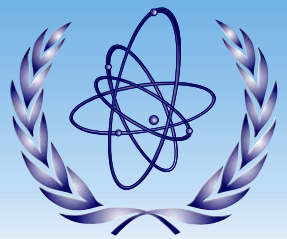


International Atomic Energy Agency

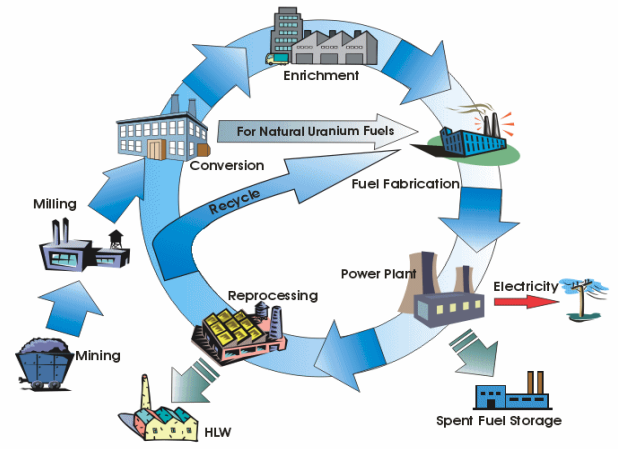
Nuclear fuel cycle and radioactive waste management (incl. decommissioning)

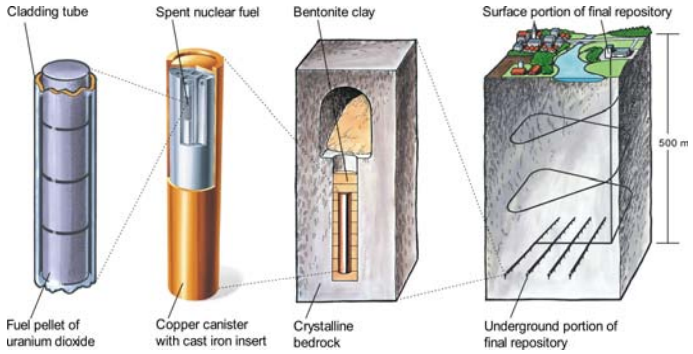
Workshop on Milestones for Nuclear Power Infrastructure Development
Vienna, 5 – 9 November 2007

Hans Forsström, Director
Division of Nuclear Fuel Cycle and Waste Technology

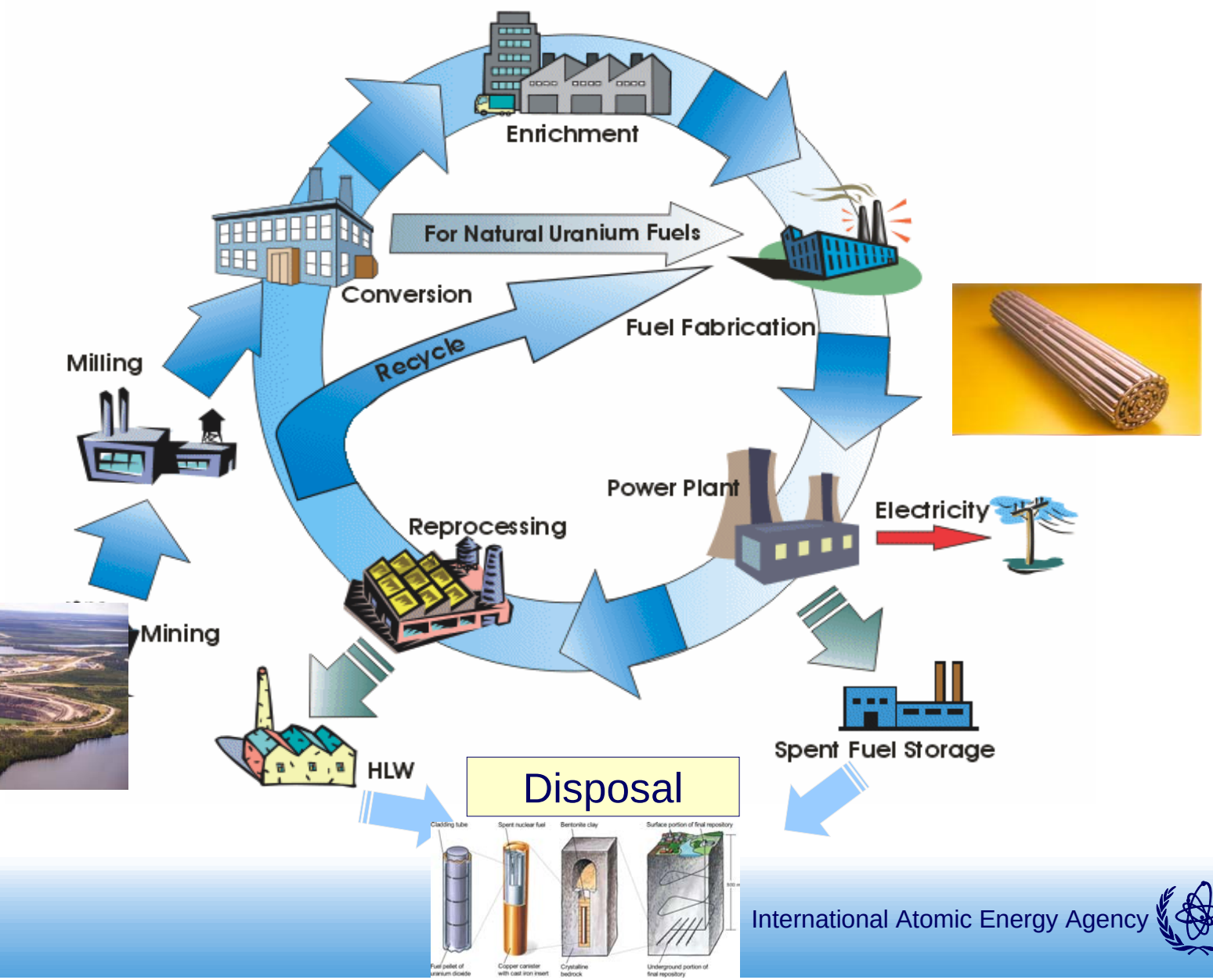
Fuel cycle and waste management
Main messages

- **Long-term commitment**
  - **Supply of fuel for ~60 years**
  - **Decommissioning ~ 20 – 40 years**
  - **Managing and disposing of radioactive waste ~ 100 years**
- **Understanding of market for fuel supply important – competitive market**
- **Strategy for spent fuel management – with flexibility**
- **Planning for disposal of all types of waste – no market (yet?)**
- **Costs for decommissioning, spent fuel and radioactive waste management appear when generation have stopped – Funding system necessary**



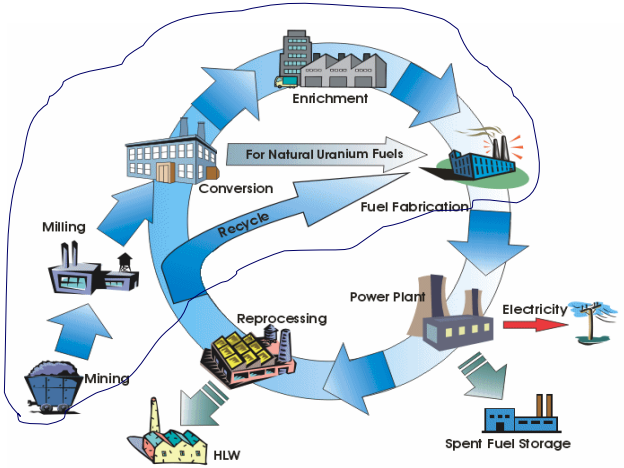


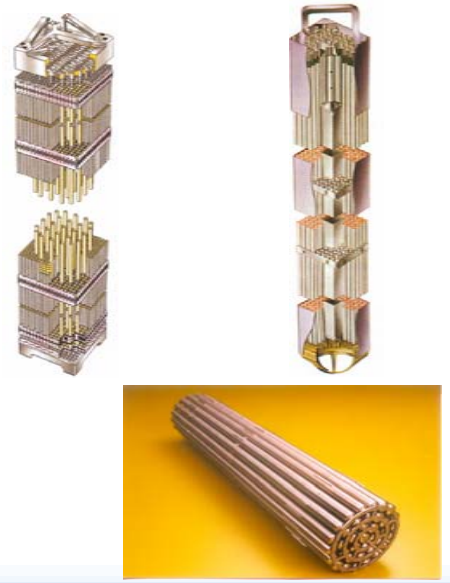
NUCLEAR FUEL CYCLE



Fuel purchasing

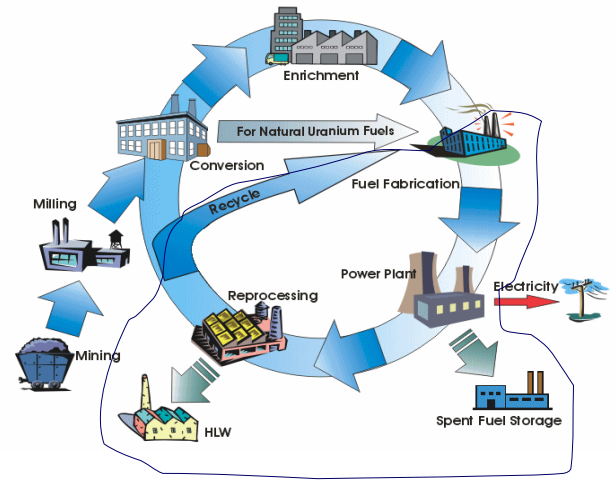
- **Different strategies**
  - **Separate purchasing of all components (natural uranium, conversion, enrichment and fabrication) on the market**
  - **Purchasing of finished fuel elements on the market**
  - **Long-term contract with reactor supplier for fuel (first core + some reloads to life-time)**
  - **Build national capacity**
- **Natural uranium, conversion and enrichment are commodities**
- **Fuel fabrication is a very specific product with a lot of IPR**
- **Production expected to match demand**
- **Assurance of supply discussed for exceptional cases**
- **Important to understand the market**





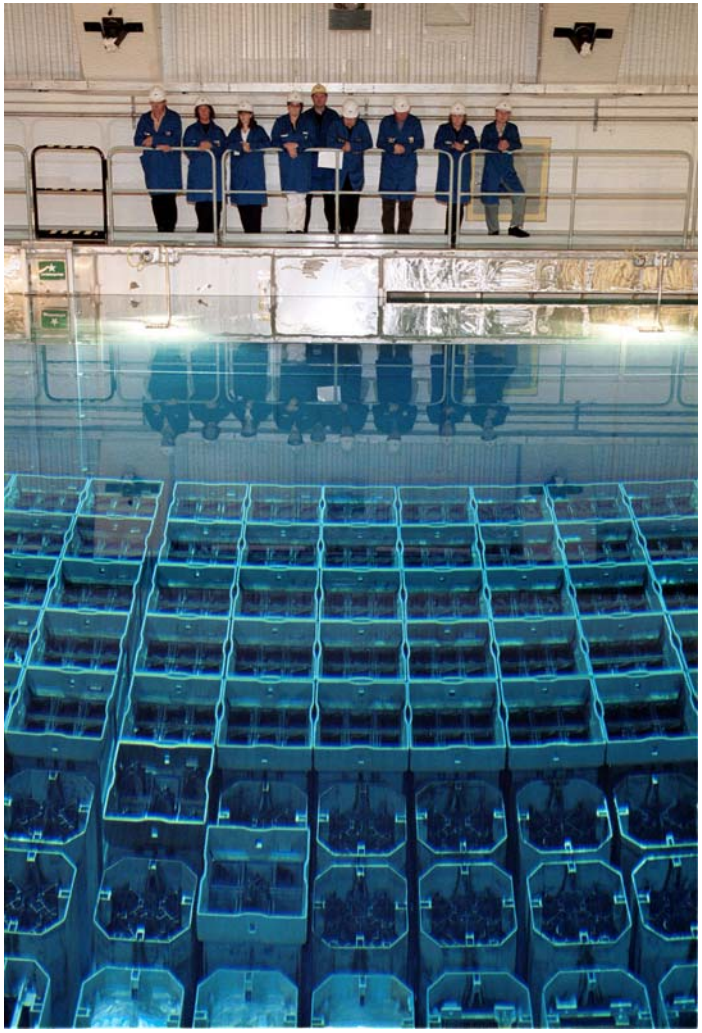
Spent Fuel Management

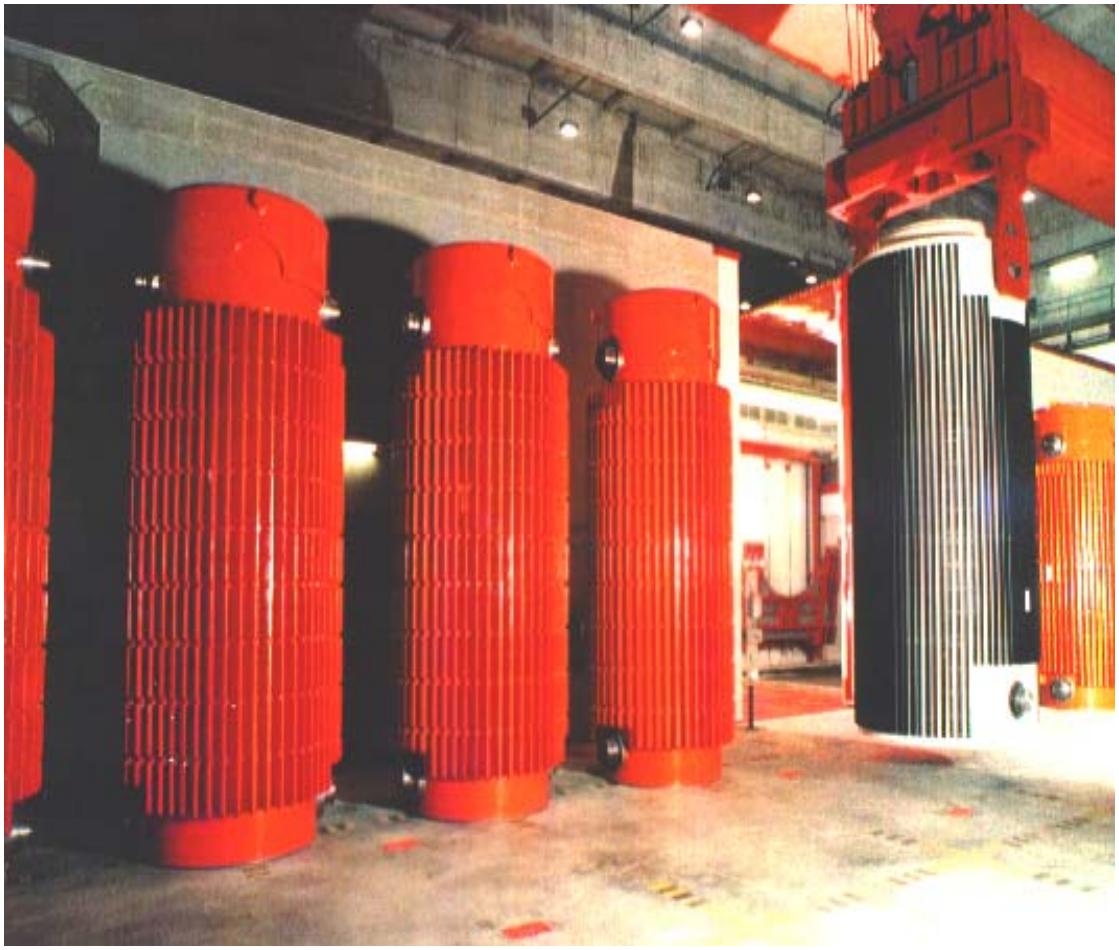
1. ***Closed cycle*** **– spent fuel reprocessed after storage – Pu + U recycled – waste disposed**
2. ***Once-through cycle*** **– spent fuel stored and then disposed**
3. ***Deferring a decision***



- ***Storage important component, probably for decades***
- ***Today only 10 – 15 % of spent fuel reprocessed and recycled as MOX***
- ***No market for disposal***

Storage of Spent Fuel

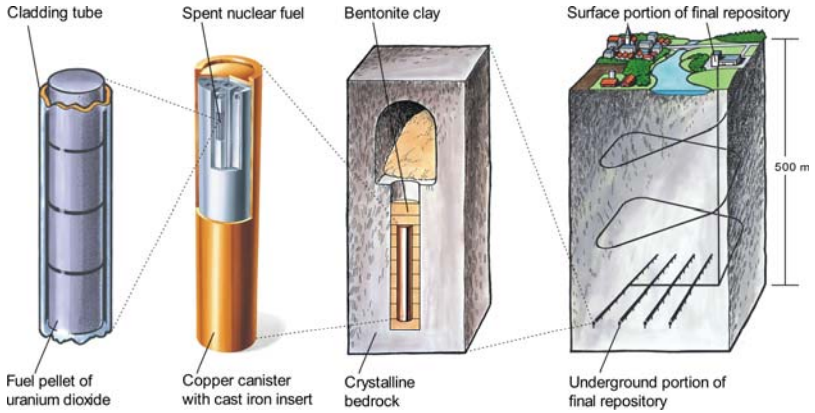




Transport of Spent Nuclear Fuel

Geological disposal

- Technical solutions are available for geological repositories
- No disposal facility for HLW or spent fuel in operation.
- Good progress for repositories for HLW or spent fuel in USA, Finland, Sweden and France. Delays in many programmes
- Typically the HLW or spent fuel will be stored for 40 – 100 years before disposal



Different types of radioactive waste

- **Exempt waste**
  - **(no restriction on reuse)**
- **Very low level waste**
  - **Simple disposal on the surface**
- **Low-level waste**
  - **Engineered surface disposal**
- **Intermediate level waste**
  - **Geological disposal at intermediate depth**
- **High-level waste and spent nuclear fuel**
  - **Geological disposal**

Different types of radioactive waste

- **Reactor operation waste**

  Mainly low-level waste
- **Exchange of components**

  Mainly low-level, but some intermediate level
- **Spent Fuel, or**
- **Reprocessing waste**

  Mostly intermediate level or high level
- **Decommissioning waste**

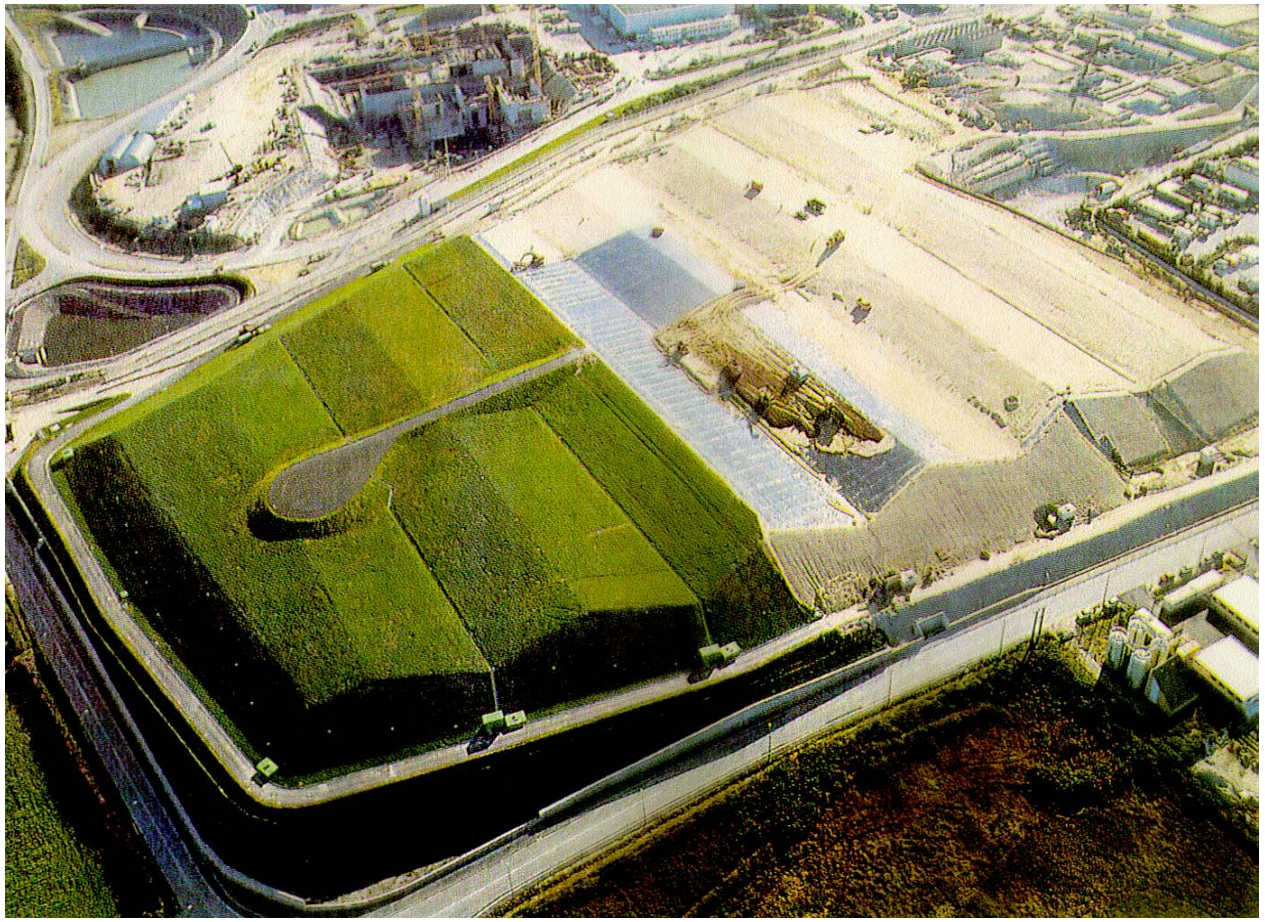
  Mainly very low or low-level, some intermediate level

Planning needed for all types, including treatment, conditioning, storage and disposal

Storage of low- and intermediate level waste

Aerial View of the El Cabril Facility in Spain

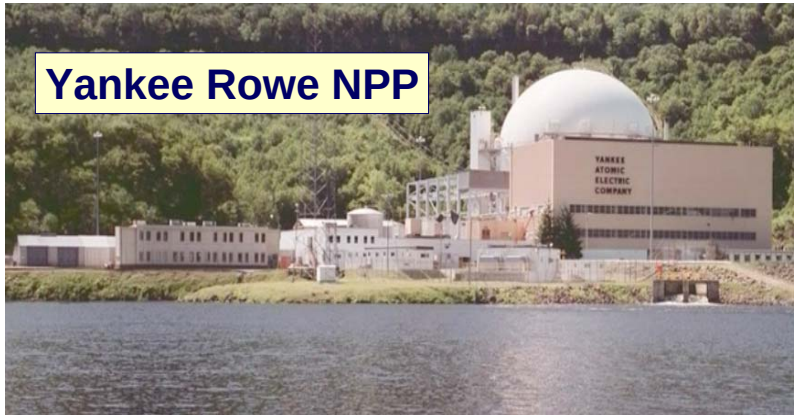
Centre de la Manche, France



Final Covering of the Low Level Waste
Disposal Facility at Centre de la Manche (France)

Decommissioning of nuclear facilities

- After finishing operation the nuclear power plant need to be decommissioned
- Preparedness for decommissioning needed
- Technology is available but can be optimized
- Timing of dismantling depend on many factors
- Waste management, planning and funding key to success
- Availability of disposal necessary



Funding of decommissioning, spent fuel and radioactive waste management

- Fairly high costs that will appear after the generation of power and revenue and sometimes very much after
- The costs should be seen as operational costs and internalized
- A stable funding system needs to be built
- Clear responsibilities for the different players need to be established, for financing, funding and implementation

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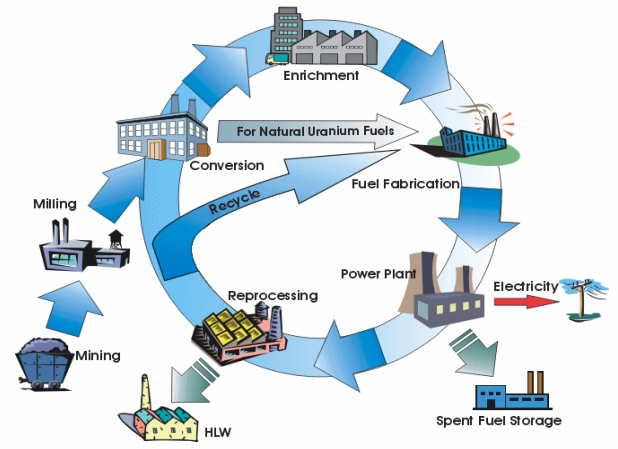

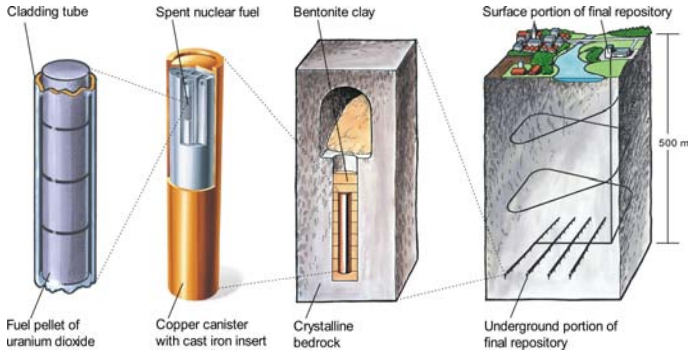

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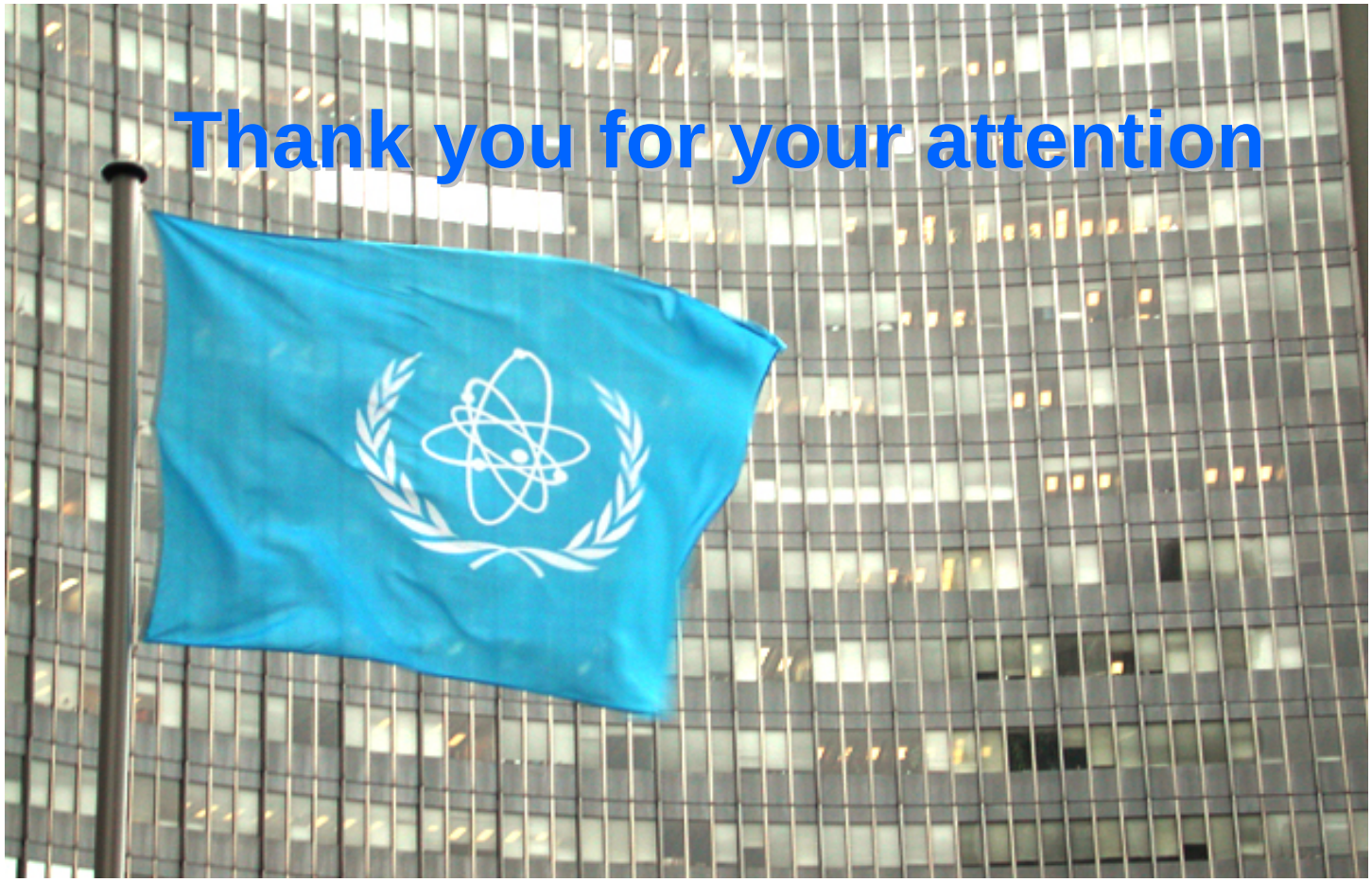

…atoms for peace.