Safe disposal of LLW in surface repository

The French case
Views from the regulator

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General principles about waste management

Role of the regulator
- Long term management of radioactive waste is a major stake in terms of nuclear safety and radiation protection. Then, safe management routes have to be developed for every type of waste;

- It is an obligation to avoid any undue burden on future generations.
- Producers of radioactive waste are tasked to manage them safely during production, treatment, packaging and storage;
- Andra, the French national agency for radioactive waste management is tasked by law with designing, sitting, operating and monitoring of disposal facilities for radioactive waste;
- ASN is responsible for the control of these installations during all phases: conception, construction, operation, decommissioning, monitoring phase
ASN duties related to waste management

Global approach

Regulation drafting and review

Elaboration of the national Plan for management of radwaste

Assessment of definition of decommissioning and long term management of radwaste costs

Assessment of strategies for decommissioning and management of radwaste

Licensing, specific authorizations

Oversight: inspections and enforcement actions

Approach by installation
# Management routes for radwaste

<table>
<thead>
<tr>
<th>Very low level (VLL)</th>
<th>Very short lived (half-life &lt; 100 days)</th>
<th>Short lived (half-life &lt; 31 years)</th>
<th>Long lived (half-life &gt; 31 years)</th>
</tr>
</thead>
</table>
| **Management by radioactive decay on the production site** | **Surface Disposal**  
*The Aube disposal centre for VLL waste*  
*Recycling management route* | | |
| then elimination in the conventional management solutions | | | |

| Low level (LL) | **Surface Disposal**  
*The Aube disposal centre for LL/IL-SL waste*  
*Recycling management route* | **Low depth disposal**  
*Under study in compliance with the law of 28th June 2006* | |

| Intermediate level (IL) | **Surface Disposal**  
*The Aube disposal centre for LL/IL-SL waste*  
*Recycling management route* | **Deep geological disposal** | |

| High level (HL) | Not applicable | **Deep geological disposal**  
*Under study in compliance with the law of 28th June 2006* | |
Some figures about LILW-SL

<table>
<thead>
<tr>
<th>Category</th>
<th>Volume at end 2010 (m$^3$ equivalent conditioned)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLW</td>
<td>2,700</td>
</tr>
<tr>
<td>ILW-LL</td>
<td>40,000</td>
</tr>
<tr>
<td>LLW-LL</td>
<td>87,000</td>
</tr>
<tr>
<td>LILW-SL</td>
<td>830,000</td>
</tr>
<tr>
<td>VLLW</td>
<td>360,000</td>
</tr>
<tr>
<td>DSF*</td>
<td>3,600</td>
</tr>
<tr>
<td>Grand total</td>
<td>~1,320,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>For 2020</th>
<th>For 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLW</td>
<td>4,000</td>
<td>5,300</td>
</tr>
<tr>
<td>ILW-LL</td>
<td>45,000</td>
<td>49,000</td>
</tr>
<tr>
<td>LLW-LL</td>
<td>89,000</td>
<td>133,000</td>
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<tr>
<td>LILW-SL</td>
<td>1,000,000</td>
<td>1,200,000</td>
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<tr>
<td>VLLW</td>
<td>762,000</td>
<td>1,300,000</td>
</tr>
<tr>
<td>Grand total</td>
<td>~1,900,000</td>
<td>~2,700,000</td>
</tr>
</tbody>
</table>
Regulatory framework related to waste management
Regulatory framework (1/2)

Legally binding

Non legally binding

Parliament

Executive power

ASN

Law

Decrees Orders

ASN decisions

ASN guidelines
Regulatory framework (2/2)
Disposal facilities

- ASN guidelines
- ASN decisions
- Decrees
- Orders
- Executive power
- TSN Act
- Waste Act
- BNI procedure decree of 2/11/07
- BNI order of 7/2/12
- ASN
- Parliament
- Law
- ASN decisions
- ASN guidelines
- Safety guide 1.2 of 1984
- Safety guide 3.2.e of 1986
Key safety principles
Timeline of a radioactive waste disposal Safety guide I.2

- Design
- Building
- Choice of a geological environment

Commissioning

Building

Operation

Monitoring phase

Closure

End of institutional control

End of institutional control
Timeline of a radioactive waste disposal
Regulator duties

Commissioning

- Design
- Building
- Choice of a geological environment

Construction
- Operation

Closure
- Monitoring phase
- Periodic safety assessment
- Specific authorizations
- Inspections
- Application file review

End of institutional control
- Periodic safety assessment
- Specific authorizations
- Inspections
- Application file review
- Application file review
Safety guide I.2
Multi-barrier system

1st barrier: waste packages
2nd barrier: the disposal cells and structures + the final capping
3rd barrier: the site
Safety guide I.2
First safety objective

Immediate protection of persons and environment against radioactive and toxic substances

Deferred protection of persons and environment against radioactive and toxic substances

Safety ensured passively

1st barrier: waste packages
2nd barrier: the disposal cells + the final capping

3rd barrier: the site + limitation of long lived radionuclides
Protection is demonstrate thought study of both air and water transfer scenarios for both operational and long term safety.

Study of scenarios after surveillance should rely on pessimistic assumptions:
- Knowledge of the disposal is lost after the end of surveillance,
- The containment of packages and cells/capping is no more efficient after end of surveillance,
- Keys parameters to define these scenarios are the one of current activities (road works techniques for instance).
Limitation of the duration before end of institutional control is possible.

Safety ensured passively

300y maximum

The fact that end of institutional control should be possible at that time doesn’t imply that it shall be ended.
The 1st barrier: the waste package

Focus on waste acceptance
Safety guide III.2.e
The waste package

Waste

Package
- Container that is suitable for handling, transportation, storage and disposal
- Containment properties or not
- Durability (perishable - e.g. non-alloy steel drums - or durable - e.g. cement drum)

Matrix:
Containment properties depend of the waste characteristics (mainly activity)
Safety guide III.2.e
The waste package

Limit of activity authorized

Encapsulated waste

Encapsulation threshold

Heterogeneous waste + matrix

Homogeneous waste + matrix

VLLW
BNI order of 7 February 2012:
The waste intended for radioactive waste disposal facilities having waste acceptance criteria is conditioned in accordance with these specifications.
Overall process of acceptance of waste

0. Waste acceptance criteria

1. Agreement

- Process controlled ASN

2. Waste package produced on the operator site

- Audits Andra

3. Acceptation procedure on disposal site

- Reviewed Andra

4. Disposal

- Reviewed ASN

Waste packaging files

- Description of the packaging process
- Quality assurance
- Packaging specifications
- Characterization methodology
- Technical tests of the package

Exchanged Producers
Acceptation procedure on disposal site

A new workshop implemented in the conditioning building to perform measurements and to take samples.
Need for an integrated view

The national plan assesses the management routes

ASN reviews the operators overall strategy

ASN reviews the strategy for management of each type of waste produced

Conception  
Operation  
Waste production  
Collecting  
Sorting  
Characterization  
Treatment  
Packaging  
Storage  
Disposal

Facility level

Operator level

National level
Optimization of a management route
Dealing with successive steps

Collecting and interim storage
ROTONDE facility

Packaging in 200L drums on site

Production of waste (tools, clothings,…) in a research reactor

Compaction of drums

Compacted drums are put in a 450L drums, embedded with cement

Disposal
Flexibility of the disposal
A key to optimize safety
Step by step building of the cells
Step by step building of the cells
A step by step building of the cells enables taking into account of:

- Feedback of previous building and operations of cells,
- Improvement of techniques and knowledge,
- New types of waste that are produced.

➔ Importance of periodic safety assessment every 10 years.
➔ Authorization of ASN for any important change in the design.