPP	**316.6million** Density 34.2 per km²	Carlsbad, New Mexico: 26,138 Density 353.2 per km²	Transuranic waste, defence-related waste containing long-lived radionuclides	Geology first – investigations initiated at Carlsbad due to an invite by the Mayor to see if local salt beds were suitable for hosting a facility.	Local mayor and the county administration (county is the local level of administration in the USA below state and federal level).	No[4]	Socio-economic including improved community and education facilities as well as a technology transfer programme. State-level infrastructure improvement support provided $20 million (£15 million) annually for 14 years only. Local jobs and impact on the local supply chain. Extra $3 million (£2.2 million) per year made available for several years to reflect a temporarily faster rate of waste emplacement signalling closure before stated time. Funded by Congress via Department of Energy. Further infrastructure spending following 2014 incident and large fine from the State of New Mexico ($75 million- £57 million).

[4] The DOE National Security and Military Applications for Nuclear Energy Authorization Act of 1980 (Public Law 96-164) prevented New Mexico from having veto power over the site. Instead a formal Consultation and Cooperation Agreement was put in place.

Country	Population	Volunteer community population	Waste	Process	Local decision maker	Local Veto	Community investment
US - Yucca Mountain	**316.6million** Density 34.2 per km²	Nye County: 43,946 Density 0.93 per km²	Spent fuel and other high level waste	Geology first. Process currently under review following 2016 Presidential election.	Under review.	Under review; State opposed since 1987	No package approved but federal law contains provision for state and county level community investment. Expectation is that this will be funded by waste producers.
UK – England, Wales and Northern Ireland	**58 million** Density 203 per km²	Unknown - site not identified	Long-lived low level waste, intermediate level waste, high level waste and spent fuel	National geological screening first, followed by call for volunteers from potentially suitable areas. More detailed evaluation will take place after a community decides to participate.	There will ultimately be a Test of Public Support (TOPS) in the potential host community. Local authorities can be involved as part of the proposed Community Partnership, but will not hold a veto. They will however have a significant (but indirect) influence over local decision making through the TOPS. The final decision-maker will be the Secretary of State.	Yes	Socio-economic from jobs and impact on local supply chains. Up to £1 million per year during 'site evaluation' and £2.5 million per year during detailed investigations. This will be funded by the UK Government. There will also be significant additional investment' in the host community once construction has been approved. Other examples of funds, which support local projects and initiatives associated with the nuclear industry include at the LLW facility at Dounreay and the LLW repository in Cumbria

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