



Nuclear Engineering Services Limited

ENGINEERING INNOVATION



R & D - Cost Minimisation and Solution Optimisation

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Presented by:

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NESL Mechanical Engineer Responsible for
SEP Cave Retrieval Development Work.

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NESL – Who we are

- NESL Operate in 3 Key Business Divisions:

NUCLEAR

DEFENCE

PJS

- Employing Some 250 Employees Across 3 Locations
- Facilities in Wolverhampton, Risley and Westlakes in West Cumbria



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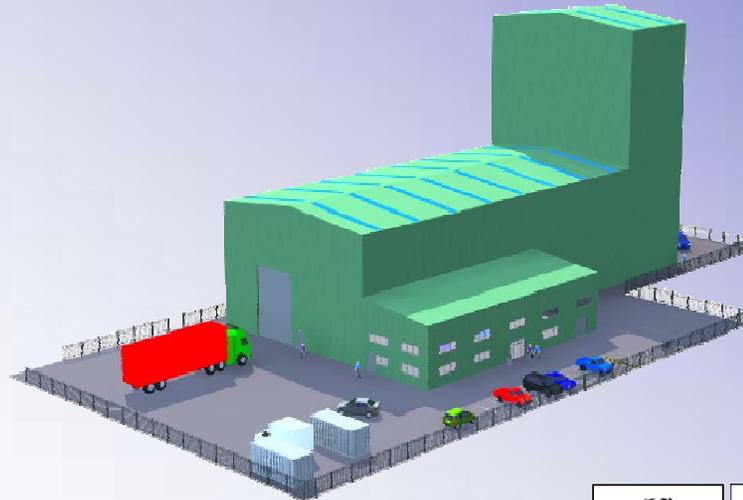




NESL – Who we are cont...

- **New Facility under construction in Beckermat**
- **Full Turnkey Solutions – Optioneering through to Installation**
- **Over 50 years Nuclear Experience – John Thompson Nuclear Components, NEI Thompson, Rolls Royce**

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Waste Storage Facility “The Challenge”

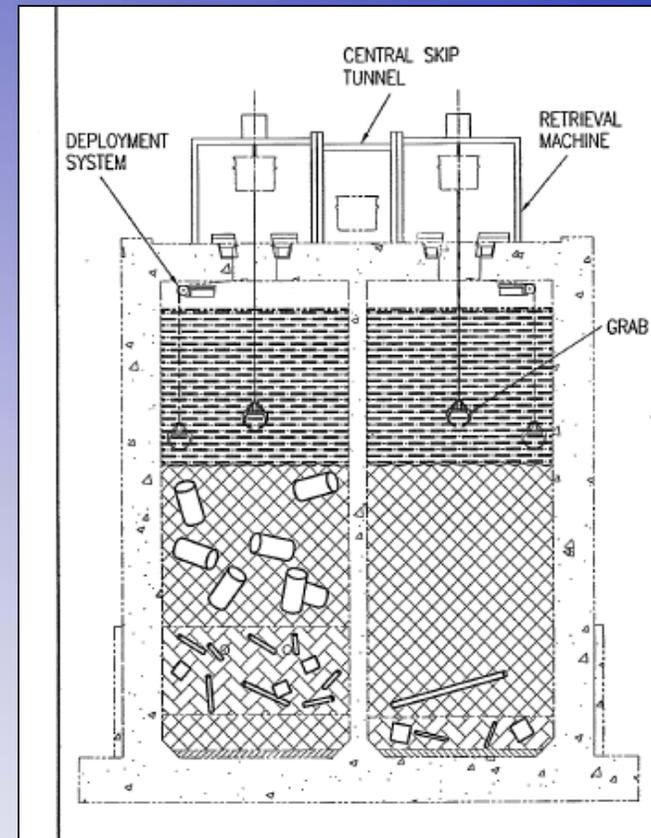
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The Challenge

- Retrieval of ILW from:
 - 22 Silos mainly above ground
 - Waste stored underwater
 - Why? - For encapsulation at Silo Direct encapsulation Plant (SDP)



The Challenge

- Constraints:
 - Space Envelope
 - Weight
 - Structural Issues
 - Waste Classification
 - Safety Case Issues
 - Time



Waste Storage Facility Proposed Solutions

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Optioneering

- **Smaller Caves considered:**
 - Size reduction issues
 - Repeated Flask Movements – Increasing Dosage Uptake
- **One Large Cave:**
 - Not sufficient to complete retrievals within time envelope
- **Multiple Caves:**
 - Space and Structural constraints restricted cave numbers
 - Impede throughput
- **3 Caves:**
 - Dedicated to similar sets of chargeholes
 - Acceptable throughput within time envelope
 - Allows for staged retrieval process



Waste Storage Facility The Solution

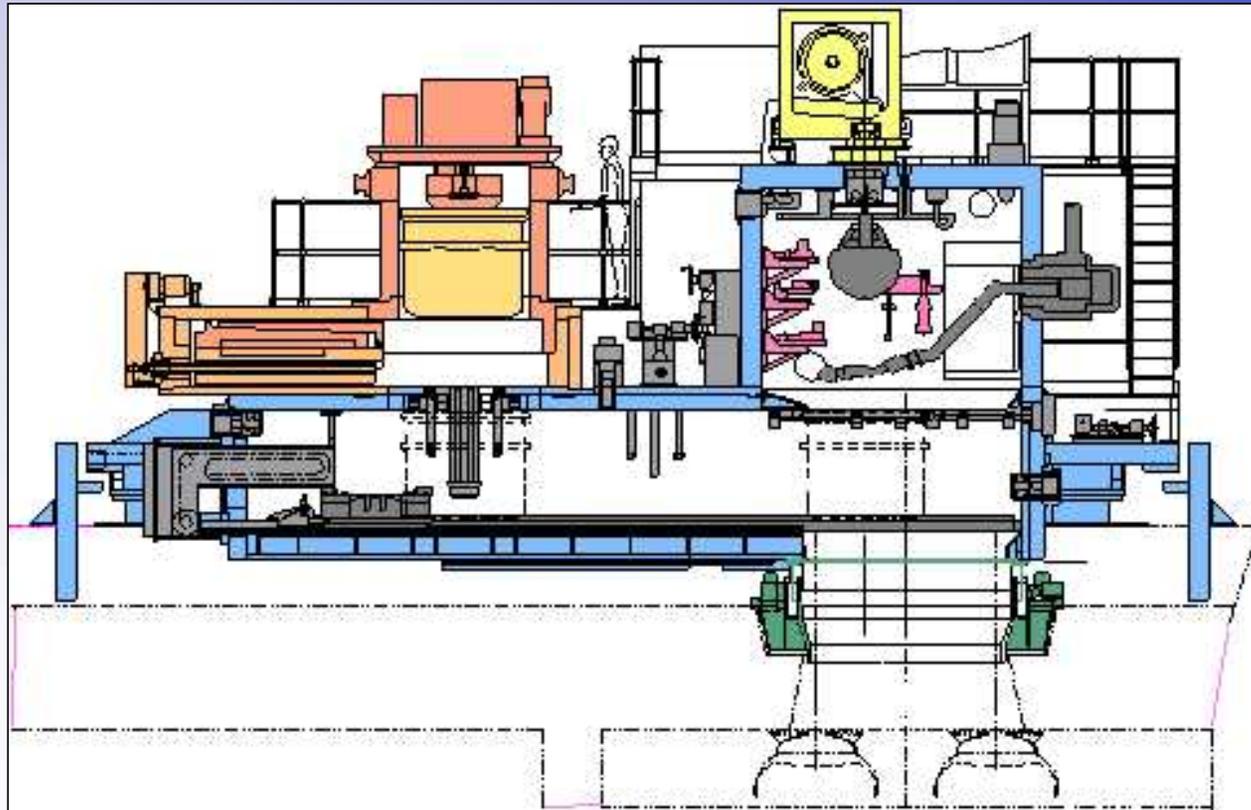
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Concept Design

- 3 Silo Emptying Plant Mechanical Retrieval Systems



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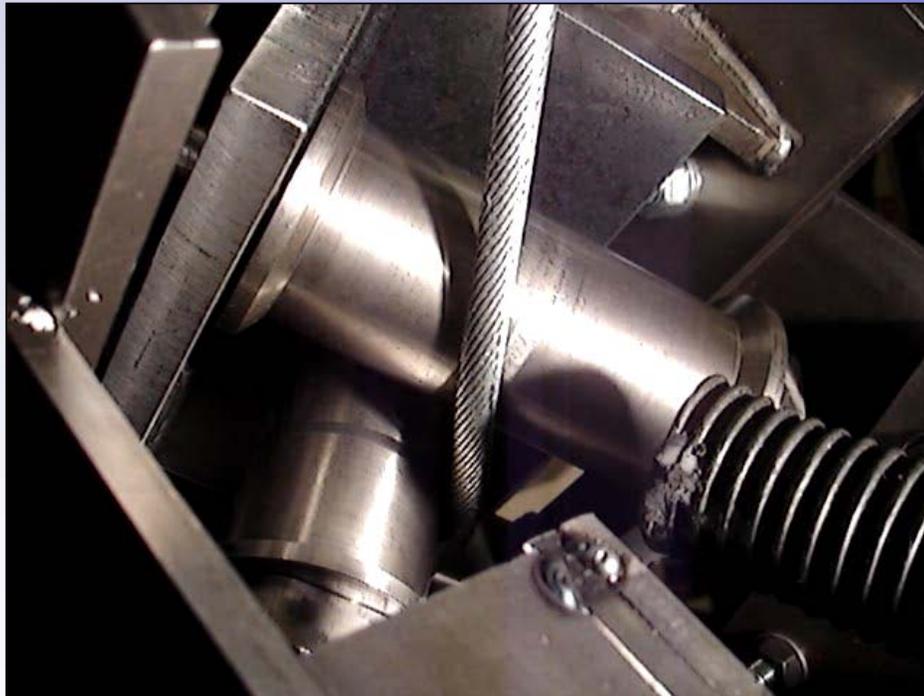
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Critical Design Area's

- Critical Design Area's include:
 - Waste Retrieval Philosophy
 - Flat Retrievals – No Craters
 - How is this Achieved?
 - Rope / Grab Manoeuvring
 - Grabbing Effects
 - Rope specification / evaluation
 - First Stage Deployment (FSD)
 - Waste Levelling - Raking
 - Second Stage Deployment (SSD)

Rope Development



- Choosing a Rope: Expertise sought!
 - Design Requirements
 - Handling Features
 - Endurance Test 1 – Short Length
 - Endurance Test 2 – Longest Working Length (Multiple Bends)

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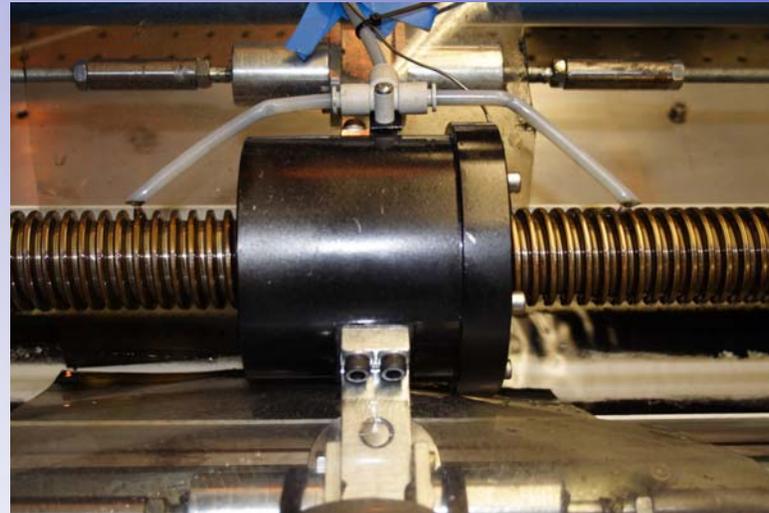


First Stage Deployment Leadscrew / Nut Development



Existing “Proven”
design concept adopted
for twin drive system
BUT No Lubrication!

Tribological Expertise
required to obtain
optimum Leadscrew
& Nut Materials



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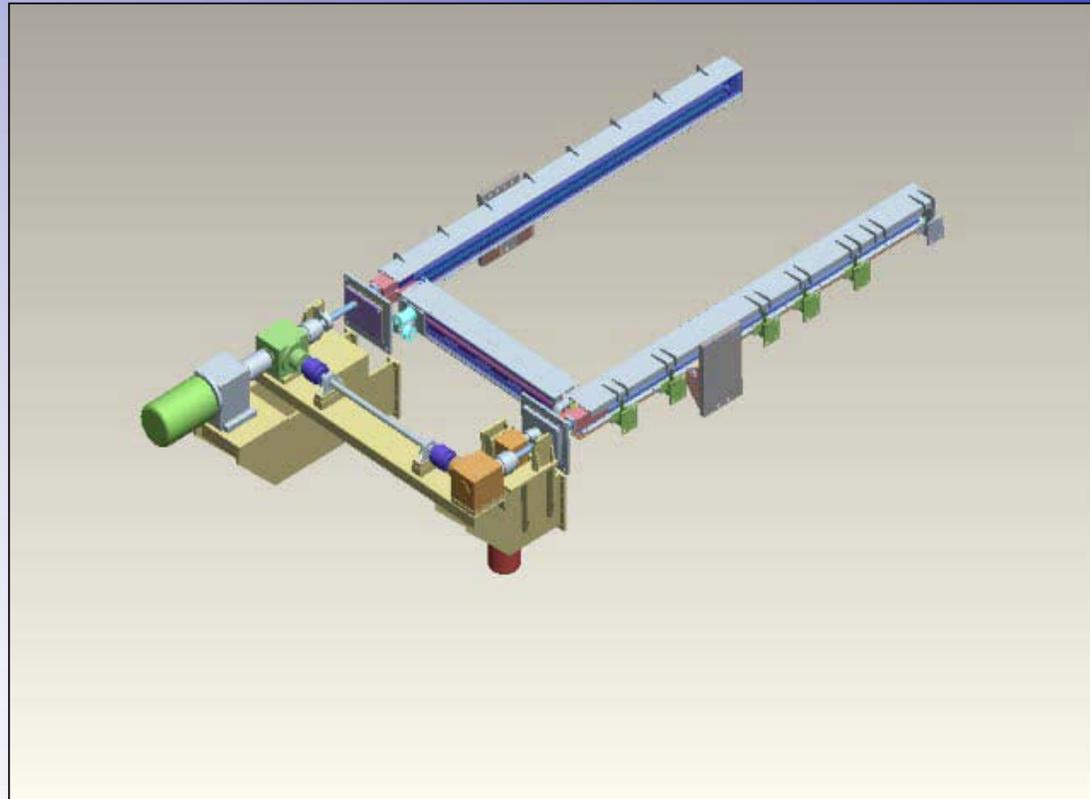




First Stage Deployment (FSD) Concept

Single point entry
for rope from hoist
is unacceptable for
Retrieval Philosophy
(Flat Retrieval)

FSD deploys
the rope & grab
to any position
within the Silo
Retrieval Aperture



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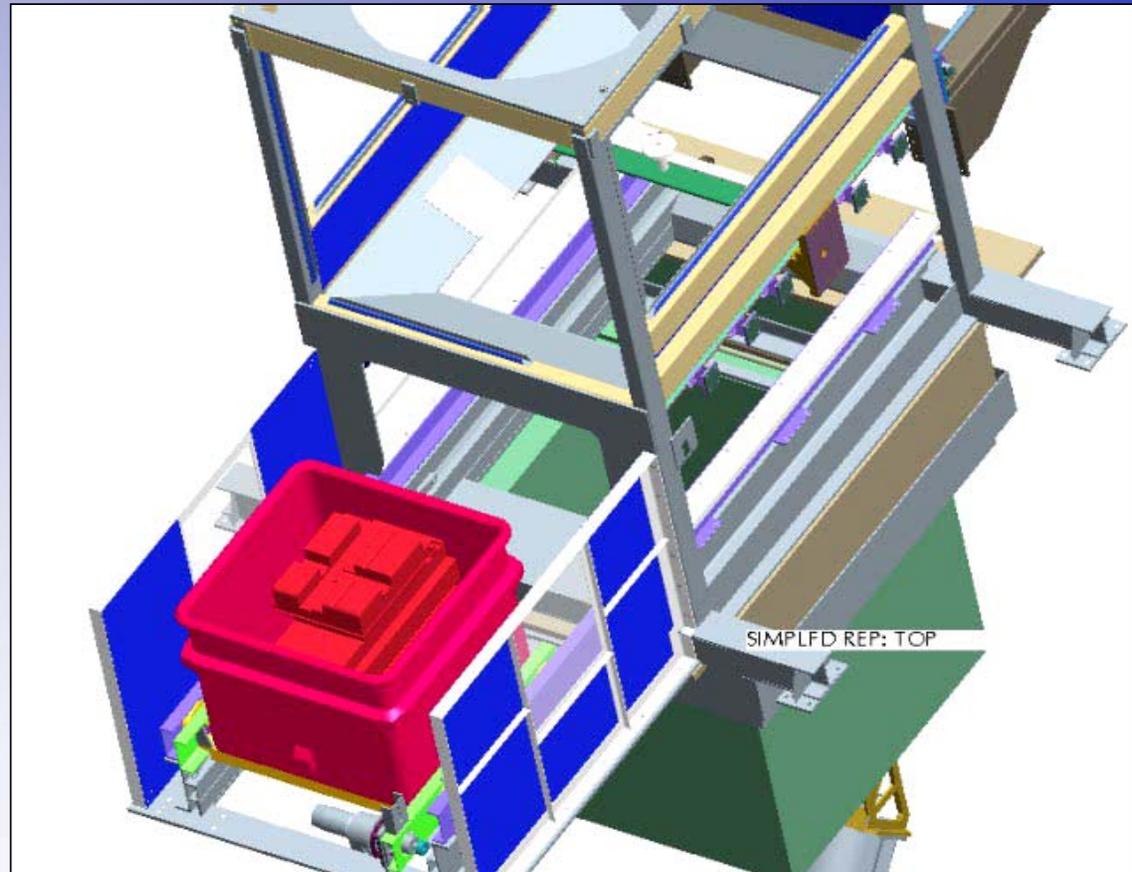
Rake Deployment Concept

FSD Clears an Opening for Rake Deployment Into the silo.

This allows the raking operations to begin, resulting in a full ullage clearance.

Now this creates the space envelope for the SSD unit to be deployed

First Stage Retrievals is now completed



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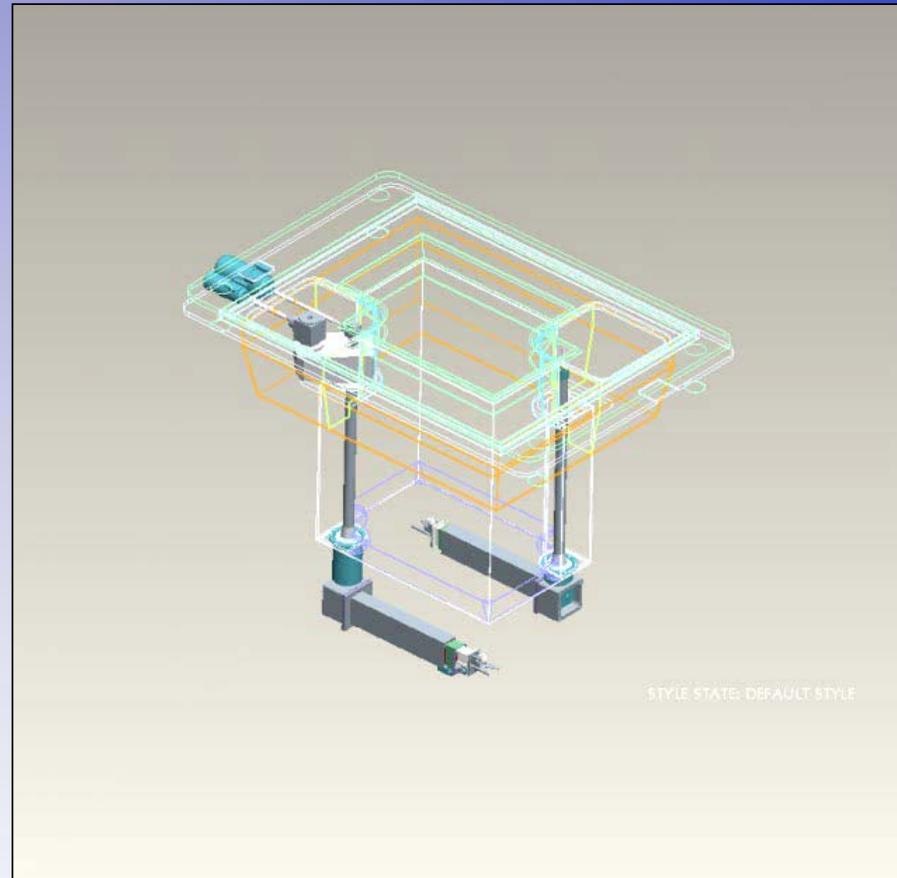
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Second Stage Deployment (SSD) Concept

The SSD can now be deployed beginning the main waste Retrieval campaign. Using the SSD the rope and grab can now reach The silo extremes resulting in full coverage and a “Flat Bed” waste retrieval.



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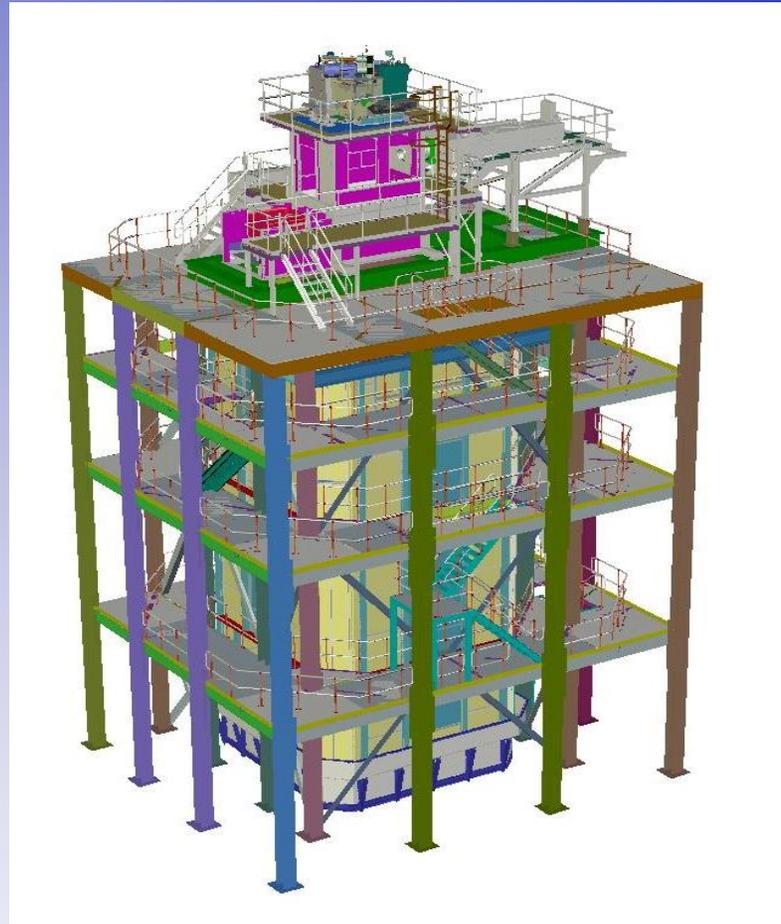




Silo Replica Retrievals Rig Concept

With the design concepts now being developed where will they be tested?

In preparation of the finished designs full testing is required. A typical silo replica is created along with the retrieval area of the SEP Cave



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Development Opportunities

- **3D Cad Model used to develop designs**
Good for space management and interfacing
However, cannot easily replicate the dynamics of moving items; e.g. the rope and hydraulic hoses.
- **Traditional Scale Model used to supplement the designs**
Good for dynamic behaviour of the retrieval process
Good visualisation to focus the attention
Proven to save costs (thousands vs hundreds of pounds)



Working Scale Model of Silo, SEP Cave & Deployment System



1:10 Full Scale Model



Evidence of Full Functional FSD & SSD Models

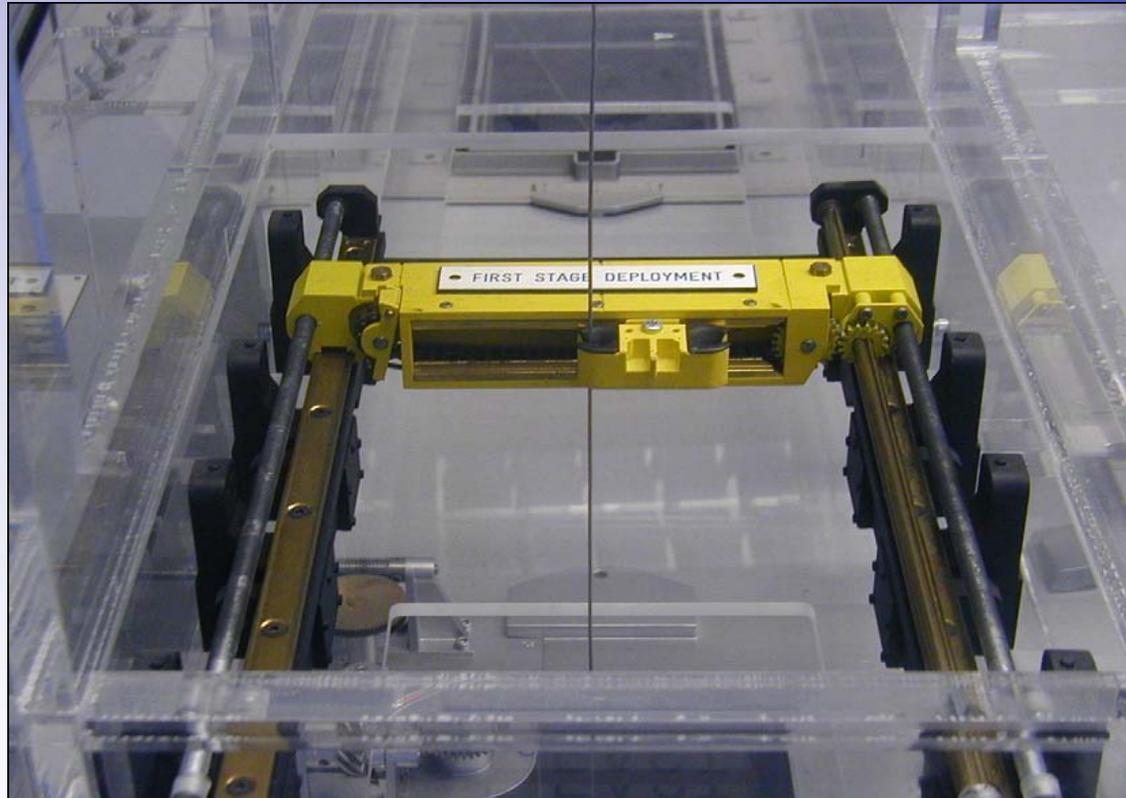
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Working Scale Model of First Stage Deployment



FSD Detail

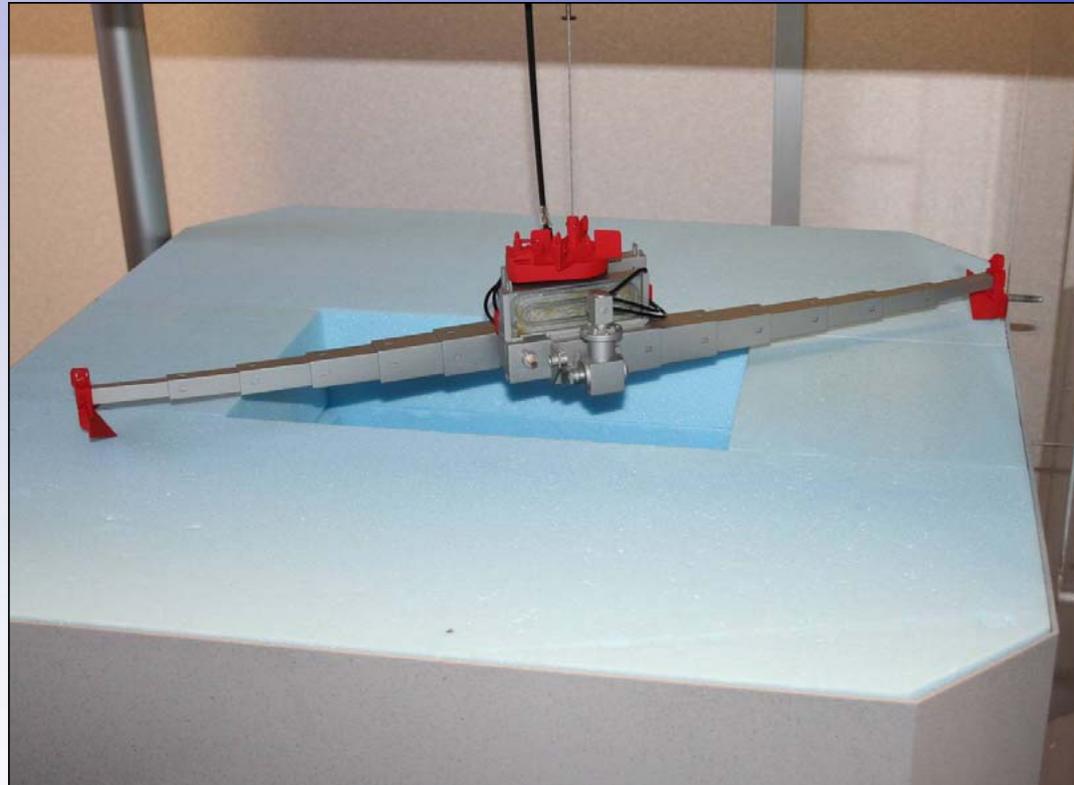
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Working Scale Model of The Silo Rake



Extended Rake Detail

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Working Scale Model of Second Stage Deployment



**SSD Model with
End Effectors (1 & 2)**

**SSD Model with
Selected End Effector 2**



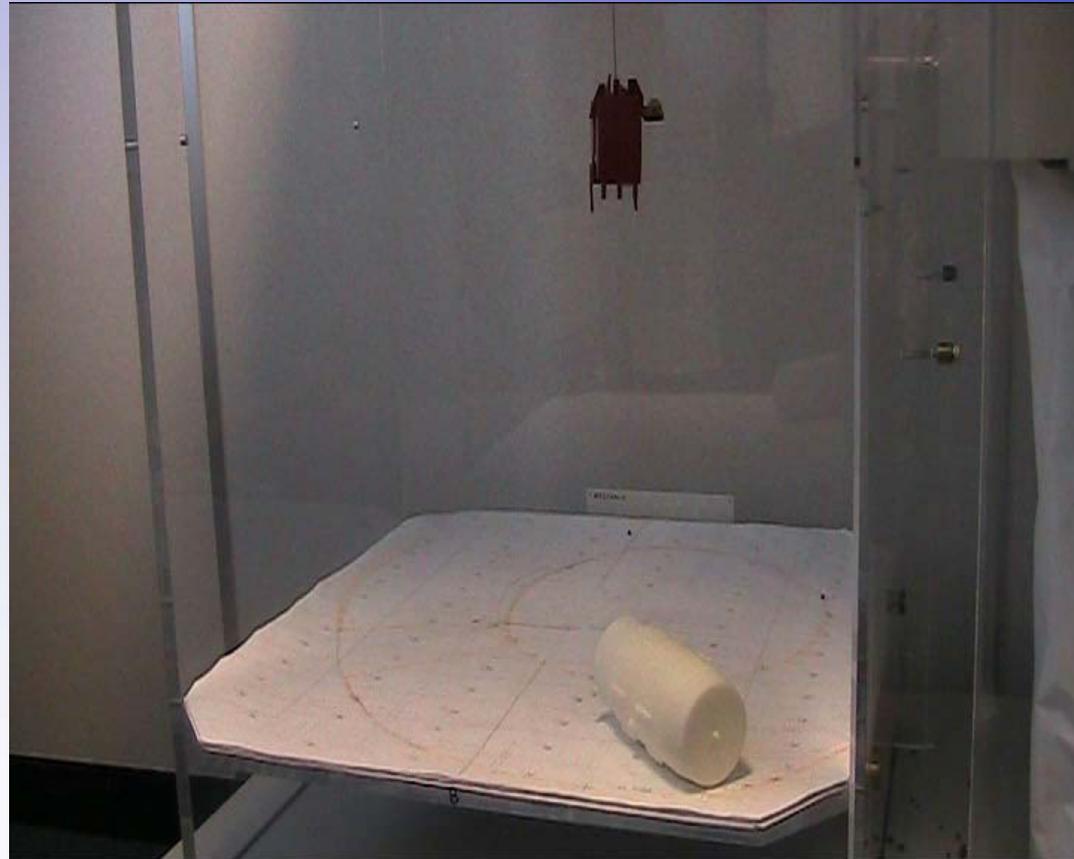
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Scale Model Video Showing Rope / Grab Deployment



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Scale Model to Actual Unit A Working Comparison



From Scale Model to Actual Workshop Build Items

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Silo Test Rig Manufacture



Full Scale Development Rig (19m high x 10m²)

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Second Stage Deployment Prototype Manufacture



SSD Extended Position



SSD Retracted Position

- Prototype proven with confidence - gained from Scale Model

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Second Stage Deployment working in position in Silo Rig



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Summary

The Route to the End Product

- Concept Design use of AutoCad 2D
- Scheme Design use of Pro-Engineer 3D and AutoCAD Promise-E software
- Functionality analysis with Traditional Full Scale Model (1:10)
- Detailed Design
- Manufacture and Testing



Any Questions



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