

An LCA approach to the management of Spent Nuclear Fuel

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DISTINCTIVE

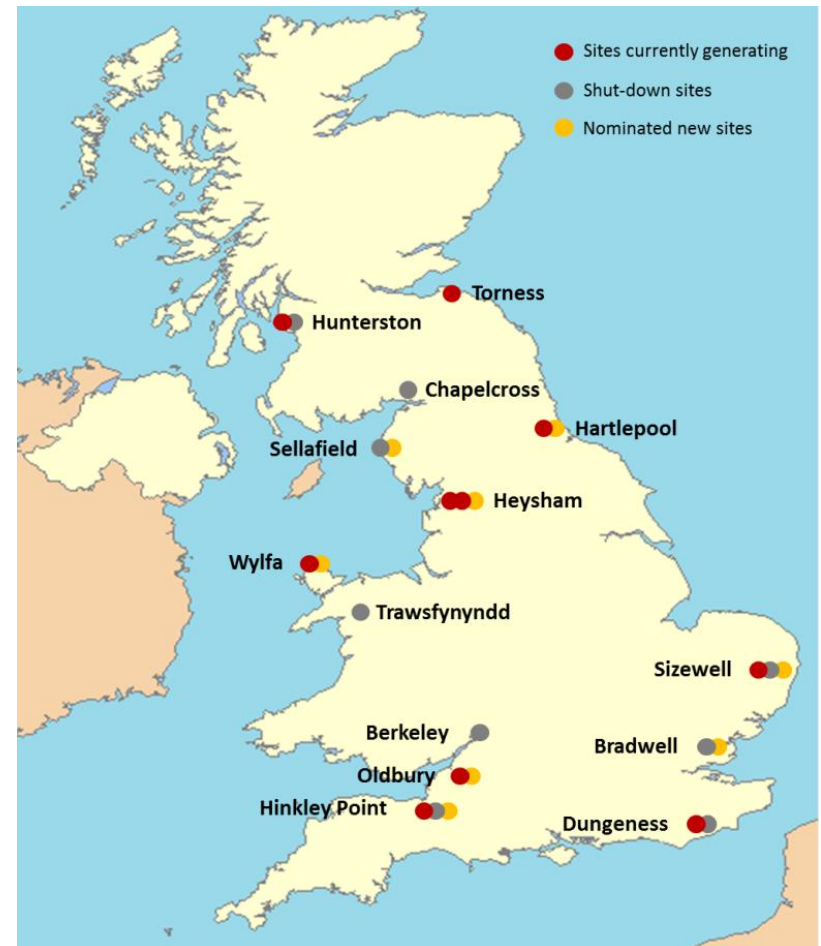
Nuclear Industry in the UK

Share of UK total electricity generation:

- 20% at 2013 → 40-50% by 2050 (Best Scenario)

Some numbers:

- 9 Operating Power Plants (10 TWe)
- 5 Planned Power Plants (15.6 TWe)
- 26 Power Plants Under Decommissioning
- 2 Operating Reprocessing Plants (**due to be closed by 2017/18**)



UK nuclear power generation reactors' map

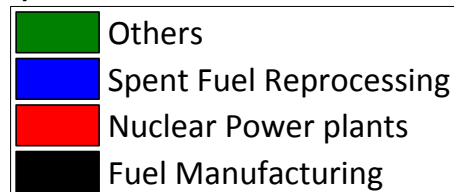
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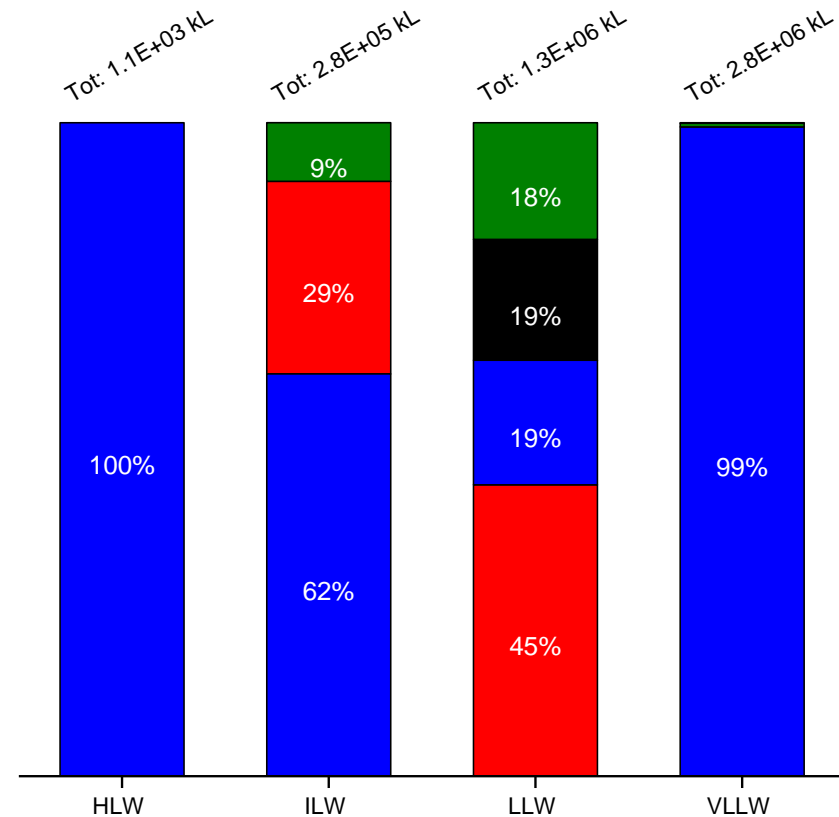
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Nuclear Waste by type



UK Radioactive Waste Inventory 2013 - Reference case

Project highlights

Aims:

- Develop a High-level conceptual Life Cycle Assessment to define how to assess the **environmental impact performance** of nuclear wastes
- **Develop a Life Cycle Assessment scenario** for the management of Spent Nuclear Fuel first and then for the entire nuclear fuel cycle (*from mining and milling, through fuel fabrication and energy production, to waste management and disposal*)

Use:

- Support **decision-making process** within the Nuclear Industry
- Improve **public perception** towards the Nuclear Energy

Work done:

- Review of existing nuclear fuel cycle configurations
- Review of existing methodologies to evaluate radiological impact of radionuclides
- Operationalize a new methodology
- Identification of a reference scenario

Life Cycle Assessment

What is it?

Life Cycle Assessment (LCA) is a tool used to help understanding the impact of human interactions with the environment by identifying and quantifying the environmental burden of an activity

How?

- Consider all energy and materials used and wastes released to the environment
- Assess their impact to the environment

| Impact | Unit Equivalent |
|---------------------------------|--------------------|
| Abiotic Depletion (elements) | Kg Sb |
| Abiotic Depletion (fossil) | Kg Oil |
| Acidification | Kg SO ₂ |
| Ecotoxicity | Kg DCB |
| Eutrophication | Kg PO ₄ |
| Global Warming | Kg CO ₂ |
| Human toxicity | Kg DCB |
| Land use | m ² a |
| Noise | Pa ² s |
| Odour | m ³ |
| Ozone Depletion | Kg CFC 11 |
| Photochemical Oxidant Formation | Kg Ethene |

Standard impact categories

Life Cycle Assessment

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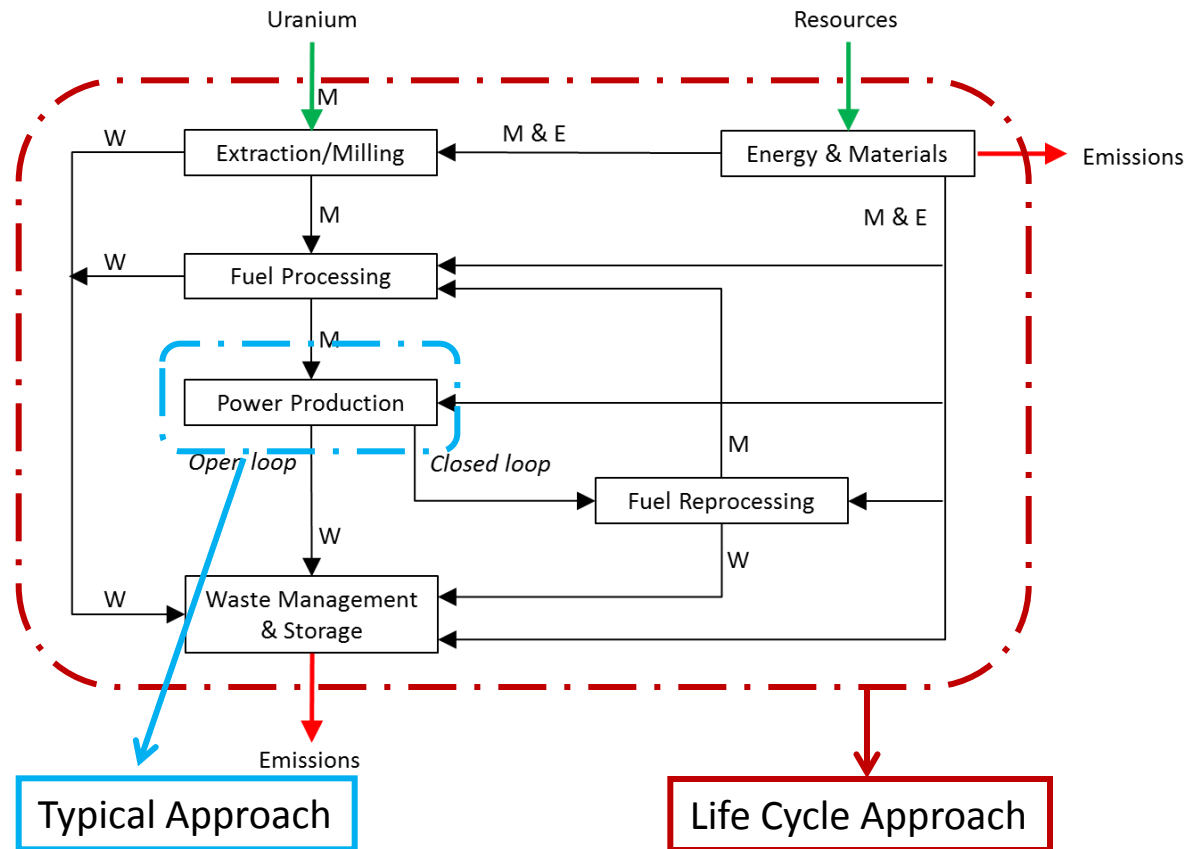
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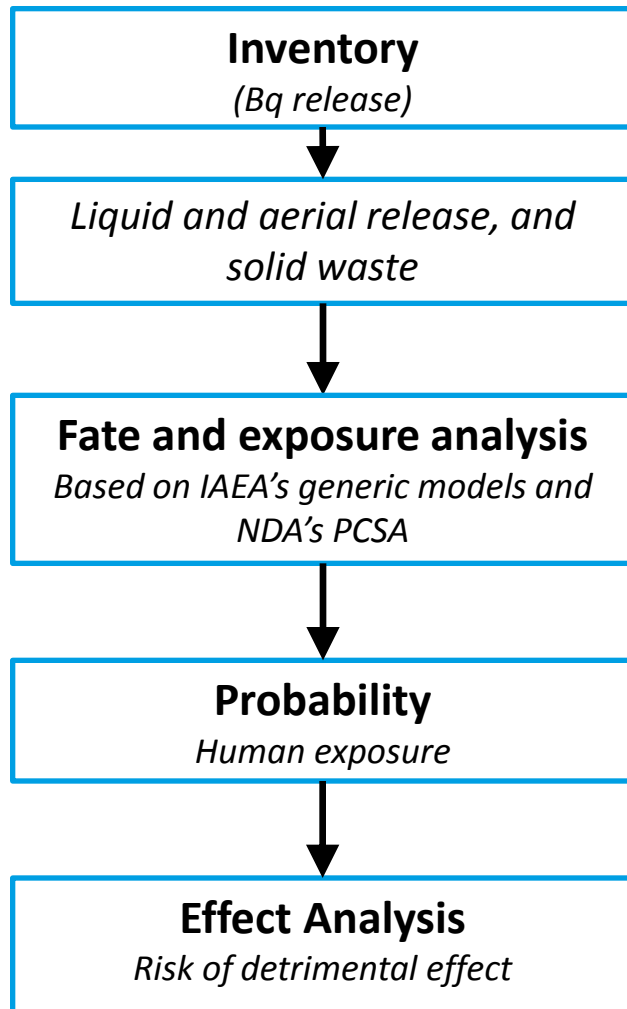
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Why?

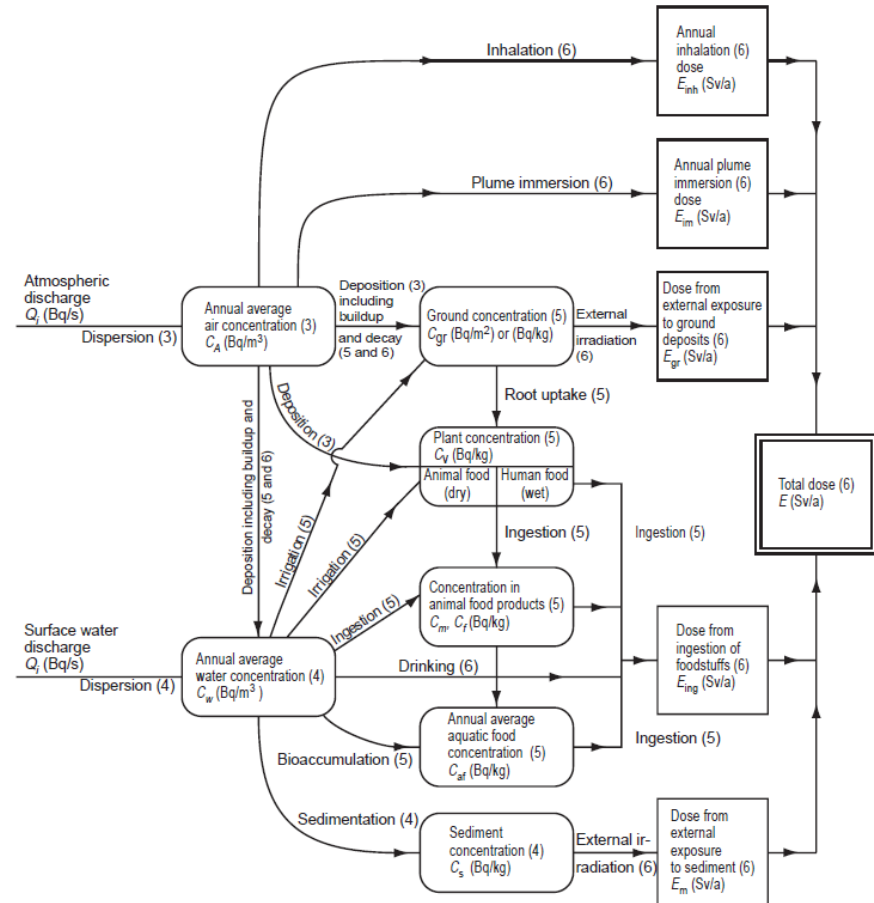
Taking a Life Cycle (also called “cradle to grave”) approach ensures that sub-optimisations are avoided and that environmental burdens are not simply shifted to other parts of the life cycle



Risk-based Approach

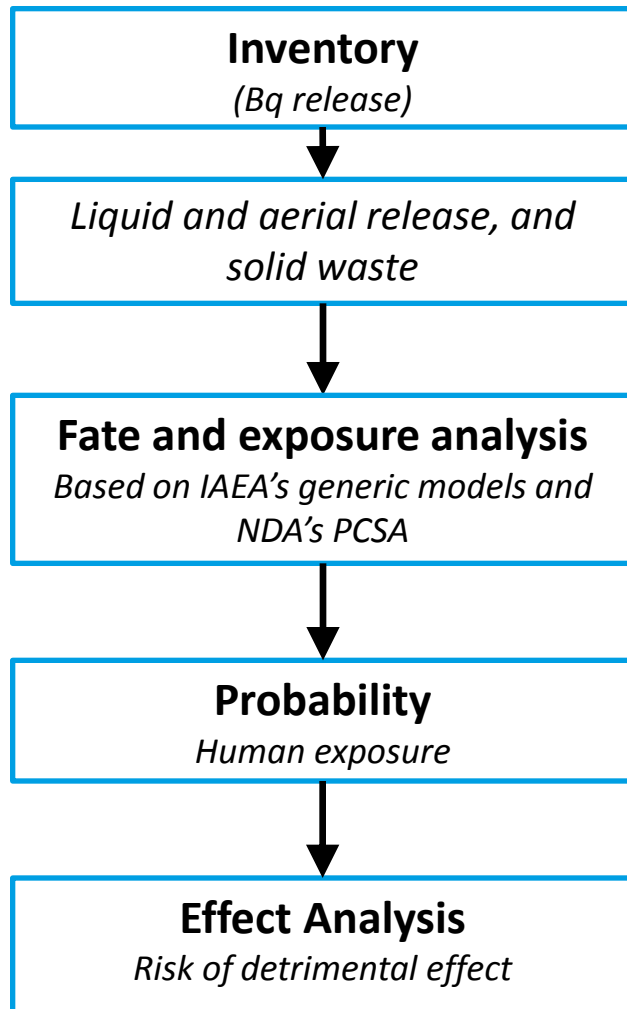


IAEA Generic model

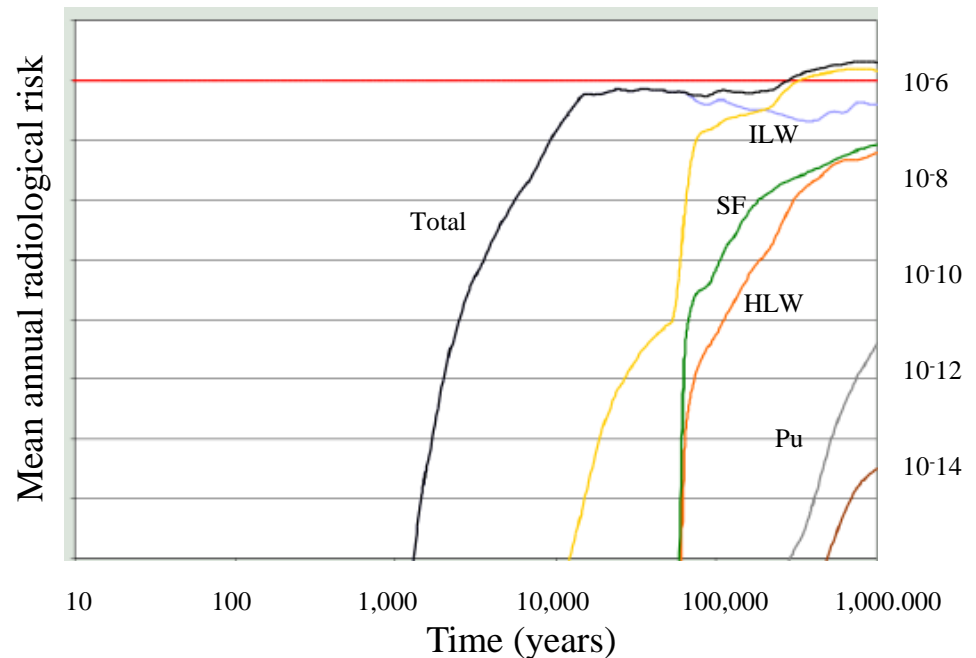


Reference: International Atomic Agency, *Generic Models for Use in Assessing the Impact of Discharges of Radioactive Substances to the Environment* (2001)

Risk-based Approach

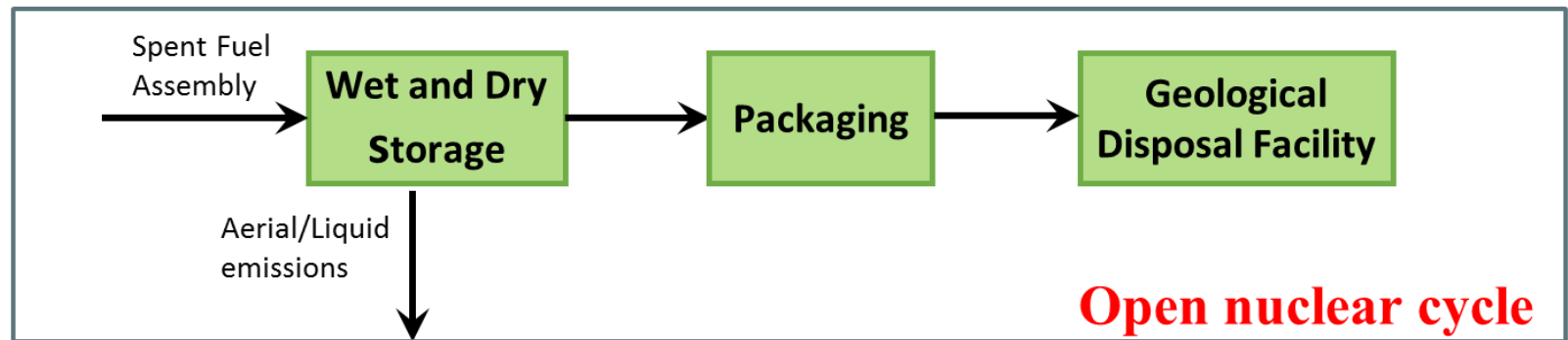
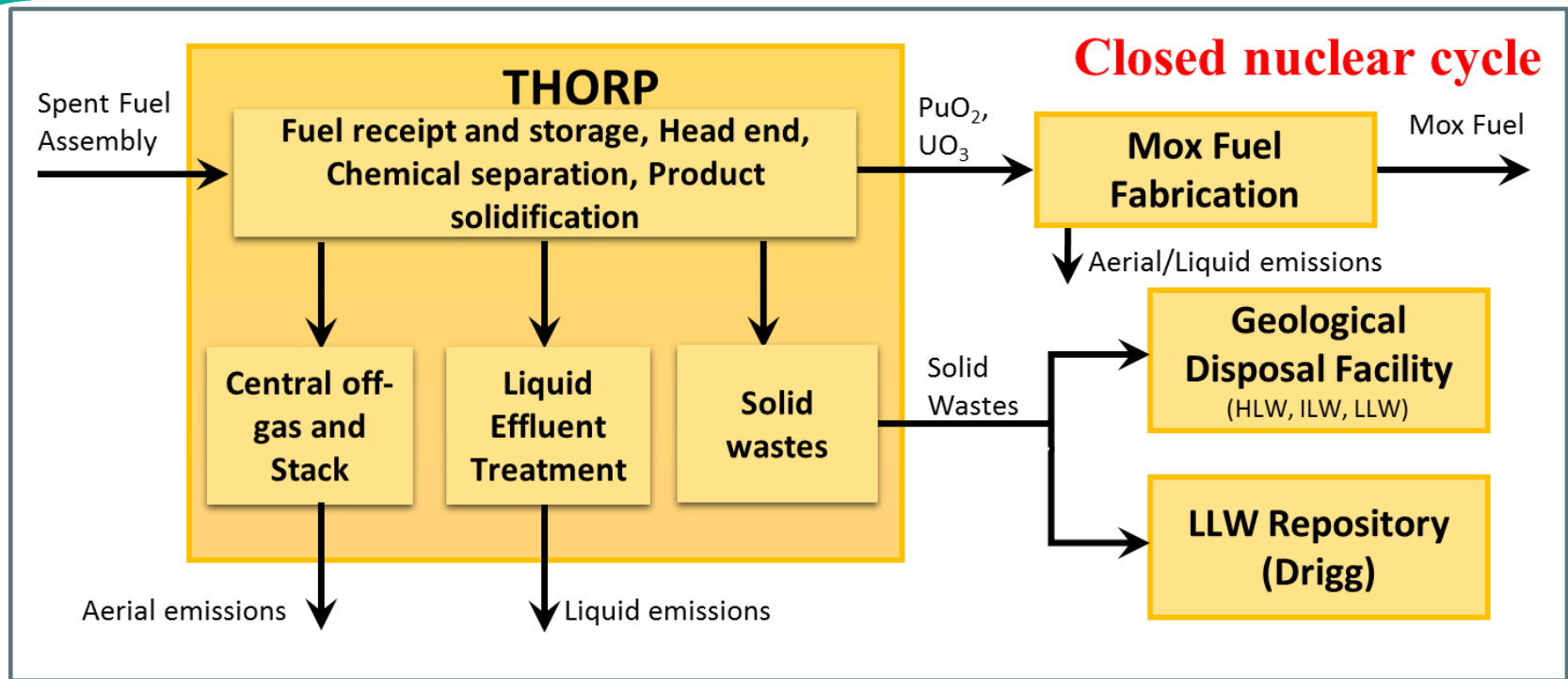


Generic Post-closure safety assessment (PCSA) of a Geological Disposal Facility (GDF)



Reference: National Decommissioning Authority, Geological Disposal: Generic Post - Closure Safety Assessment (2010), report no. NDA/RWMD/030

Scenarios – Management of SNF



Conclusions and Future work

- **Life Cycle Assessment** can be used to compare alternative strategic options for the nuclear industry;
- **A Risk-based approach has been operationalized** in order to assess the impact of nuclear wastes;
- **Preliminary results show** that:
 - Liquid emissions have the highest impact between standard impact categories;
 - Radiological impact of solid wastes is negligible.

Future work:

- Complete the closed scenario and compare results with the open scenario;
- Identify alternative options;
- Extend reference scenario to the whole nuclear fuel cycle.

Thanks