Developing repositories for VLLW and LILW: challenges and solutions

Dr Stasys Motiejūnas, Head of Waste Disposal Division
Radioactive Waste Management Agency (RATA), Lithuania

Lithuania is the only nuclear country within the Baltic States
Lithuanian Profile

- From 1984 till 2009 Lithuania operated single Nuclear Power Plant – Ignalina NPP
  - The NPP was the main source of electricity in Lithuania
  - it has generated 80-85% of the total electricity production
- Lithuania has no uranium mining and nuclear fuel fabrication industry
  - The nuclear fuel was supplied by Russia
  - There are no plans for fuel reprocessing
- Lithuania has no research reactor

WASTE SOURCES IN LITHUANIA

- Ignalina Nuclear Power Plant consisting of two RBMK-1500 type reactors, commissioned in December 1983 and August 1987
- Unit 1 was closed down for decommissioning in 2004 while the unit 2 was stopped in 2009
- Former operator of the NPP is responsible for decommissioning/dismantling activities
- Maišiagala repository for institutional waste operational period: 1963-1989, capacity: 200 m³ - in 2006 reconsidered as storage facility
In Lithuania more than 99% of waste is generated by Ignalina NPP
- Operation
- Dismantling
- Institutional waste, orphan sources

The Joint Convention represents an incentive instrument which aims at achieving and maintaining a high level of safety worldwide in spent fuel and radioactive waste management

EU Directive 2011/70/Euratom establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste
### Classification of solid waste in Lithuania and waste disposal ways

<table>
<thead>
<tr>
<th>Class</th>
<th>Final processing</th>
<th>Disposal way</th>
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</thead>
<tbody>
<tr>
<td><strong>Short-lived waste</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A – Very low level</td>
<td>Unnecessary</td>
<td>Simple landfill</td>
</tr>
<tr>
<td>B – Low level</td>
<td>Required</td>
<td>Near surface</td>
</tr>
<tr>
<td>C – Intermediate level</td>
<td>Required</td>
<td>Near surface</td>
</tr>
<tr>
<td><strong>Long-lived waste</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D – Low level</td>
<td>Required</td>
<td>Near surface or intermediate depth</td>
</tr>
<tr>
<td>E – Intermediate level</td>
<td>Required</td>
<td>Geological</td>
</tr>
<tr>
<td>F – Spent sealed sources</td>
<td>Required</td>
<td>Geological</td>
</tr>
<tr>
<td>Spent fuel</td>
<td>Required</td>
<td>Geological</td>
</tr>
</tbody>
</table>

### Three waste streams

- **Short Lived Very Low Level Waste**
- **Short lived Low and Intermediate Level Waste**
- **Long Lived Intermediate Level, Spent Fuel, Spent Sealed Sources**

### Three disposal facilities

- Simple Landfill
- Near Surface Repository with concrete vaults
- Geological repository
Preliminary waste amounts at Ignalina NPP

- ~ 60 000 m³ of VLLW will be disposed of in the Landfill type repository
- ~ 100 000 m³ of LILW will be disposed of in the m³ repository with concrete vaults
- ~ 17 000 m³ of bituminized waste will be left in the upgraded storage facility or disposed of in the LILW repository, depending on the investigation results
- ~ 6 500 m³ of Long-Lived wastes (including graphite waste) will be stored

NATIONAL STRATEGY FOR RADIOACTIVE WASTE MANAGEMENT

Approved by the Government in 2002 and updated in 2008

- It is foreseen to establish:
  - landfill repository for VLLW (60 000 m³); by 2017
  - near surface repository for LILW (100 000 m³); by 2020
  - new dry spent nuclear fuel storage for all spent fuel; by 2012
  - interim storage for long-lived waste; by 2017

- Disposal of SNF and other LLW is not planned in the nearest future
  - The Spent Fuel and Long Lived Waste will be stored until future disposal in a geological disposal facility will be available
Sites selected for the repositories

Conceptual and planning stage

- Development of the NSR Reference Design/Disposal concept
  - Prepared by Swedish companies in 2002
- Development of Siting Criteria and a siting plan
  - Siting Criteria prepared by RATA in 2003
- Development of Generic Waste Acceptance Criteria
  - Prepared by RATA in 2003
Features of the NSR Reference Design/Disposal concept

- The preliminary design and site selection are interdependent and iterative processes
  - dependent on knowledge of:
    - waste inventory and
    - local conditions
- Reference Environment:
  - Sedimentary firm soil
  - Ground water 1 m below the surface
  - Tectonic movements up to 3.5 mm per year
  - Earthquake magnitude on Richter scale is 4
  - Annual precipitation: 900 mm per year, 150 mm for a single day
  - Length of draught period up to 2 months

Technical design of the Landfill: cross section

- Containers do not fulfill safety function
NSR: A "hill"-type repository with reinforced concrete vaults constructed above the groundwater level

Proposed multi-barrier disposal system protects the waste during 300 years

- The waste matrix and packagings
- Backfill
- Concrete vaults
- Clay based barrier
- Natural ground

Applicable siting strategies

- Dedicated site
  - to use nuclear sites
- "Scientific" approach
  - Step-vise process:
    - regional screening, narrowing number of potential sites…
    - Arbitrary ranking of multiple parameters applying weighting factors
    - Nether look for the best site!
- Volunteering
  - Siting criteria must be developed in advance and
  - Compensation package should be proposed
Hydrological criteria

- The hydrogeological setting of the region should include:
  - low ground water level
  - low groundwater flow
  - long flow pathways
  - long distance to “well”
- Preference should be given:
  - to regions that could make characterising or modelling of the hydrogeological system easy
  - to regions that have the main hydrological characteristics available

Consultations with the local public during Environmental Impact Assessment
Site characterization

- In 2004 RATA started characterization of sites and assessment of the potential environmental impact
- In 2006 RATA completed comprehensive geological, hydrological and hydrogeological characterization of three candidate sites
- The siting process has been reviewed by international experts in December 2005
  - [www.iaea.org/publications](http://www.iaea.org/publications)
- The Environmental Impact Assessment Report approved in 2007

NSR Technical Design development

- Procurement of services
- Conclusion of a contract with AREVA, ANDRA and Lithuanian companies
  - Ignalina NPP is responsible for management of the Contract
Content of the Design Contract

- Final site characterization
  - Geotechnical investigations
- Basic Design
- Technical Design
- Preliminary Safety Assessment
- Final Waste Acceptance Criteria
- Technical supervision during construction

Repository for Very Low-Level Waste

- Development of the Landfill type repository dedicated for disposal of VLLW is in design phase
- Waste will be disposed of in a very simple manner without conditioning
Packages of
Very Low-Level Waste

There are three types of package foreseen for disposal in the Landfill:

- Half ISO containers filed with waste (pieces of concrete, metal)
- Boundless of compressed waste (organics and other compressible wastes)
- Big bags with ion exchange resins

Waste Acceptance for disposal
Development of WAC

- RATA prepares draft of the WAC
- Nuclear authority approves

- Operational safety
- Post-Closure safety
  - intrusion
  - radionuclide migration
- Step-vice approach in development of WAC
  - From generic to site/facility specific
Control of Waste Packages

- Waste generator is responsible for the QA measures
- RATA – the operator of disposal facility performs inspections at waste producer site
- Verification of waste packages will be performed during waste acceptance to the repository

NATIONAL STRATEGY FOR RADIOACTIVE WASTE MANAGEMENT

Aproved by the Government in 2002 and updated in 2008

- It is foreseen to establish:
  - landfill repository for VLLW (60 000 m³); by 2017
  - however, according current assessment the volume will be significantly bigger
  - near surface repository for LILW (100 000 m³); by 2020
  - new dry spent nuclear fuel storage for all spent fuel; by 2012
  - interim storage for long-lived waste; by 2017

- Disposal of SNF and other LLW is not planned in the nearest future
  - The Spent Fuel and Long Lived Waste will be stored until future disposal in a geological disposal facility will be available
The main challenges

- Lack of public acceptance
- Unfavorable geography: proximity to national border
- Complicate environment (high ground water table)
  - Designing robust surface water draining system
- Not well known waste volume and properties
  - According newest assessment volume of VLLW will significantly exceed Landfill capacity
- Delays
  - Due to wrong planning
  - Limited project management experience
  - Institutional framework

IAEA PEER REVIEW MISSION IS AN IMPORTANT TOOL FOR CONFIDENCE BUILDING

- Was held in December 2005
- Purpose of the mission:
  - an independent assessment of the safety of the considered sites and feasibility of the proposed reference design to local conditions;
- Mission result:
  - informed RATA whether its programme is consistent with international standards and with good practices from other disposal programmes
Thank you!