Managing uncertainty in a complex and hazardous environment: experience with the Pile Fuel Cladding Silo

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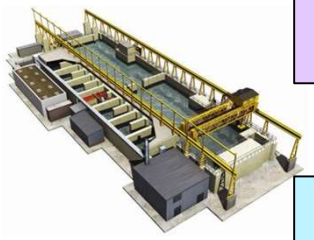
Overview of the Sellafield site

Sellafield Ltd

Pile Fuel Reprocessing



Windscale Piles

Pile Fuel Storage Pond

Pile Fuel Cladding Silo

Reprocessing Plant

Uranyl Nitrate purification

Uranyl Nitrate export

Plutonium Finishing & Metal Production

Butex Distillation

Spent Solvent Storage

HA Evaporators

HA Liquor Storage

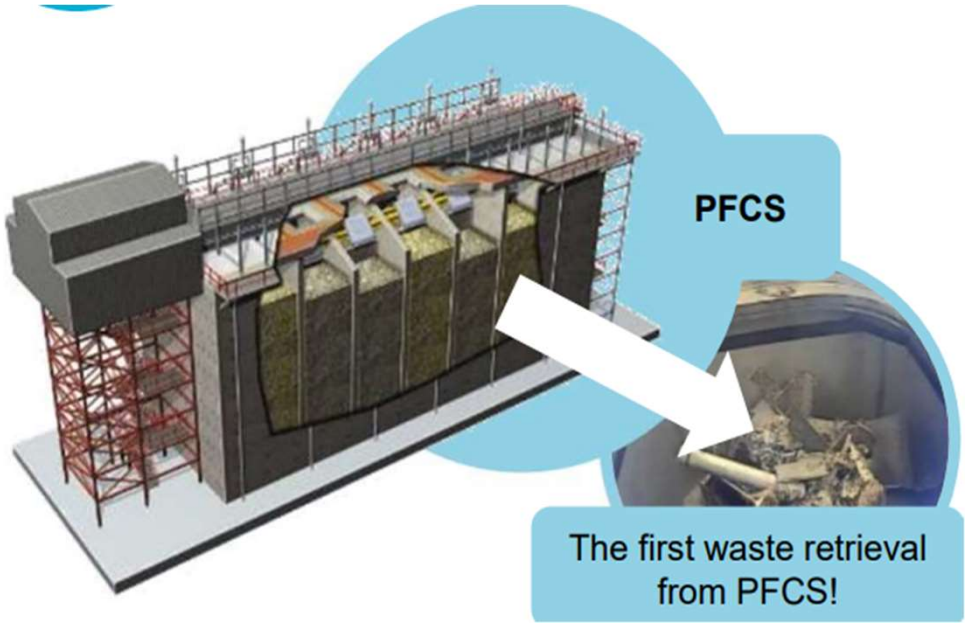
MA Tank Farm

LA Effluent Treatment

Sea Discharge

Background information: Pile Fuel Cladding Silo (PFCS)

- Commissioned in the 1950s as the first dry Intermediate Level Waste (ILW) store at Sellafield.
- Waste was tipped in 1952-1964.
- 6 compartments, containing almost 3,200 cubic metres of solid waste
- Waste is a mix of
  - graphite and aluminium cladding from decanning operations of pile fuel
  - Before MSSS was available, Magnox cladding swarf was tipped into the silo
  - There are also other wastes from that time period stored (contaminated items)



- This is a representation of the facility (PFCS)

Work already undertaken on the facility

Clean and stabilise

Silo door installation

Retrievals Access Penetration

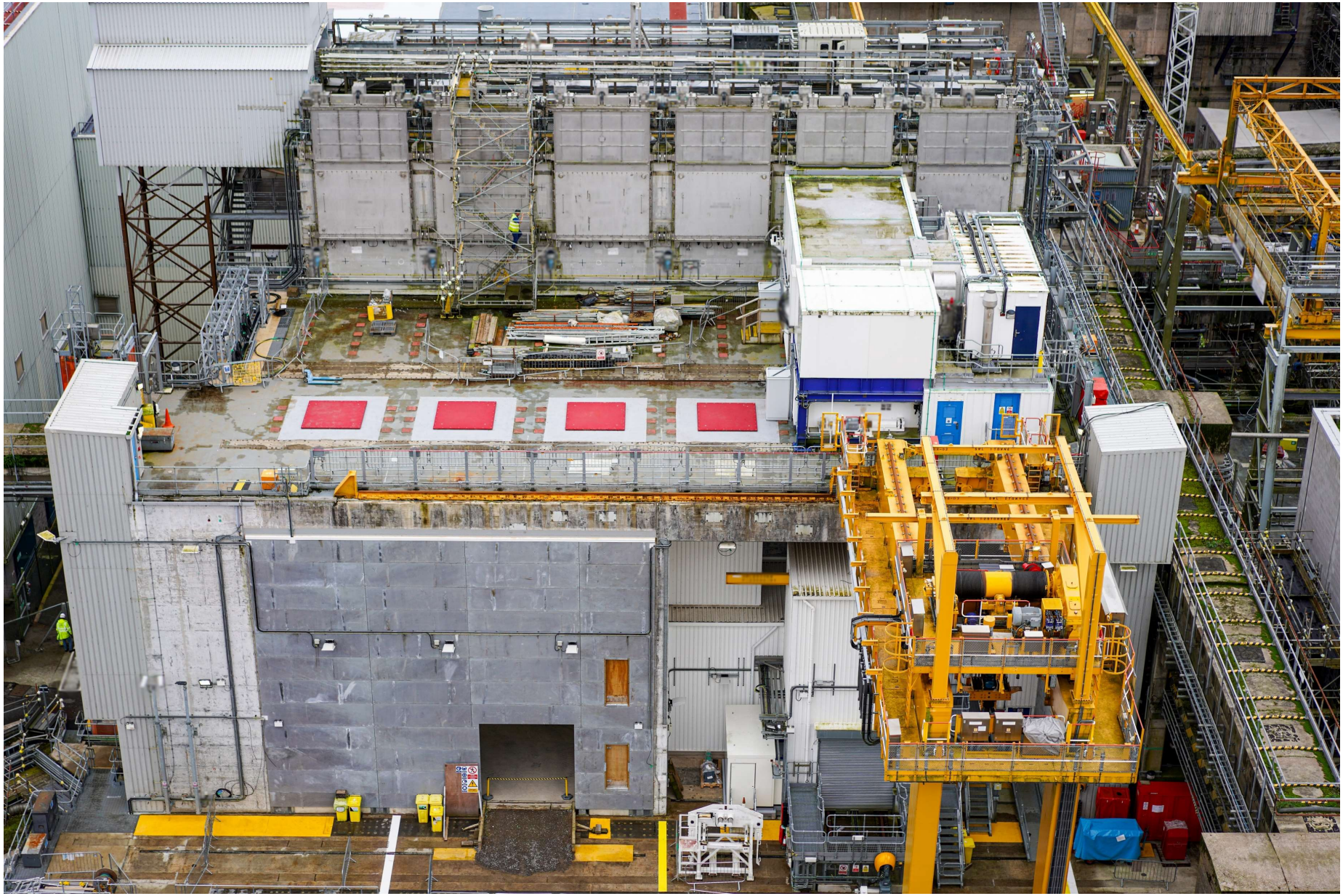
Visit during installation period

Retrievals Equipment Installation

Project Timeline

Dates	Activity
2002-2014	Initial Legacy Ponds and Silos Early Remediation Project (LP&SERP) Project design phase of works
2014-2015	Design complexity in initial solution led to Programme Pause and a Strategic re-think
2015	Project Pause completed and established a new Programme framework, Lead and Learn approach and simplified Early Retrievals design (using Commercial Off The Shelf components)
2015-2019	Early Retrievals Project made then delivered a fully installed Retrievals Unit to the PFCS facility (see next slide)
2019-2023	Inactive and active works commenced to bring Retrievals Unit into service. Completion of Interim Storage facility. Provision of offline Unit B Test and Training Facility
2023	Successful Retrieval of the first filled Waste Container from the PFCS Facility and export into Interim Storage Facility

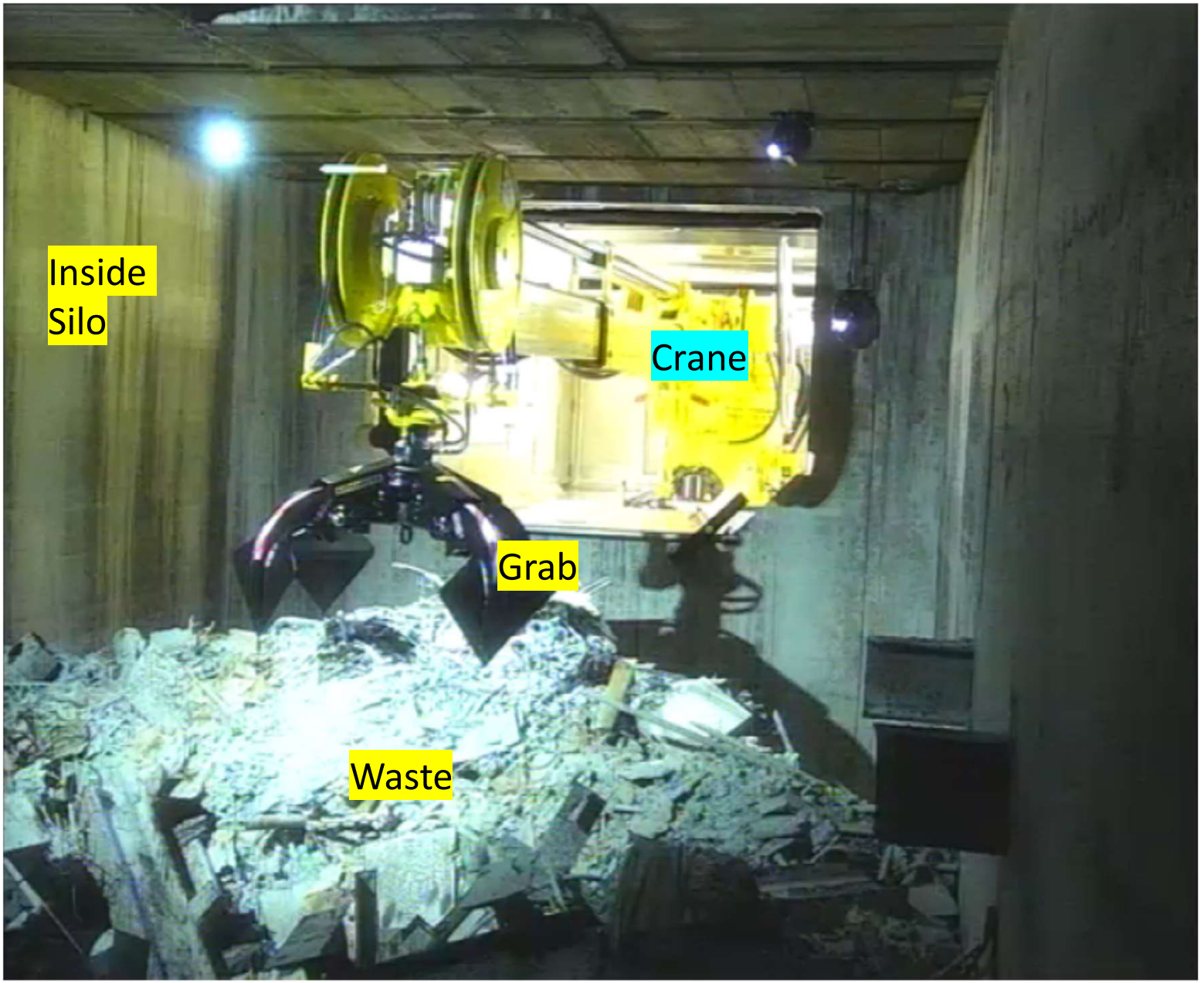
PFCS Waste Retrievals System



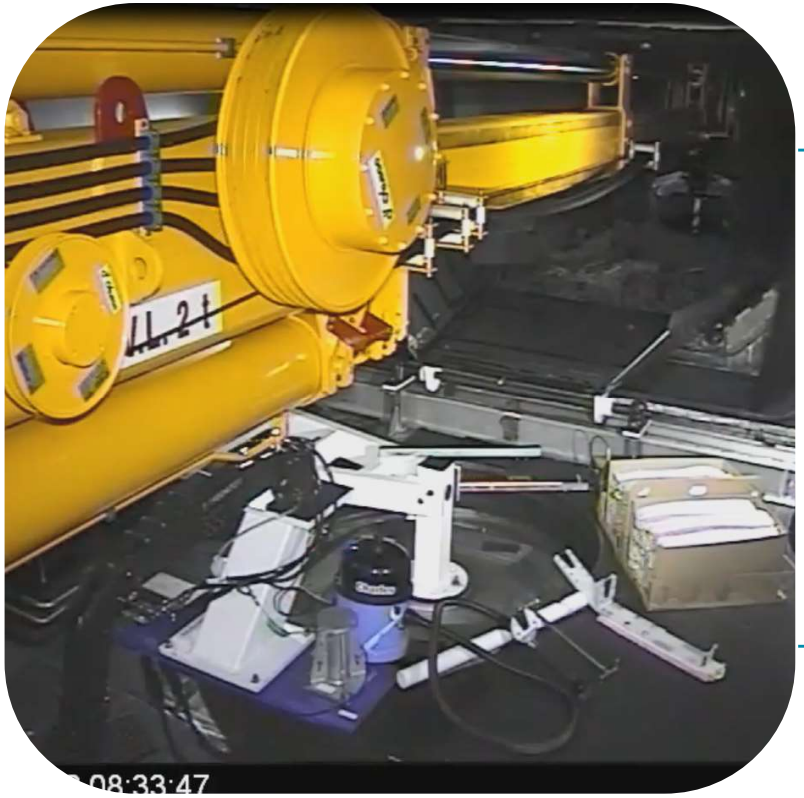
Waste retrieval

Screen grab of video showing waste from inside the silo.

This shows the waste retrievals crane (yellow), the grab (black) and the waste itself (grey)



Retrievals Crane: what happened?



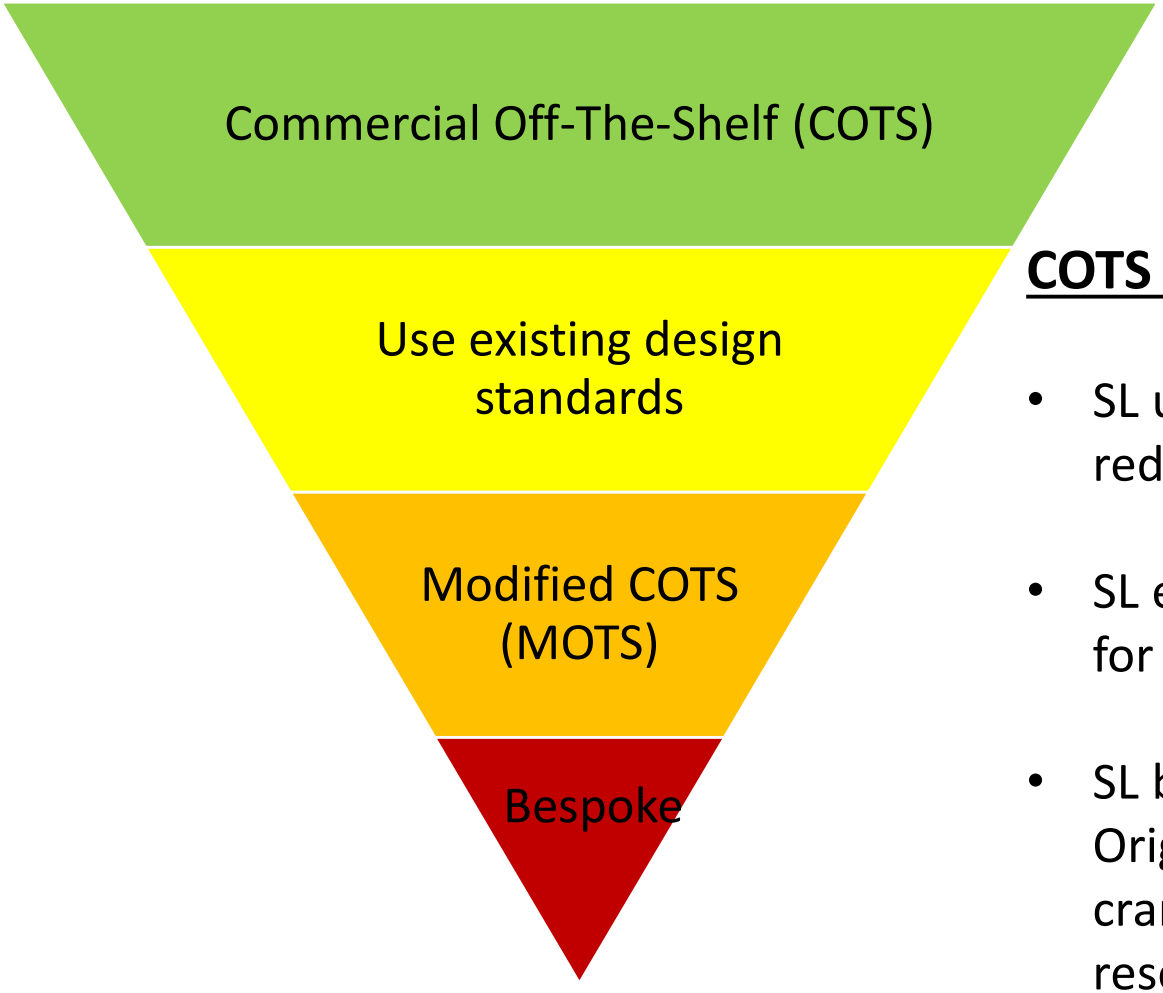
Double Blocking

Failure to Retract

Timeline of crane recovery

- Initial event: Waste Retrievals Crane failed to retract
- Damage to rope observed
- Diagnostic tests leading to successful retraction of crane under its own power
- Parallel investigations regarding rope condition and suitability for winch retraction (Operating Instruction in place for this method)
- Crane fully retracted into Main Containment Room
- Silo door closed (to control atmosphere in silo and allow access to Main Containment Room)
- Surveys and inspections of crane – required personnel entry to Main Containment Room.
- Investigations
- Agree, design and implement required repairs (again with personnel entry)
- Recommission
- Retrieve first box of waste
- This took over 12 months to fully return to retrievals (2023-2024)

Learning From Experience : crane recovery



COTS Equipment:

- SL utilised COTS crane as part of the redesign works (not bespoke)
- SL ensured suitable for the application (fit for purpose)
- SL built good relationship with the Original Equipment Manufacturer (e.g. crane supplier) to enable modifications to resolve problems identified during use

Lead and Learn Approach

- Retrievals from the facility (PFCS) has been set up using a lead and learn approach
  - Safety culture means that safety is paramount, but with “lead and learn” it is accepted that there will be challenges arising during the full lifetime of the retrievals operations.
- With this approach it was important to set initial expectations up for timescales
  - Lead and learn means that problems are solved as they are encountered; this provides flexibility to address uncertainty present with this novel and complex project
  - Work done upfront to understand overall suitability of the equipment prior to installation
- There are two retrievals machines
  - First unit is currently installed on Sellafield site and undertaking retrievals
  - Second unit is at the supply chain site and is being improved with learning from the first unit
  - Second machine will then be transported to then installed on Sellafield site so two compartments can be accessed at once
- Sellafield works hard to resolve issues as they emerge and clearly explain how we have addressed these
- Subsequent slides show a case study for problem solving and the facilities Sellafield has available for this

How to address uncertainty : a case study looking at lead and learn approach

- Sellafield have used lead and learn, with an appropriate safety culture to ensure that changing conditions are identified and responded to
- The following case study is an example of this approach
- Dust management was recognised as a challenge, but it was not originally anticipated to impact significantly on the retrievals operations
- As retrievals operations progressed, it has become evident that this issue could impact on the retrievals operations over the long time period of retrievals
- Therefore a solution is required to maintain progress

Case Study: Dust Plume

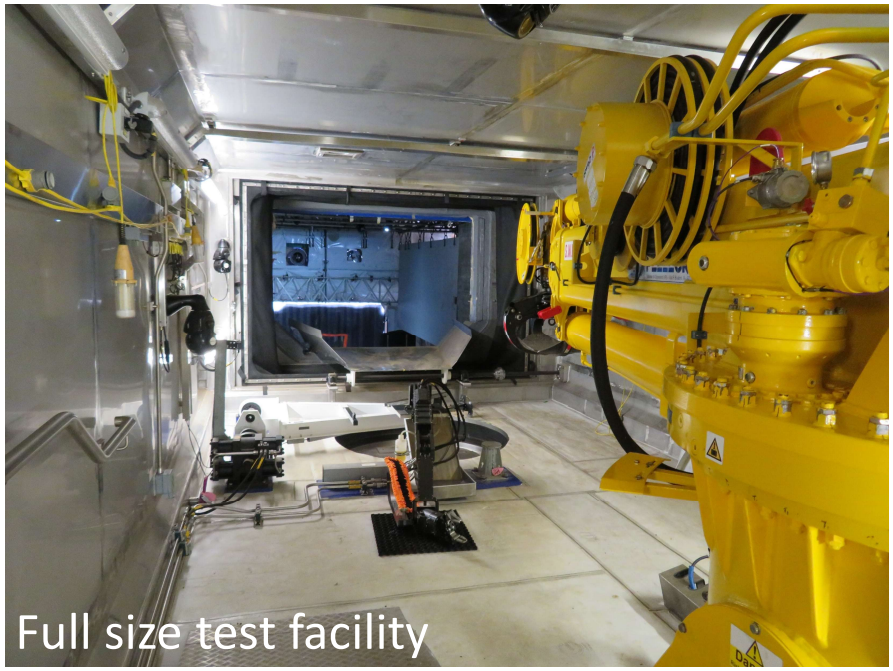
- These images show the problem being faced with dust

- Waste being retrieved

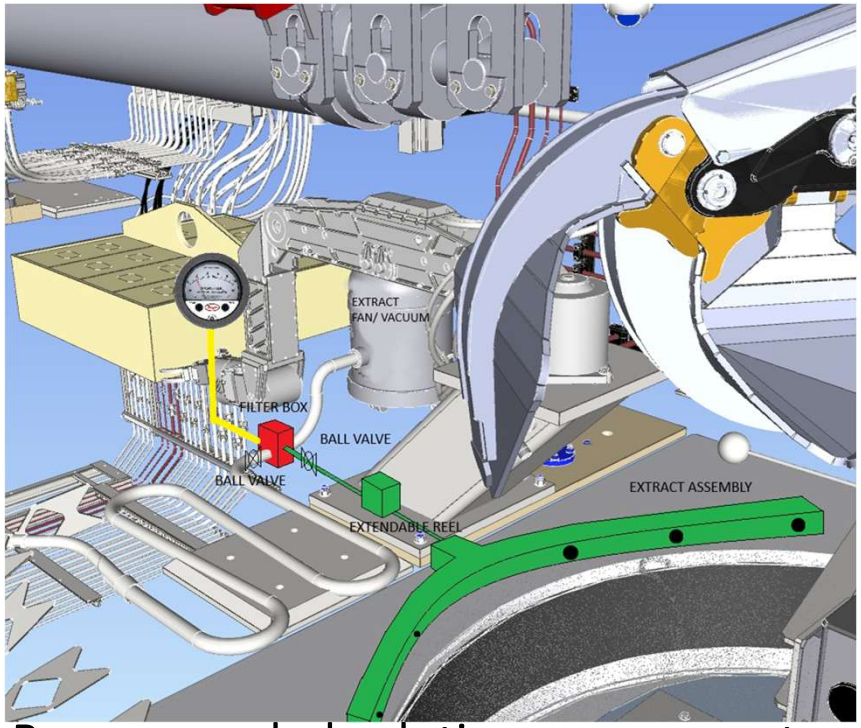
- Dust plume generated when waste is put into the container

Dust: Solving the problem

- First, a problem statement is defined by personnel familiar with the facility.
  - This is sufficiently detailed that a project team (from Sellafield and the supply chain) can devise solutions
- Constraints are identified through collaboration between the project team (responsible for developing this solution) and facility representatives (operational teams)
- Solutions are developed from a test rig up through prototyping then up to full scale
- Recommended solution identified



Full size test facility



Recommended solution: vacuum extract

What is needed to make this happen?

- There needs to be a dedicated team to focus on this problem solving work with access to relevant experts from the facility and relevant experts from Sellafield (e.g. covering engineering design)
- Total time for this was 6 weeks to get to recommended solution

- The Sellafield Engineering Centre of Excellence has specific facilities for trial work to ensure quality output

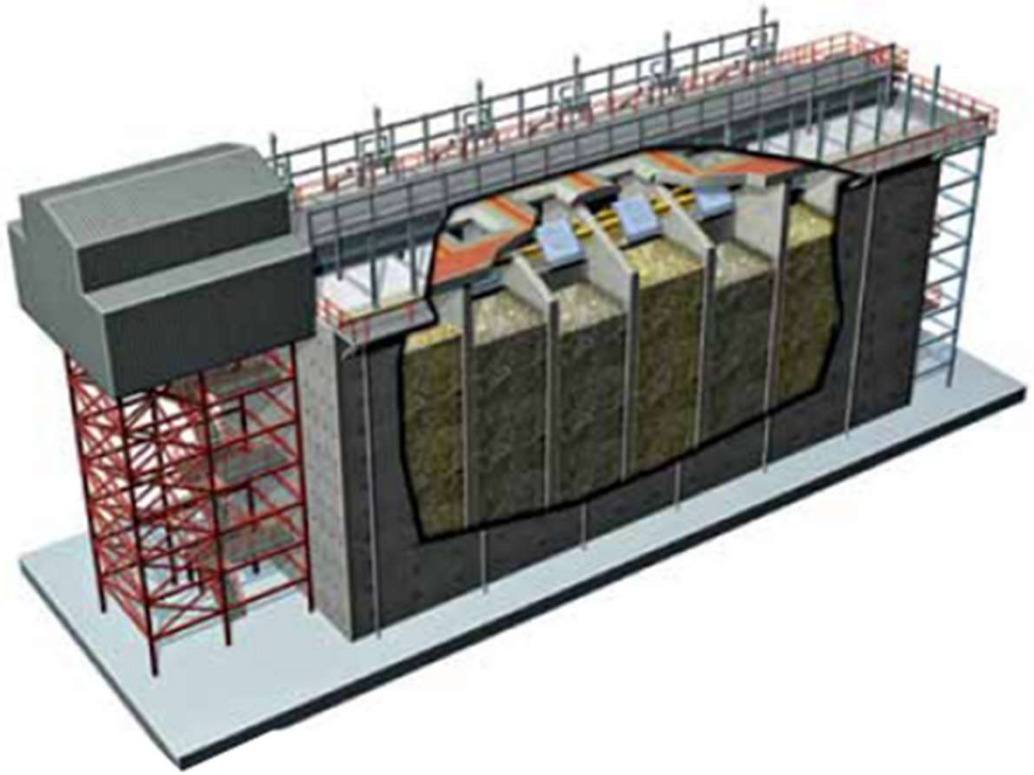
How to avoid “silo” mentality

- The project team is comprised of Sellafield resource and supply chain resource to ensure we have the right mix of skills to deliver this work
- Safety personnel available directly as part of the project team and from the SHEQ (Safety, Health, Environment and Quality) Directorate
- Other Sellafield teams have been aligned through focus on achieving the key outcomes for hazard and risk reduction from the facility
- These outcomes are identified as “Key Decommissioning Milestones” and recognised across Sellafield as important deliverables: these are used to devise annual targets at company level

Retrievals progress to date

19

Boxes removed



~2,200

boxes will be required to empty all 6 compartments

Summary

- The project is in a challenging aged facility with uncertainty regarding the waste behaviour
- A “lead and learn” approach has been adopted
- Having the right people with the appropriate skills mix is essential
- Management places trust in the operators to ensure the work is delivered
- Sellafield works closely with our regulators to keep them informed of the current status of the work
- It is important to have the right mix of personnel engaged on the project, but also to ensure that focus is retained on the overall delivery