Risk Management in Nuclear Decommissioning

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Agenda

- **Introduction** - to provide UK context
- Identification of **challenges** which can impact on the risk assessment
- **Solutions** are presented to manage the challenges
- **Project examples** are provided to demonstrate how challenges have been overcome by implementing the solutions

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Introduction – UK Context

- The current UK nuclear industry portfolio is extensive and varied, including:
  - Reactors
  - Fuel manufacturing and reprocessing facilities
  - Research facilities
  - Defence related facilities
  - Naval dockyards and bases

- Legacy facilities represent a significant proportion of the portfolio

- This portfolio is set to increase with new reactors and the geological disposal facility

Introduction - Decommissioning

- Decommissioning entails a change in the:
  - Operational environment
  - Operational purpose and mind-set
  - Potentially new or different hazards (both radiological and conventional)
  - Risk to operators and members of the public

- Potential changes to the hazards can result from, for example:
  - Introduction of additional plant and systems used for decommissioning e.g. Waste Management Facility
  - Undertaking parallel construction and decommissioning activities
  - Significant conventional hazards arising from dismantling
  - Breaking containment to gain access to areas

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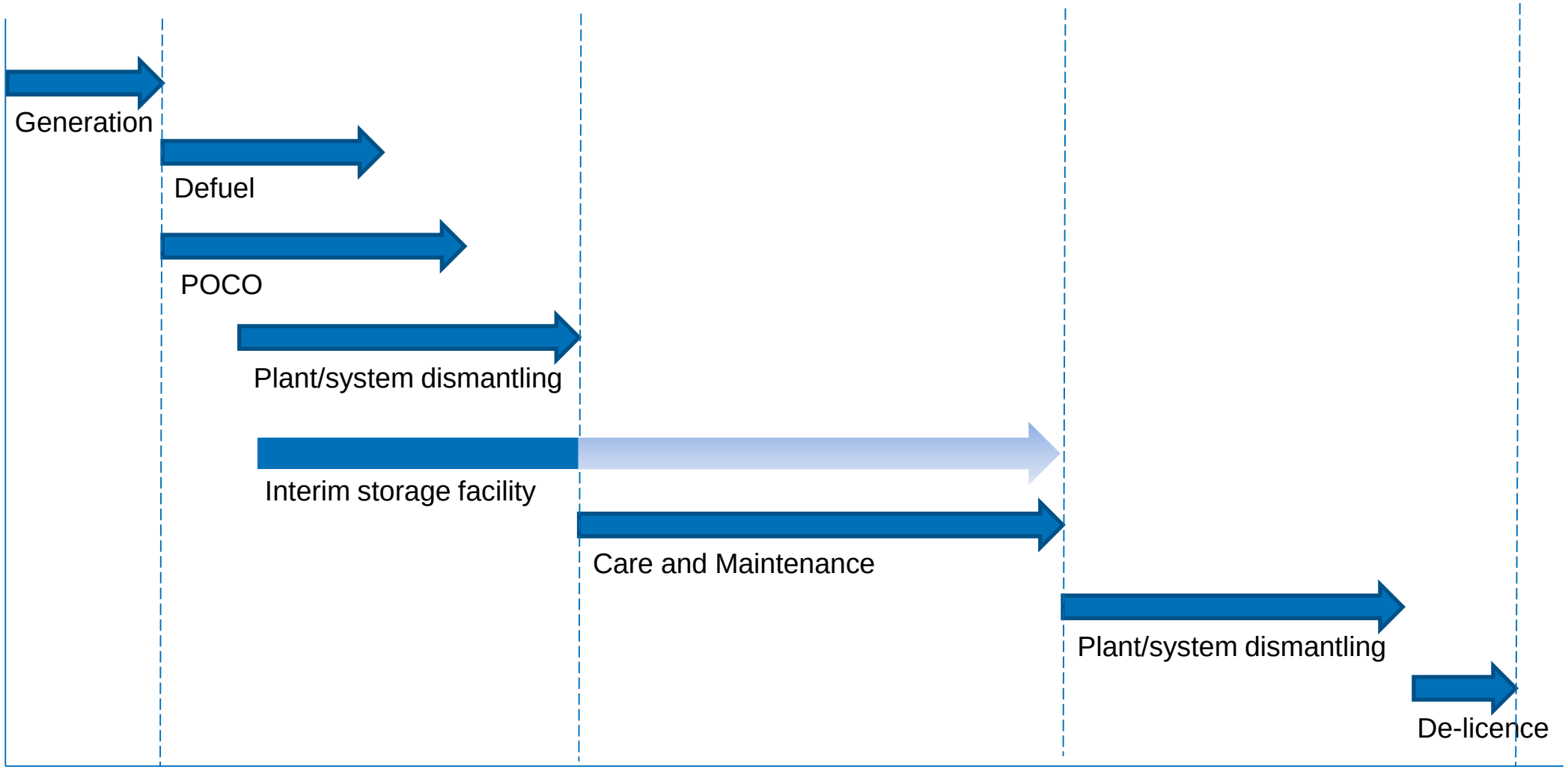
Introduction – illustrative programme of reactor decommissioning



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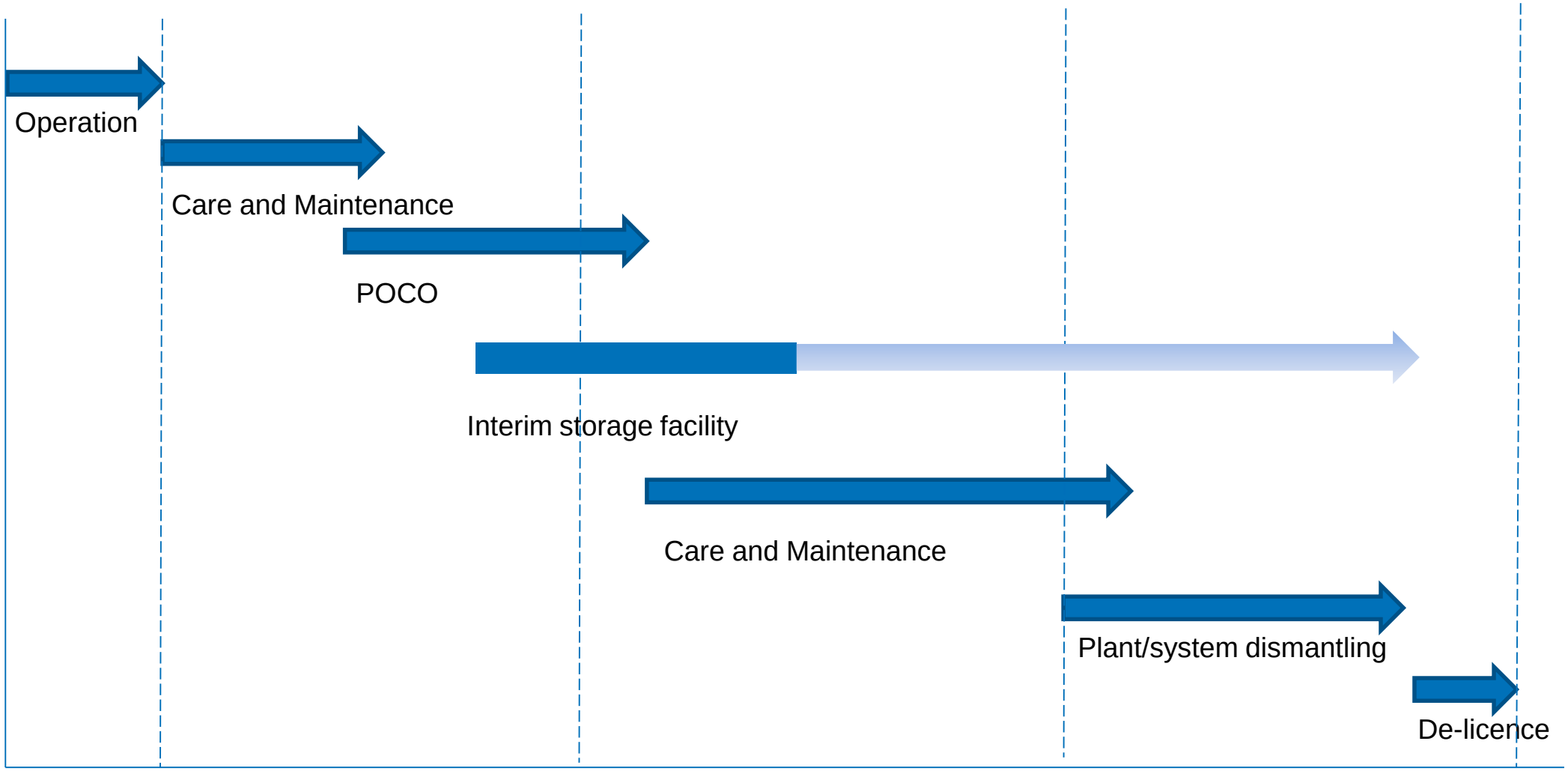
Introduction – illustrative programme of nuclear legacy facility



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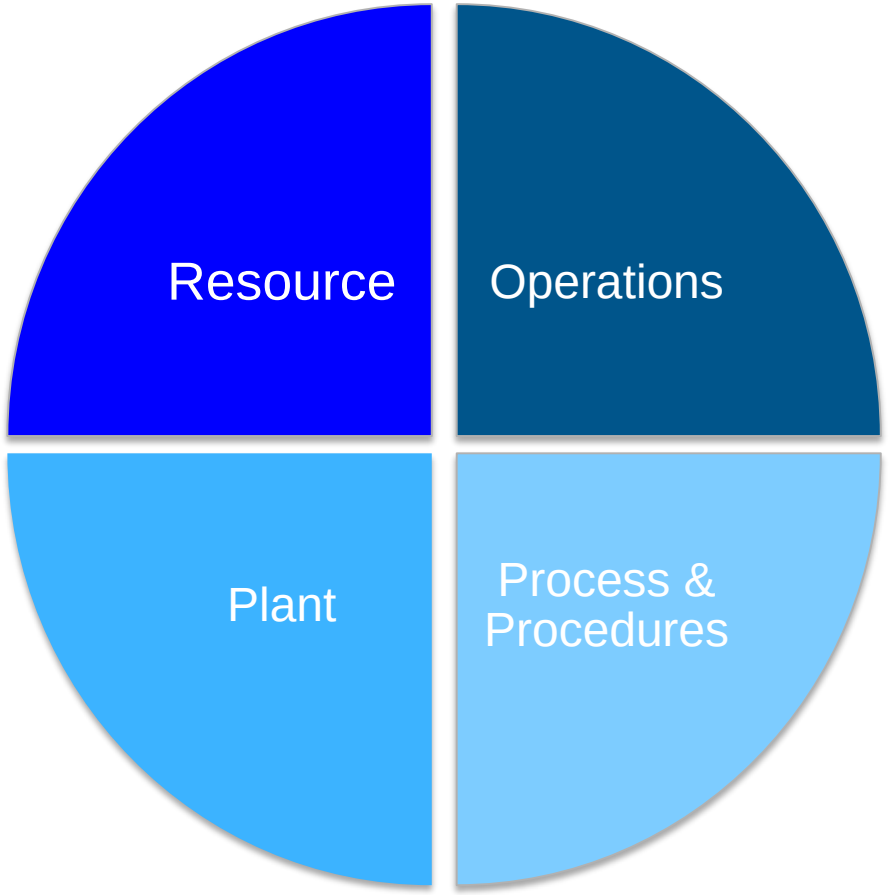
Challenges



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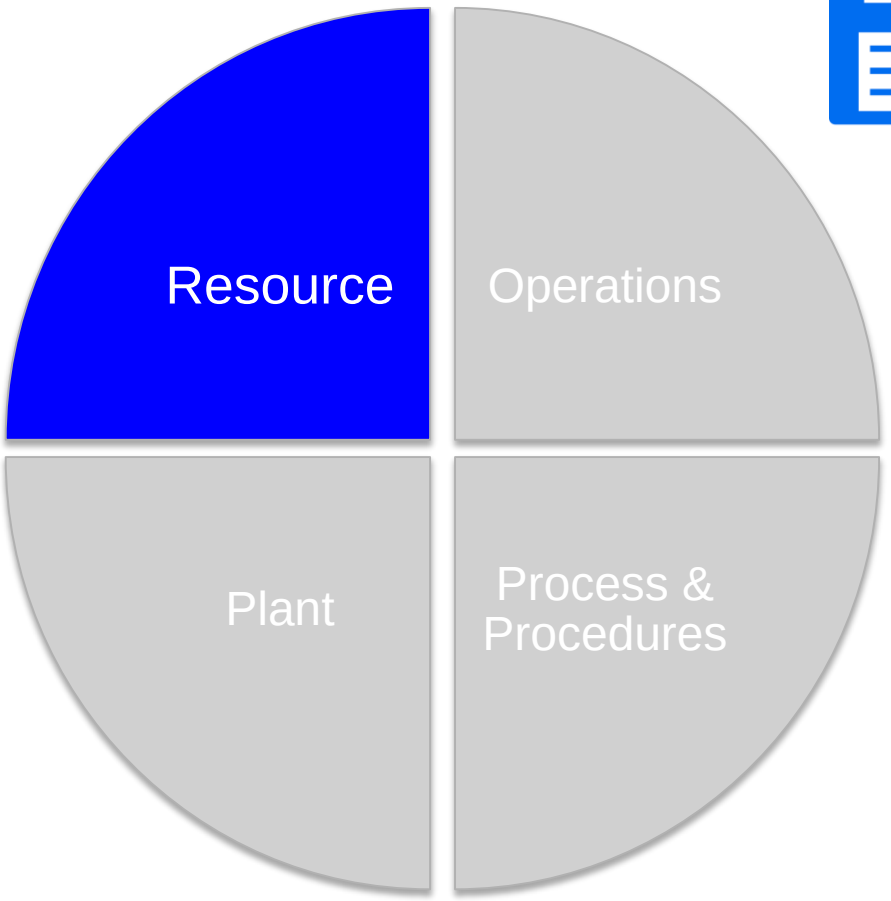
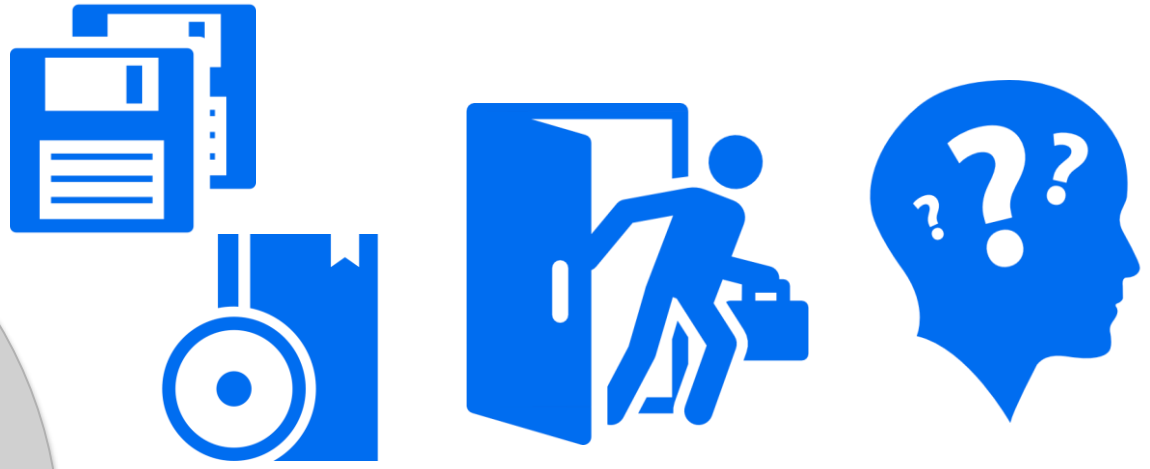
Challenges





- Loss of people, information & knowledge
- Cultural changes
- Change of resource capability requirements e.g. decommissioning mindset as opposed to power generation

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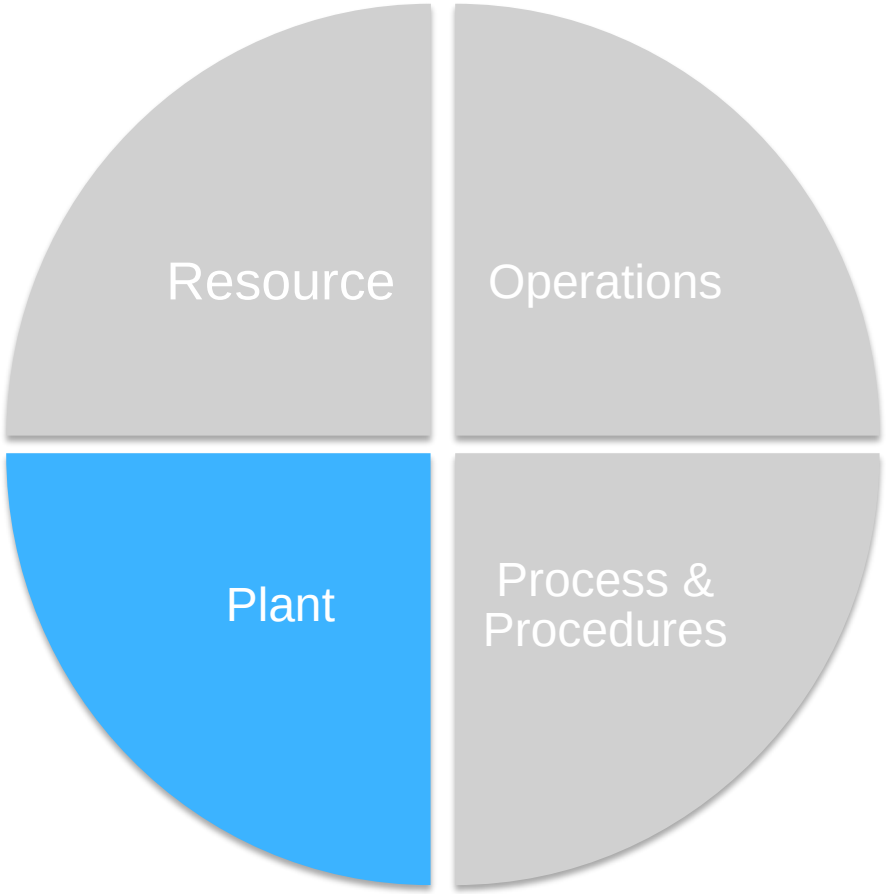
Challenges



AGE

- Ageing and obsolescence
- Unknown condition of plant and systems
- Uncertainties with radiological inventory
- Not designed with decommissioning in mind

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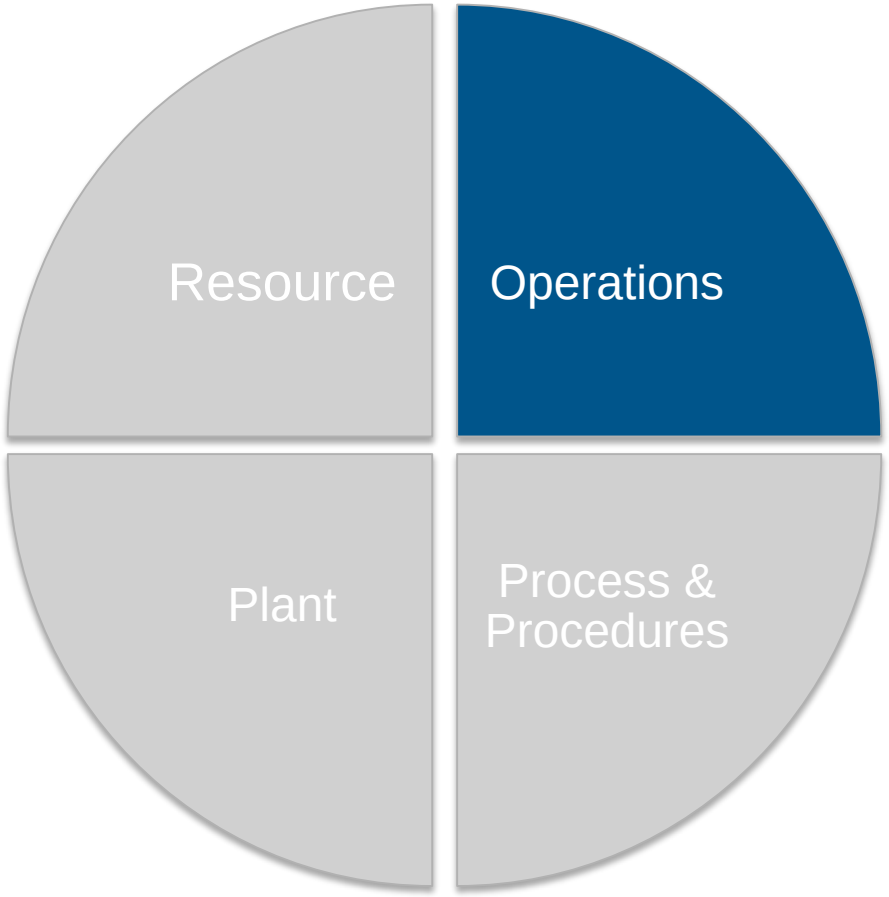
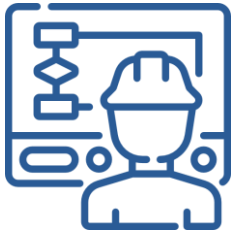
Challenges





- Change of operational requirements
- Changing environment
- Hazard types and risks will change
- Parallel activities e.g. dismantling, construction and decommissioning

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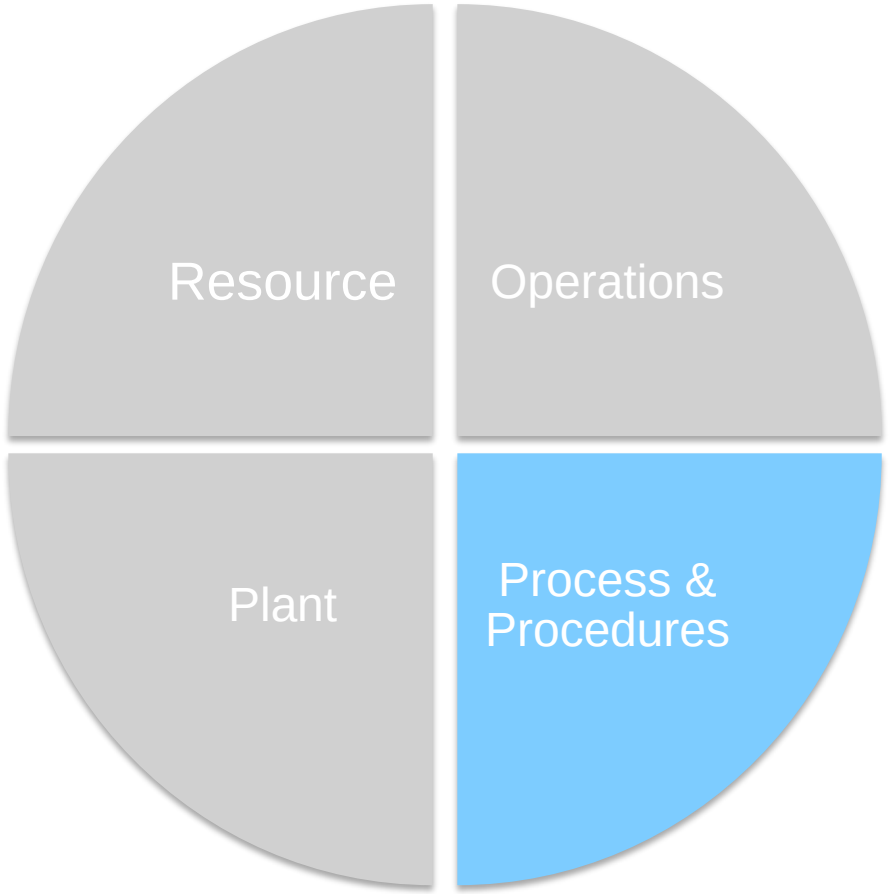
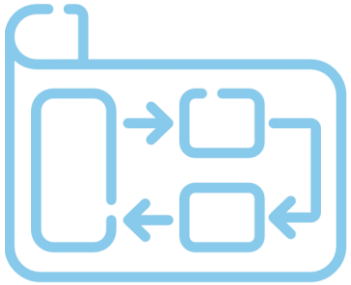
Challenges





- Compliance with specific UK Nuclear License Condition for Decommissioning
- Not fit for purpose and/or need to be reviewed and amended
- Future changes to requirements e.g. standards

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Impacts to the Risk Assessment from these Challenges

- **Uncertainties** result in the risk assessment having to make worst case or overly conservative assumptions about the plant and radiological inventory. **Overestimating the risk**

- Plant **unable to support claims/demands of safety case and operations**
- **Selection of the most onerous option/method** to decommission e.g. introduction of unnecessary over engineered controls, high costs and implementation duration

- Overly complex**, inflexible safety justification**
- **This overall can increase the programme duration and costs**
  - further ageing of facilities, structures, systems and components
  - further delays and costs

Solutions

- **Design for decommissioning**
  - Assists with decommissioning operations and managing plant
  - Consider ageing and obsolescence

- **Knowledge transfer and organisational review**
  - Mitigate loss of information and experience (resource)
  - Manage uncertainties

- **Review processes and procedures**
  - Enable proportionate and pragmatic approach with a degree of flexibility
  - Encourage holistic arguments and balance of risk (conventional/radiological)
  - Review safety assessment methodology

- **Integrated safety and Design/Engineering Teams**
  - Aid the management of emergent issues efficiently (changing operational environments)

Solutions

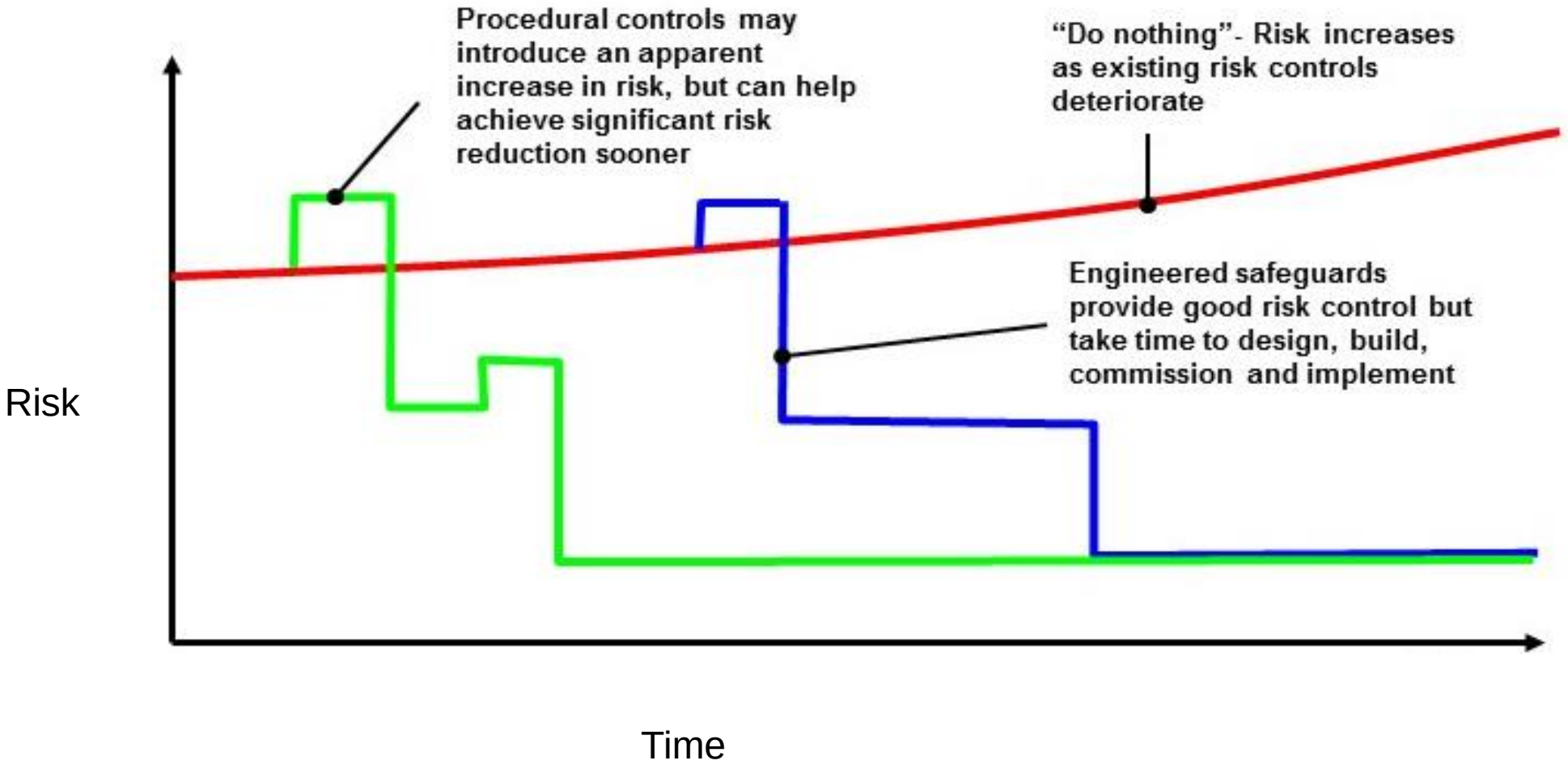
- **Safety Case Strategy**
  - Identify potential issues e.g. uncertainties and management method
  - Inform option studies

- **Overarching Safety Case**
  - Establish operating overall envelope, staged to develop knowledge and approach, provides flexibility

- **Optimisation of safety case as decommissioning progress**
  - Periodic review to manage changes
  - Reduction of claims and plant and systems to maintained as safety systems
  - Digilisation to drive efficiency

- **Fit for purpose solutions**
  - Consideration given to the use of safety measures which are not as high on the risk reduction hierarchy given the overall context of decommissioning (see adjacent figure)

Solutions – Proportional and Pragmatic Approach to Safety Case



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Project Example 1 - Legacy facility with uncertainties

Challenge

- Internal transport flask is located on top of an inspection cell, position and lid unsecured.
- The flask **contents are unknown** with **poor records and information**.
- Decommissioning is due to commence.

Risks

- Flask falling from height with a **loss of contents** to the main access/egress route to/from facility.
- The **most conservative consequences** had to be **assumed** for the initial risk assessment**.**
- The **withstand** of the cell and hoist structure to certain fault conditions e.g. seismic events has to, initially, be **based on the most conservative consequences.**
- Potentially **significant shortfall** and decommissioning project burden.

Project Example 1 - Legacy facility with uncertainties

Solutions

- Establish a simple yet safe method which could be quickly deployed to determine the flask contents.
- Enable the risk assessment and safety case to be updated and potentially a more pragmatic decommissioning strategy to be devised.
- Solution = **use of an operator and very simple engineered long reach tool**
- **Short-term increase in the potential risk to the operato**r but long-term risk reduction and benefit.
- Flask contained a solid item resulting the worst case consequence assessment being revised, the shortfall being less onerous and issue and decommissioning strategy being updated.

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Project Example 1 - Lessons Learnt

Solutions

If uncertainties exist, especially with the radiological inventory, conservative assessments can drive strategy and unnecessary time delays and costs.

Therefore the project should aim to reduce the uncertainty as early as possible in the project and consider:

- Use of non-complex engineering solutions
- Consideration should be given to safety features lower down in the risk reduction hierarchy if savings can be achieved in terms of programme time
- Short term increases in risk to make long-term benefits
- Use of a dynamic risk assessment to deal with emergent issues

Project Example 2 - Challenge

- Fuel free reactor graphite core dismantling of a which is currently in a state a care and maintenance

- There are inherent risks associated with dismantling and retrieval of irradiated material some of which is designated as ILW from the reactor:
  - Direct doses to the operator from exposure to ILW and in particular components with high dose rates.
  - Volume of graphite material and duration of operation poses normal operations dose issues.

- Direct dose from a component radioactive ‘hot spot’ as the exact location is unknown

- The highly irradiated components may not be revealed until the operations are well underway

- Other issues include: ageing and uncertainty with the condition of the plant

- Can the optioneering and Safety Case justify dismantling now rather than later?

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Project Example 2 - Solution

- A **detailed option study** was undertaken and informed by the **initial safety assessment**. This option study devised and substantiated the project strategy

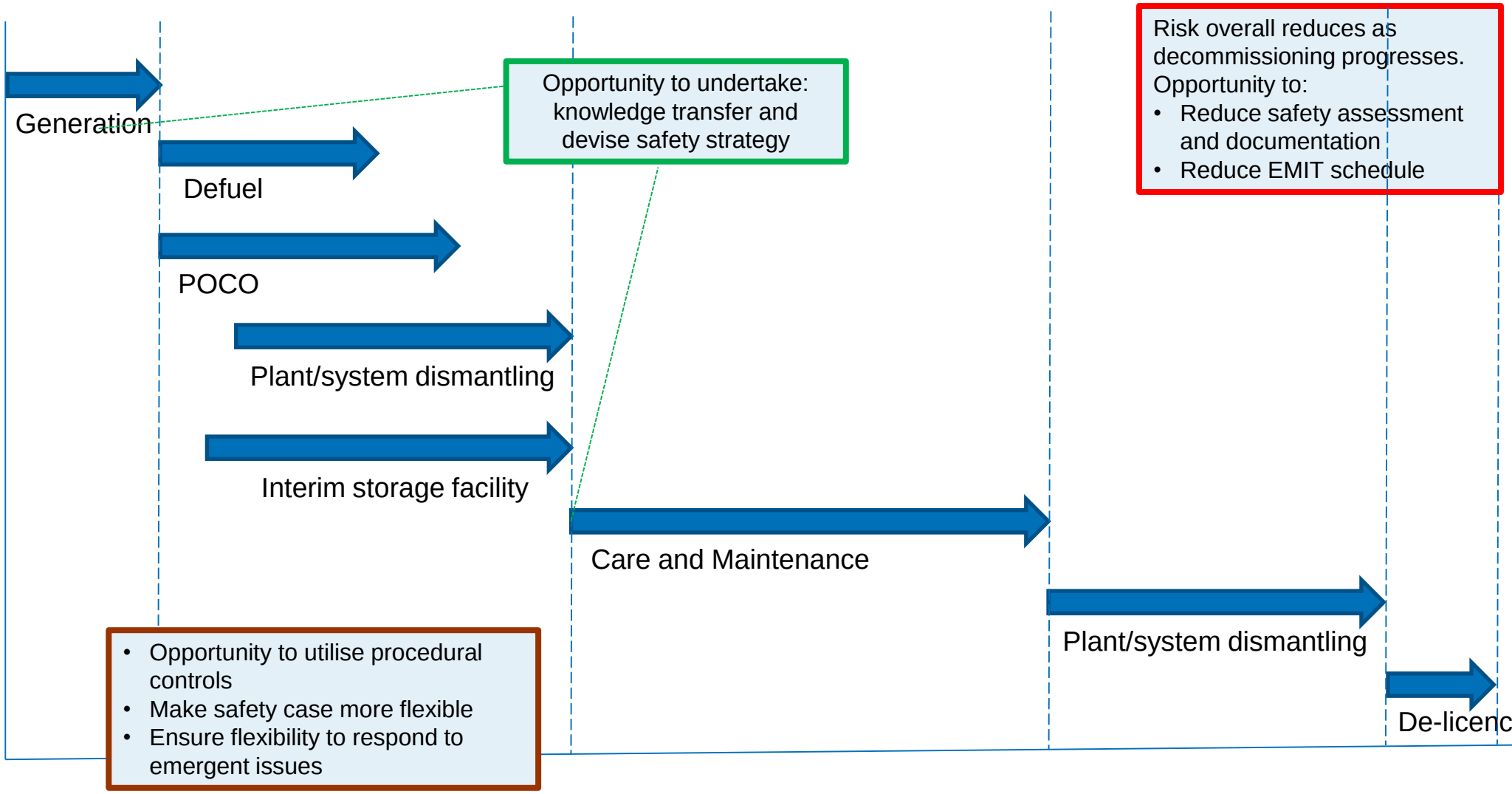
- Safety justification was provided through the following approach:
  - Planning and production of a safety assessment strategy
  - Utilising **significant operational information and knowledg**e to inform decision making and risk assessment.
  - Producing **radiological consequence assessment early** in the project to identify potential problem areas.
  - Designation of appropriate controls to manage the risks e.g. using **both operators and simple commonly used cost effective engineered solution**s
  - Undertaking a **staged approach to dismantling and decommissioning**.

Summary

- The risks stay approximately constant for operating facilities, whereas there is often an increase during decommissioning and clean-up activities with a net reduction in the long-term

- Use this transition period as an **opportunity to** produce a more dynamic, proportionate and pragmatic safety case which provides flexibility in terms of its update and operating envelope, and a safety case which can be easily understood

Periodic Review of Safety – provides the opportunity to plan and optimise the safety case



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Attributes

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