Geological Disposal Option and Institutional Issues

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Difficulties in Radioactive Waste Disposal Site Acquisition (Korean Example)

Fundamental Principles
- Direct control by the government
- Top priority on safety
- Minimization of waste generation
- “Polluters pay” principle
- Transparency of site selection process

National Radioactive Waste Management Program
- An LILW repository by 2008
- A centralized interim storage for spent fuel by 2016 in the same site
The first round of site selection : 1986 – 1996

- **1st attempt : 1986 – 1989**
  - Three sites identified through literature survey

- **2nd attempt : 1990 – 1991**
  - Ahn-myun island selected for site investigation

- **3rd attempt : 1991 - 1993**
  - Six sites identified by a third party (SNU)

- **4th attempt : 1993 - 1994**
  - A financial support package for three sites were suggested.

- **5th attempt : 1994 - 1995**
  - The Gul-up island chosen by the Government
The second round (1997-2004)

- 6th attempt: 2000 - 2001
  - Solicitation offered to 46 local governments
- 7th attempt: 2002 - 2003
  - Solicitation to four possible cities around NPP's
- 8th attempt: 2003
  - Wido at Buan county was a potential candidate.
- 9th attempt: 2004.2 – 2004.9
  - A financial support package was offered to 7 cities.
New approach proposed in 2005 and new Site Selection Process & Schedule

- **Public Notice** (By '05.6.16)
- **Application for Hosting** (By '05.8.31)
- **Request for referendum** (By '05.9.15)
- **Process for Vote** (By '05.10.04)
- **Voting** (By '05.11.02)

- Simultaneously for all applied local governments

- If necessary, **Public Census**

- Local government to MOCIE with council’s agreement

- MOCIE to local government

- Designate Candidate Site
## Result of the Local Referendum

<table>
<thead>
<tr>
<th>City</th>
<th>Rate of vote (%)</th>
<th>Approval rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gyeong-Ju city</td>
<td>70.8</td>
<td>89.5</td>
</tr>
<tr>
<td>Po-Hang city</td>
<td>47.7</td>
<td>67.5</td>
</tr>
<tr>
<td>Yeong-Deok city</td>
<td>80.2</td>
<td>79.3</td>
</tr>
<tr>
<td>Gun-San city</td>
<td>70.2</td>
<td>84.4</td>
</tr>
</tbody>
</table>
LILW Repository Site

Wolsong#1,2,3,4

Shin-Wolsong #1,#2

Bong-Gil Ri, Gyeong-Ju (Adjacent to Wolsong NPP)

LILW Repository site (2.0 km²)
Disposal Facility Profile

Entrance tunnels
(W 8.0m, H 7.5m)
- Operation tunnel
- Construction tunnel

Disposal caverns
- Vertical Silo
27.3m (D) x 50m(H)
16,700 drums/silo
HLW Repository
More Difficult (?)

U. S. A
Finland
Sweden
France
Japan
Concept change

HLW \rightarrow (P & T) \rightarrow ILW or LLW

Easier disposal (?)
Radioactive Decay

The diagram illustrates the decay of radioactive materials over time. It shows the relative radiotoxicity of different materials as a function of time. The graph compares natural uranium ore, spent fuel containing plutonium (Pu), and another material containing major actinides (MA) and fission products (FP). The removal of plutonium (Pu) and major actinides (MA) is indicated at specific time points.
Feasibility (?)

* Technical considerations
  - Decontamination Factor
  - Suitability for Disposal
* Regulatory Aspects
* Economical Considerations
* Public Acceptance
Technical Progress

* Progress on Aqueous and Pyrochemical Partitioning Technologies
* Progress on Transmutation Technology
* Decontamination Factor for Radionuclides
* Deep Geological Disposal Studies
New Classification of Radioactive Waste
(proposed by IAEA)

- HLW: high level waste (deep geological disposal)
- ILW: intermediate level waste (intermediate depth disposal)
- LLW: low level waste (near surface disposal)
- VSLW: very short lived waste (decay storage)
- VLLW: very low level waste (landfill disposal)
- EW: exempt waste (exemption / clearance)

Option I
(just below HLW)

Option II
THE GOAL OF DISPOSAL

The disposal of radioactive waste includes all activities focussed on the emplacement of radioactive waste in a facility with no intention of retrieving it in the future.

The GOAL of disposal is the limitation of radiological impacts of radioactive waste to acceptable levels that ensure the protection of man and the environment, to be achieved through the effective and efficient use of resources.

In seeking to achieve this goal an objective of disposal is to minimize the integrated detriment from the handling of radioactive waste during disposal operations and the post-closure phase.
RADIOACTIVE WASTE DISPOSAL OPTIONS

SURFACE DISPOSAL (LLW & ILW Short half life) — Disposal at Intermediate Depths (LLW & ILW Long half life) — DEEP GEOLOGICAL DISPOSAL (HLW & ILW Long half life)

HIGH RELIANCE ON ENGINEERED BARRIERS supported by natural site characteristics

Characterisation & post-closure safety assessment relatively straightforward - limited time scale and near-surface characterisation

Long-term Institutional control may continue after emplacement and closure to ensure managed safety

HIGH RELIANCE ON NATURAL BARRIERS supported by engineered and chemical barriers

Characterisation & post-closure safety assessment relatively complex - very long time scales and detailed understanding of the sub-surface necessary

Possible post-closure monitoring but concept relies on passive safety
FACTORS AFFECTING CHOICE OF DISPOSAL OPTION

- Ensuring the Safety and Basic Principles and Objectives are met through the choice of an appropriate disposal concept will depend on:
  - Nature of the waste
  - Quantity of waste
  - Site Characteristics
  - Other Factors (e.g. socio-political)

- Disposal is intended to be permanent, but a programme can be designed to include the option of retrievability (reversing the action of waste emplacement before or after closure) and/or reversibility (reverse one or more steps in a repository development at any stage) – but if these are built into the overall concept they must not detract from the basic safety function.
Regulatory Aspects

* Surface Disposal for LLW
  - Fairly well established and in force

* Deep Geological Disposal for HLW
  - Established and in further development

* Disposal for ILW
  - Disposal at intermediate(?) depth
  - Unclear position
Institutional control

Under DOE P 454.1

“Institutional controls” may include administrative or legal controls, physical barriers or markers, and methods to preserve information and data and inform current and future generations of hazards and risks, effectively on a site-wide basis.
Institutional control requirements

* Surface disposal for LLW
  - Fairly well established and in force

* Deep geological disposal for HLW
  - Needs to be in further development

* Intermediate depth disposal for ILW
  - Needs to be developed
Public Acceptance

* Public Acceptance and Perception for the disposal of ILW
  – Option II

* Public Acceptance and Perception for the disposal of LLW
  – Option I
HOME WORK

* Target
  – Option I (HLW → LLW) or Option II (HLW → ILW) depends on Technical Achievement

* Performance Test
  – Source term, Waste form, Reference engineered barrier, Reference site, Risk assessment, etc.

* PA Enhancement Program Development
A Multinational Research Project
- Objective to verify the feasibility of the Option I
- Evaluate the input data for the Option I, reference source term, waste form, engineered barrier, reference site characteristics, etc.
- Develop tools to assess the performance objectives for Option I

KOREA willing to launch a research project.