# European Commission's Perspective on the Management of Spent Nuclear Fuel

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30th INMM Spent Fuel Seminar

12-14 January 2015, Arlington, USA



## 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

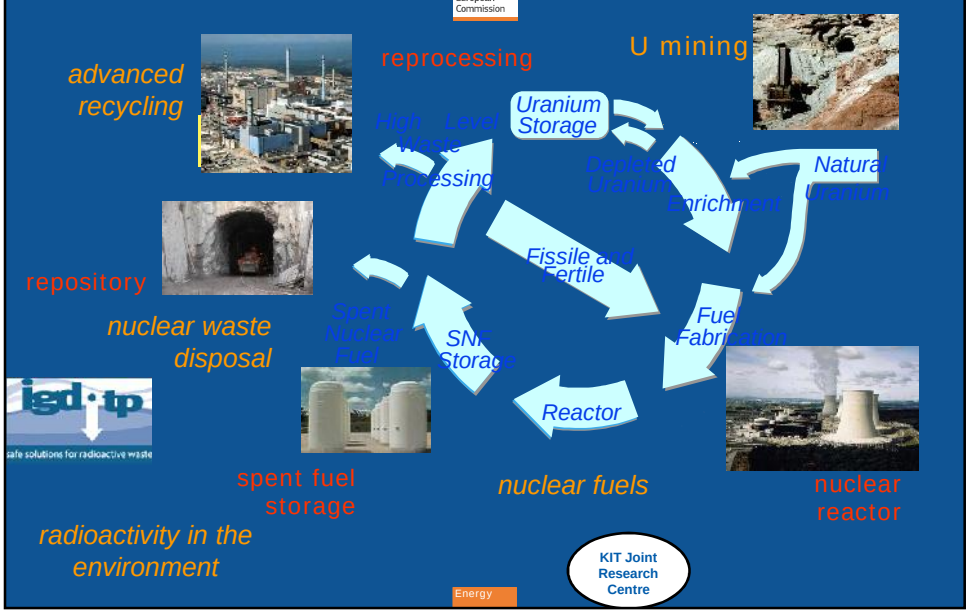
**European Union**

- 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



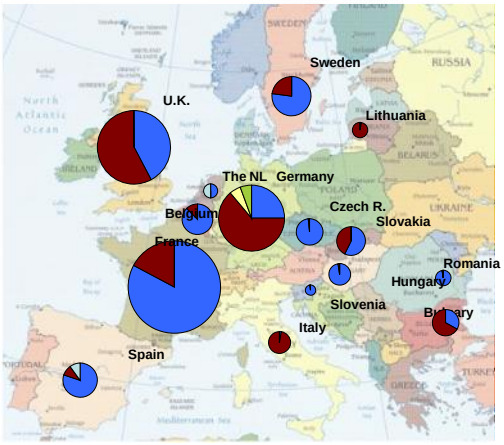


## Nuclear Fuel Cycle

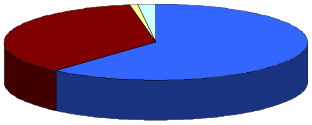


## NPPs in the EU

### NPPs in the EU




- Operational
- Shutdown - Dismantling
- Fully Dismantled
- Long Term Safe Conservation



**TOTAL**
**Power reactors in EU: 220**

**Operating reactors: 131**

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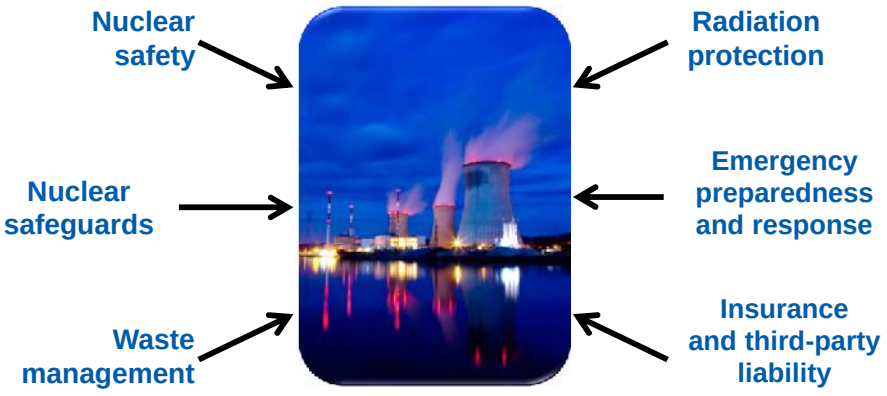
## EURATOM Treaty

### EURATOM competences for nuclear

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## Directive 2011/70/EURATOM

**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**.

http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011L0070&qid=1397211079180



## Directive 2011/70/EURATOM

- **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



## 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

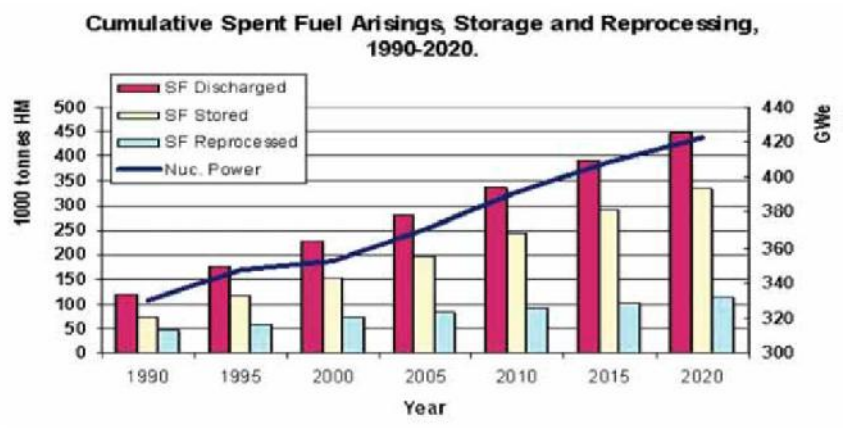
### Outline

- 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

KIT Joint Research Centre



## Nuclear Fuel Cycle Back-end

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European Commission

*spent nuclear fuel*

spent fuel storage

Interim storage

short - term

long - term

final

non-retrievable

retrievable

reprocessing

aqueous (PUREX + advanced)

pyro (IFR /RIAR + advanced)

metallic

oxide

*separated radiotoxic elements*

solidification

transmutation

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## Intermediate storage

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Intermediate storage of canisters at La Hague before geological repository

Wet and Dry storage of spent fuel

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## Spent fuel transport

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European Commission

shielded casks for the transport of used fuel assemblies between:

reactor, intermediate storage, reprocessing, final disposal

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## Final disposal strategy

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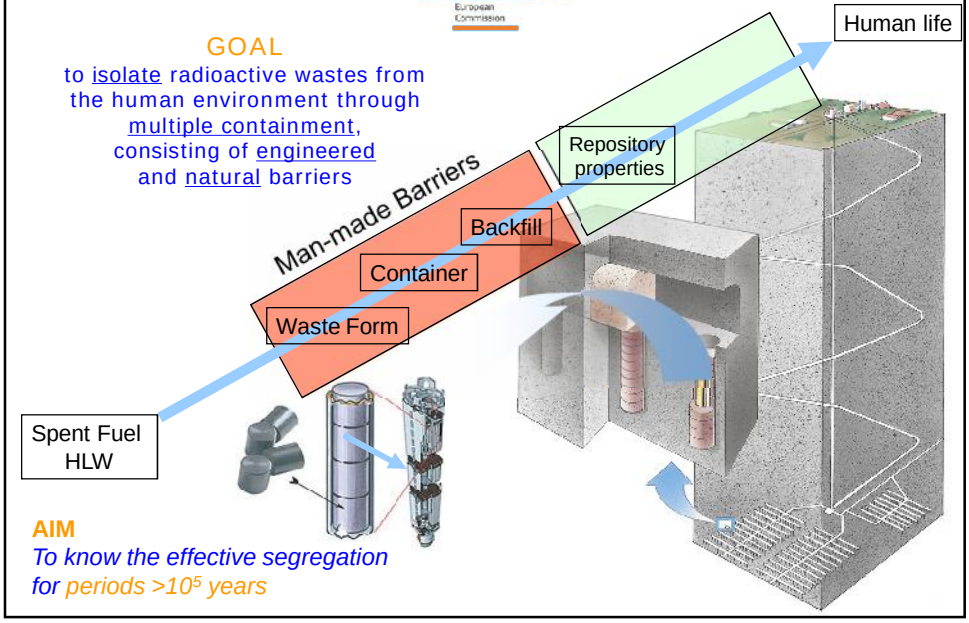
GOAL

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

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**underground laboratories for site exploration**

*hard rock or granite:*

Onkalo, Finland  Äspö, Sweden

*salt:*

Gorleben, Germany
WIPP, New Mexico, USA

*clay, mudstone*

Bures, France
Hades, Belgium
Grimsel, Switzerland







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## Spent fuel and HLW disposal implementation

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**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




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## EC's Nuclear Services


### EC's Nuclear Pole in Luxembourg

- → *Supply*
- → *Safety*
- → ***Safeguards***
- → *Radioprotection*
- → *Waste Management*



## EC's Nuclear Services


### 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**

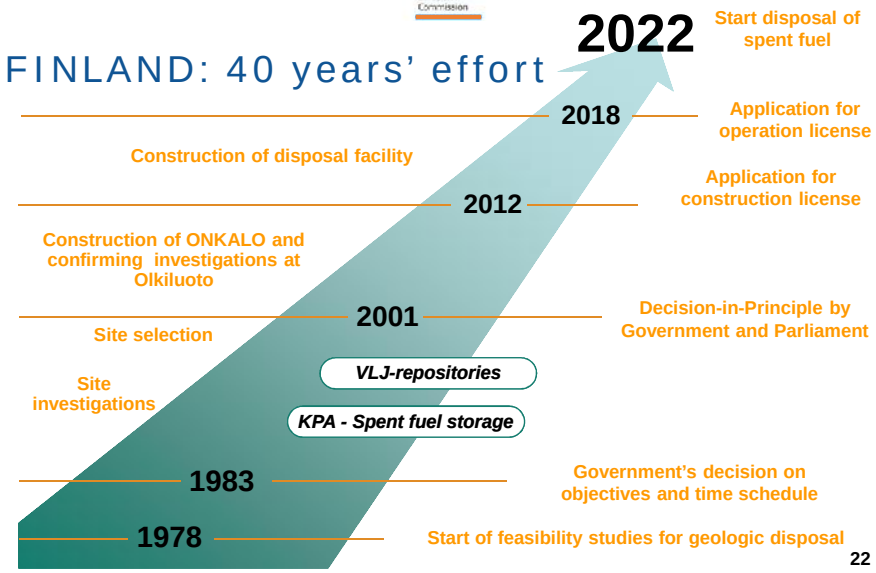
*New Safeguards Approaches:*

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





courtesy of POSIVA Oy



# Thank you!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