Energy

European Commission’s Perspective on the Management of Spent Nuclear Fuel

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Overview

- European Union
- Nuclear Fuel Cycle / Spent Nuclear Fuel
- Directive 2011/70/EURATOM
- Management of Spent Fuel in the European Union
- Final Disposal
- Safeguarding Spent Fuel in the EU
- First geological repositories in EU
The EU

European Union

• 28 Member States
• 26 NNWS, 2 NWS (FR, UK)
• Each EU country can decide whether it wants to include nuclear power in its energy mix
• Nuclear accounts for more than one fourth of electricity
• All types of nuclear facilities
• NPPs (in 16/28 MS) and Research Reactors
• Approx. 3200 tonnes/year (HM) Spent Fuel
• EURATOM Treaty since 1957

Nuclear Fuel Cycle

U mining

advanced recycling

repository

radioactivity in the environment

reprocessing

spent fuel storage

nuclear waste disposal

Uranium Storage

Fisile and Fertile

Natural Uranium

Spent Uranium

Natural Uranium

Fisile and Fertile

Uranium 235

Nuclear Fuels

Uranium 238

Nuclear Reactor

KIT Joint Research Centre
NPPs in the EU

Power reactors in EU: 220
Operating reactors: 131

EURATOM Treaty

EURATOM competences for nuclear

- Nuclear safety
- Radiation protection
- Nuclear safeguards
- Emergency preparedness and response
- Waste management
- Insurance and third-party liability
COUNCIL DIRECTIVE 2011/70/EURATOM of 19 July 2011

establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste

The Directive asks Member States to present national programmes, indicating when, where and how they will construct and manage final repositories guaranteeing the highest safety standards.

The safety standards become legally binding and enforceable in the European Union. Member States have to submit the first report on the implementation of their national programmes in 2015.


- **Goals**
  - safe, responsible and long-term management
  - high level of safety in the management of SNF/RW in the EU

- **Key features**
  - legally binding standards for management of SNF/RW
  - strict conditions on exports of radioactive waste outside the EU
  - promotes transparency, public information and participation

- **Main bases**
  - IAEA Safety Standards
  - Joint Convention on the safety of spent fuel and radioactive waste management
**Directive 2011/70/EURATOM**

**Transposition - 23 August 2013**

**National programmes (23 August 2015) and updates**

**MS reports every 3 years (23 August 2015)**

**Peer reviews (every 10 y)**

**Shipment to third countries (case by case)**

**EC report**

to the Council & the European Parliament

- progress and status
- future prospects
- inventory
- 2016

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**Directive Summary**

- Ultimate goal – safe and responsible waste and spent fuel management and high level of safety in EU
- Transposition review underway
- First national programmes and reports cycle - 2016
- Outcomes of first reporting and review
  - Workshop 2016/2017
- The second national reports – 23 Aug 2018
- Ongoing activities:
  - Update of legislation, national programmes
  - Peer reviews and shipment notifications
SNF Policy

Outline

- Two major options: open and closed fuel cycle
- Long-term intermediate storage of spent fuel or vitrified waste in both cases
- Final disposal projects most advanced in Finland and Sweden
- Industrial reprocessing mainly at La Hague (F), Sellafield (UK)
- Advanced closed fuel cycle demonstrated for oxide (SUPERFACT) and metallic (METAPHIX) fuel
- Transmutation in fast reactors (ASTRID) and ADS (MYRRHA)
- Focus on a safe implementation of all of these processes

World SNF Inventories


- SF Discharged
- SF Stored
- SF Reprocessed
- Nuc. Power

1100 tonnes HU


Nuclear Fuel Cycle
Back-end

spent nuclear fuel

spent fuel storage

Interim storage

short - term

long - term

final

reprocessing

aqueous (PUREX + advanced)

pyro (IFR/RIAR + advanced)

metallic

oxide

separated radiotoxic elements

solidification

transmutation

Intermediate storage

Intermediate storage of canisters at La Hague before geological repository

Wet and Dry storage of spent fuel
Spent fuel transport

Shielded casks for the transport of used fuel assemblies between:
- reactor, intermediate storage,
- reprocessing, final disposal

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Final disposal strategy

**GOAL**
To isolate radioactive wastes from the human environment through multiple containment, consisting of engineered and natural barriers

**AIM**
To know the effective segregation for periods >10^5 years
Spent fuel and HLW disposal implementation

underground laboratories for site exploration

- hard rock or granite:
  - Onkalo, Finland
  - Aspö, Sweden

- salt:
  - Gorleben, Germany
  - WIPP, New Mexico, USA

- clay, mudstone:
  - Bures, France
  - Hades, Belgium
  - Grimsel, Switzerland

major geological formations

- hard rock or granite:
  - Olkiluoto, Finland, Forsmark, Sweden

- salt:
  - Gorleben, Germany, WIPP, New Mexico, USA

- clay, mudstone:
  - Bures, France, site tbd, Belgium, Switzerland

- volcanic rock (ignimbrite):
  - Yucca Mountain, Nevada, USA
EC’s Nuclear Services

**EC’s Nuclear Pole in Luxembourg**

- Supply
- Safety
- Safeguards
- Radioprotection
- Waste Management

**EC’s SAFEGUARDS Services in Luxembourg**

- 200 staff
- 120 inspectors
- 1000 MBAs
- 1300 inspections per year – about half jointly with IAEA
- 1.6 mio accountancy lines processed yearly
Euratom Safeguards

New Challenges in novel types of nuclear installations:
- ENCAPSULATION PLANTS
- GEOLOGICAL REPOSitories

New Safeguards Approaches:
- Safeguards by Design (SbD)
- Unattended measurements
- Remote Date Transmission
- Co-op with IAEA, MS, OPs

Finland’s Geological Repository Project

FINLAND: 40 years’ effort

1978 Start of feasibility studies for geologic disposal
1983 Site investigations
2001 Decision-in-Principle by Government and Parliament
2012 Site selection and confirming investigations at Olkiluoto
2018 Application for construction license
2018 Application for operation license
2022 Start disposal of spent fuel

354 KPA - Spent fuel storage
375 VLJ -repositories
372 courtesy of POSIVA Oy

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Thank you!

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