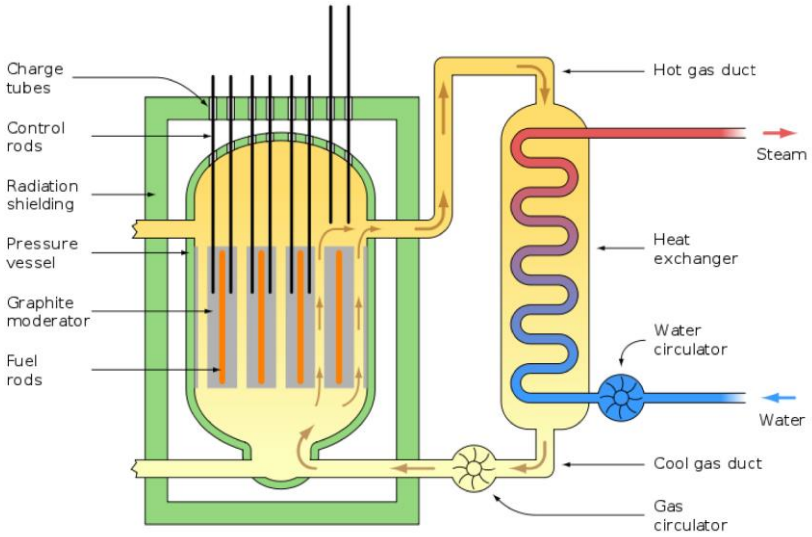
Studsvik

Berkeley Boilers Project

Studsvik Symposium April 2014

Berkeley NPP

- Twin Magnox Reactors
- Operating 1962 – 1989
- First UK commercial reactor to enter decommissioning
- Currently managed on behalf of the Nuclear Decommissioning Authority by Energy Solutions Inc.
- Boilers deplanted in 1997
- Full care & maintenance status by 2021
- Final site clearance in 2070’s



Berkeley Boilers

- 8 boilers (heat exchangers) per reactor
  - Length: 21 meters
  - Diameter: 5 meters
  - Weight: 310 tonnes
- Total activity of ~40 GBq/boiler
- Dose rates up to 50µSv/hr
- One boiler sized reduced on site in the 1990's
- Remaining 15 stored horizontally
- Lifetime plan was for boilers to remain until 2070's

Studies

Graduate Study 2010 – Treat Now?

- Government LLW Policy, 2007
  - Presumption to Early Solutions
- National Low Level Waste (LLW) Strategy, 2010
- For LLW metals the Best Available Technique is to treat/recycle
- Noticeable change to the site skyline
- Provides base load for supply chain
- Remains LLW if stored to final site clearance on site, so why not do it now?
  - Storage saddles in need of replacement,
  - Undue loading of reactor basement walls
- Funding available “in year”

Feasibility Study – March 2011

- Suitable route available that minimises road transport
  - Road to Sharpness Docks
  - Barge to Avonmouth as Sharpness access is limited
  - Sea going vessel to Sweden
- Route survey undertaken as part of the transport study identified challenges on route
  - Telephone cables
  - Utilities
  - Street furniture
  - Bridges/culverts
  - Tree trimming
  - Road closures

Stakeholders & Regulators

Early Engagement

- Office for Nuclear Regulation
- Environment Agency
- Site Stakeholders Group
- Swedish Regulator SSM
- Finnish Regulator STUK
- Maritime & Coastguard Agency
- Gloucestershire County Council
- Highways Agency
- Port Authorities & Trustees

Feasibility Study – March 2011

Conclusions

- Transport as whole units was feasible
- SCO-1 Criteria met
- Initial Regulatory interaction was positive
- Methods were proven
- Preparatory Works should be carried out to reduce project risk
  - Health Physics Surveys and Characterisation
  - Non Destructive Examination
  - Engineering Design Assessment
  - Bridge & Culvert Assessment
  - Transport and Load Planning
  - Trans Frontier Shipping Approval
  - Confirmation of Transport Category

Preparatory work was key to unlocking the project and exploiting in-year funding

Programme of Work

Tendering Programme

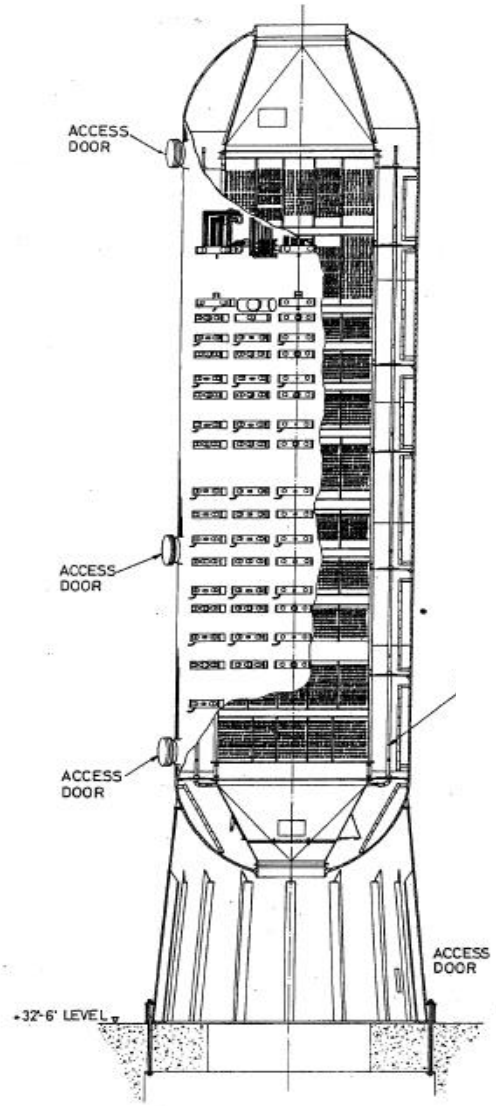
- Competitive Tendering Exercise August 2011
  - New Constraint – Ground Loadings due to underground structures
- Project Funding possible late 2011 – “Flywheel”
- Key Driver – Specified number of boilers off site by 31st March 2012
  This was Lot 1 : Minimum 1 x boiler : Studsvik Proposed 5 x boilers
- Remaining boilers to be dealt with under separate contract (Lot 2)
- All preparatory work identified in study was still required
- Lot 2 was re- bid in August 2012 for removal of remaining boilers by 31st March 2013

Contract Programme

	Lot 1	Lot 2
• Contract award:	4th Nov 2011	5th Nov 2012
• Highways Agency approval:	12th Jan 2012	16th Nov 2012
• TFS Approval:	19th Jan 2012	In place
• Lift 1st boiler:	25th Feb 2012	12th Jan 2013
• Transport 1st boiler:	16th Mar 2012	22nd Feb 2013
• Transport last boiler:	22nd Mar 2012	15th Mar 2013
• Last boiler in Sweden:	6th Apr 2012	31st Mar 2013

Design Considerations

Structural Integrity

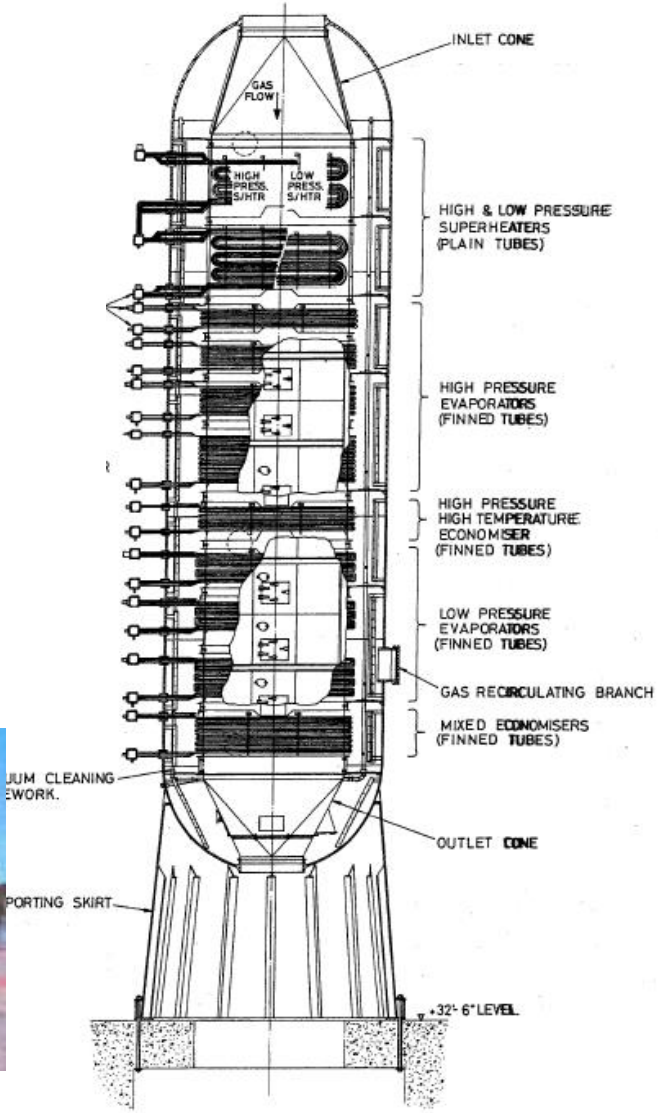


Review of Component parts

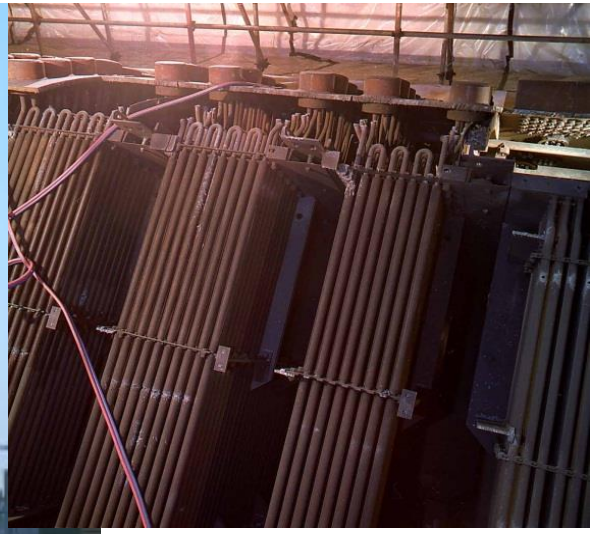
- Boiler Shell
- Saddles
- Internal Structures
- Tubes

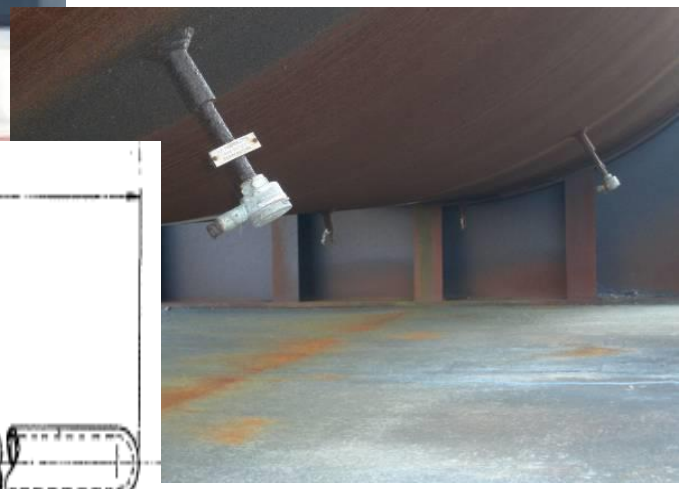
Assessment methods

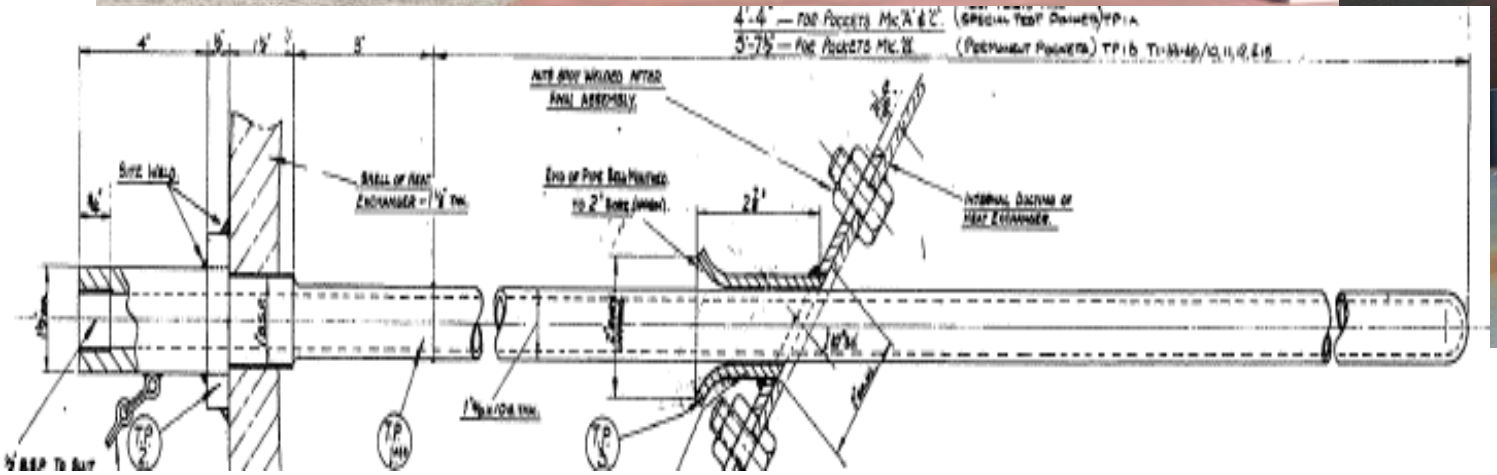
- Design information
- Inspection & survey
- Operation & maintenance records



Penetrations – Method of Sealing

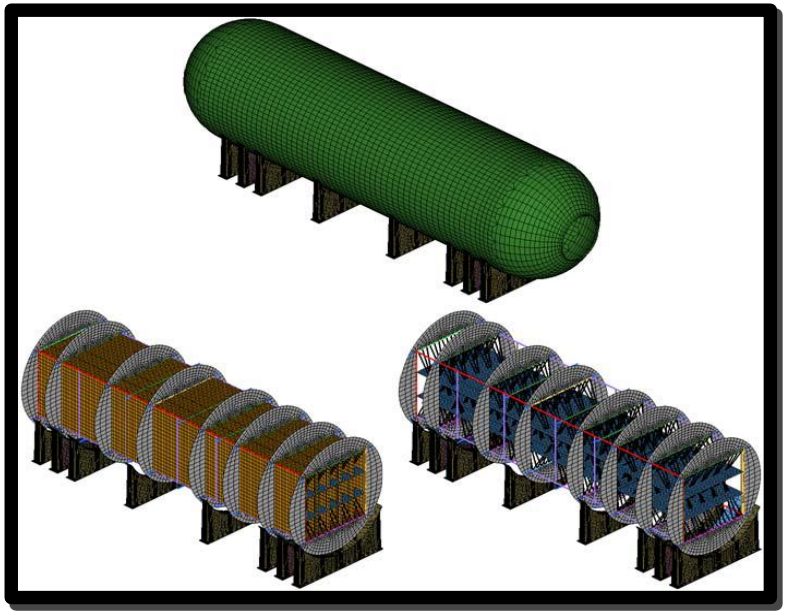






Design - Enabling Works

- Engineering
  - Weld Assessment
  - Finite Element Analysis
  - Loading Models



- Non Destructive Examination
  - Boiler Vessel
  - Seal Welds
  - Flanged Connections
  - Saddles

Project Delivery

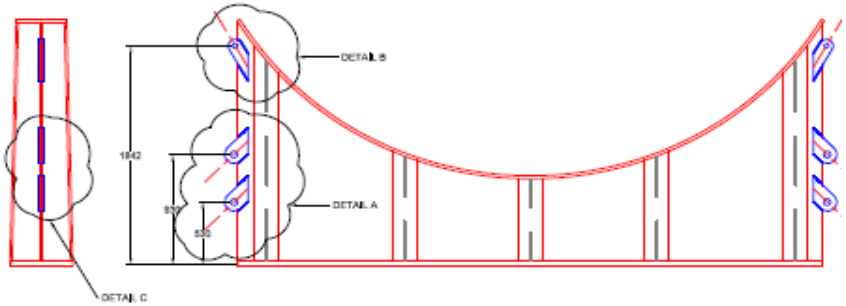
Delivery - Enabling Works

- Project and Site Mobilisation
- Documentation
  - Project and Specific
- Regulatory Authorisations
- Substantiation
  - Design Integrity (engineering review, NDE)
  - Radiological Condition (surveys)
  - Radiological Characterisation (WAC Studsvik & LLWR)
  - Transport Category
  - Regulators (ONR RMTT, EA, HA, GCC, Port Authorities)
  - Boiler preparation
  - Ground Loading

Integral tasks that must be completed before lifting / transport could commence

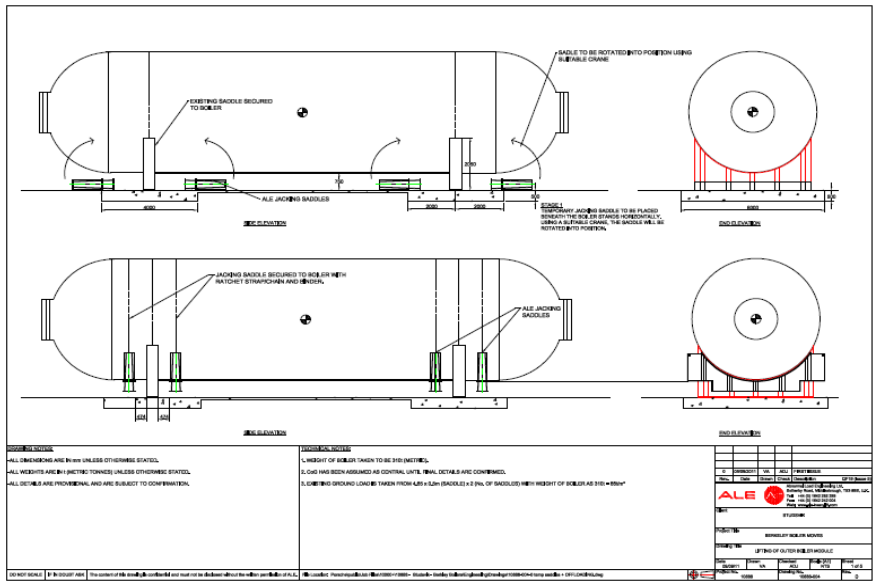
Site Preparation

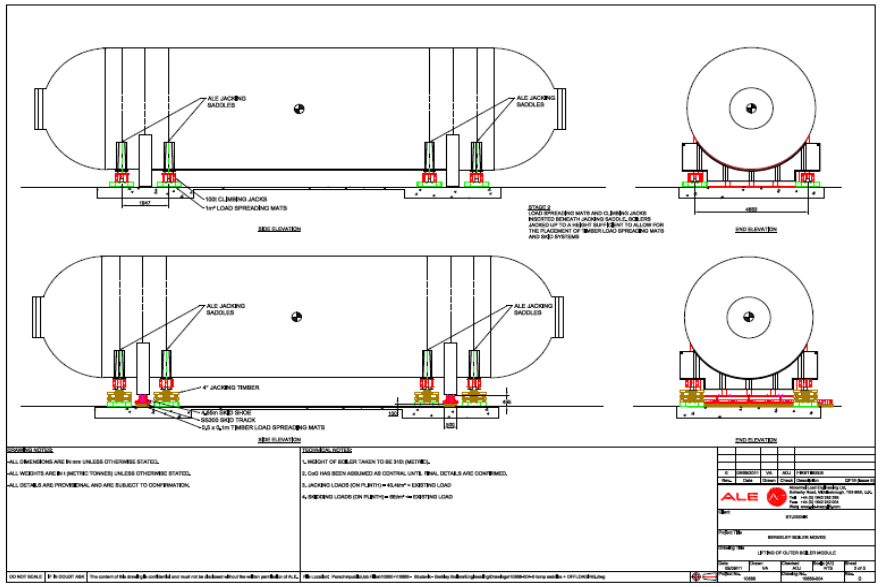
- Removal of ancillary steelwork
- Thermocouples / penetrations
- NDE & Visual Inspection
  - Boilers
  - Transport Saddles
- Welding
- Health Physics Surveys
  - Early completion
  - Regulatory checks
- Civil Preparations



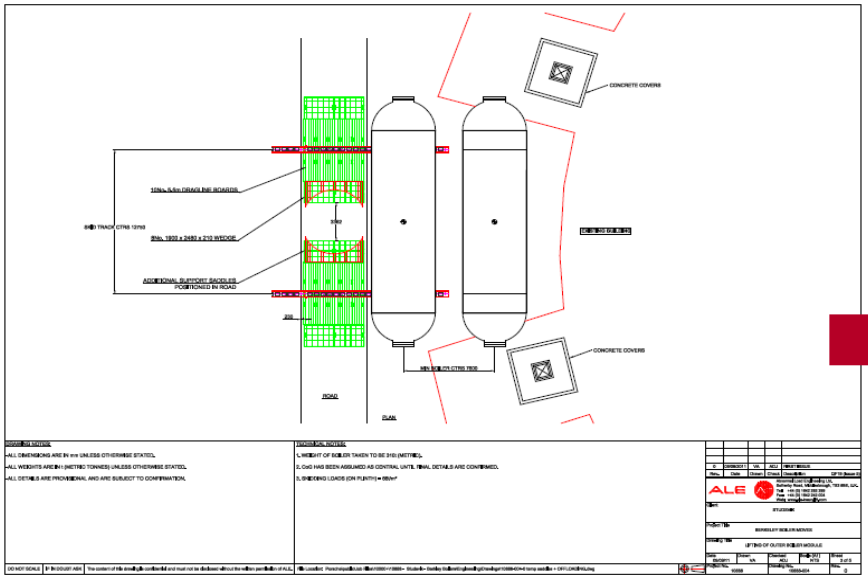
Lifting and Site Transport

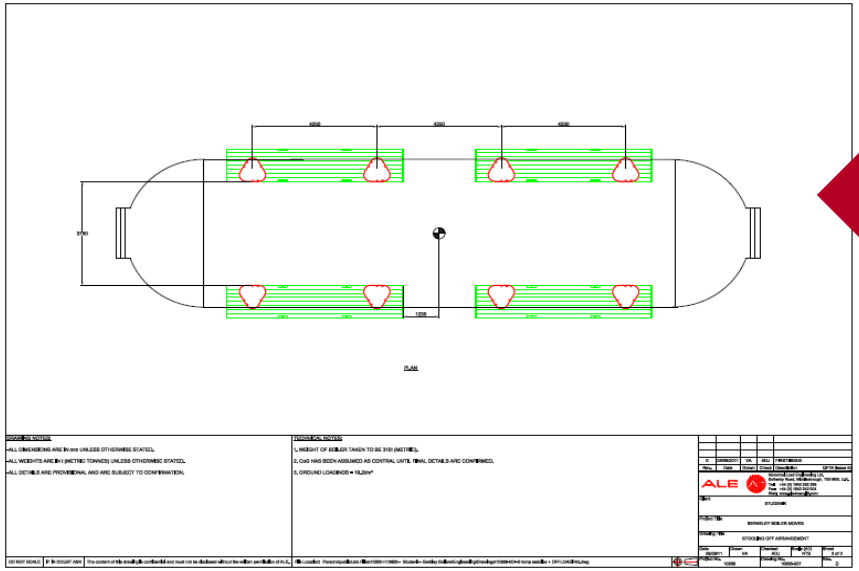
Lifting to skid tracks





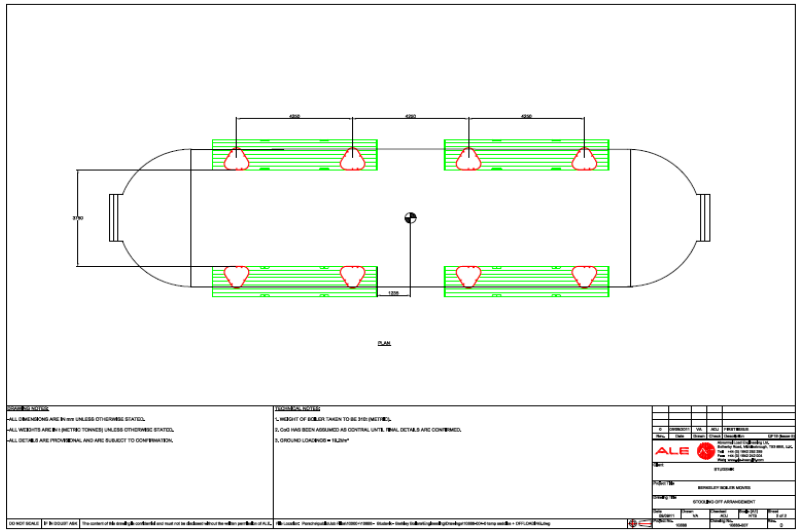
Skidding & Transfer to Site Storage



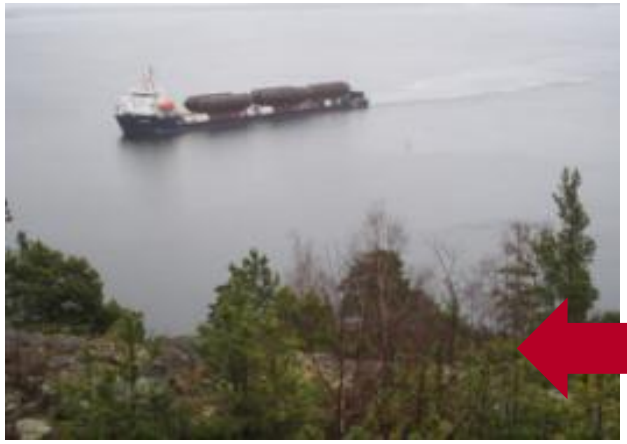


Off site transport

Transhipment to road trailer via SPT



Shipping operations

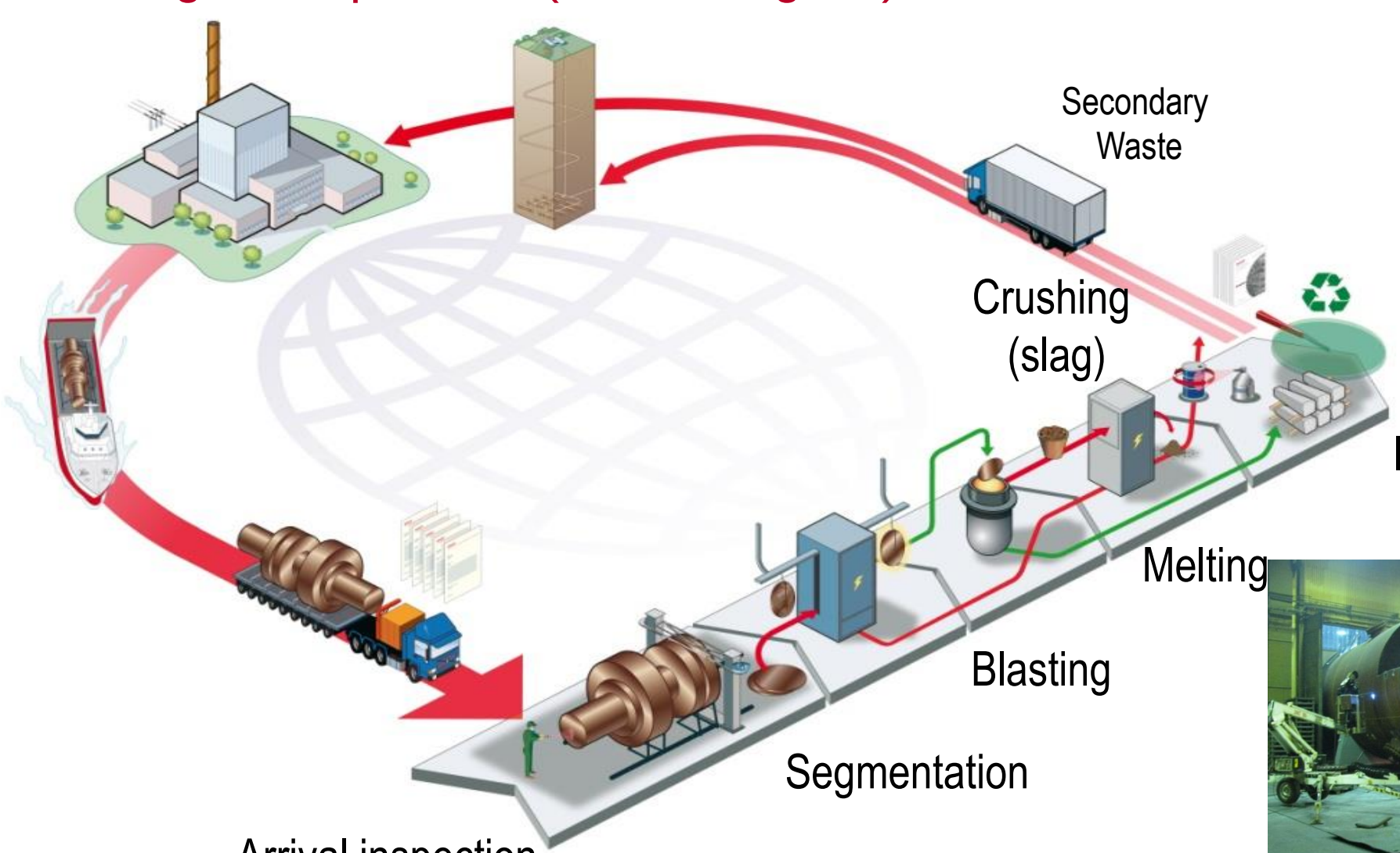


Video – First Project (Lot 1)

Treatment

Volume reduction & recycling - SWE

Large Components (BWR, Magnox)



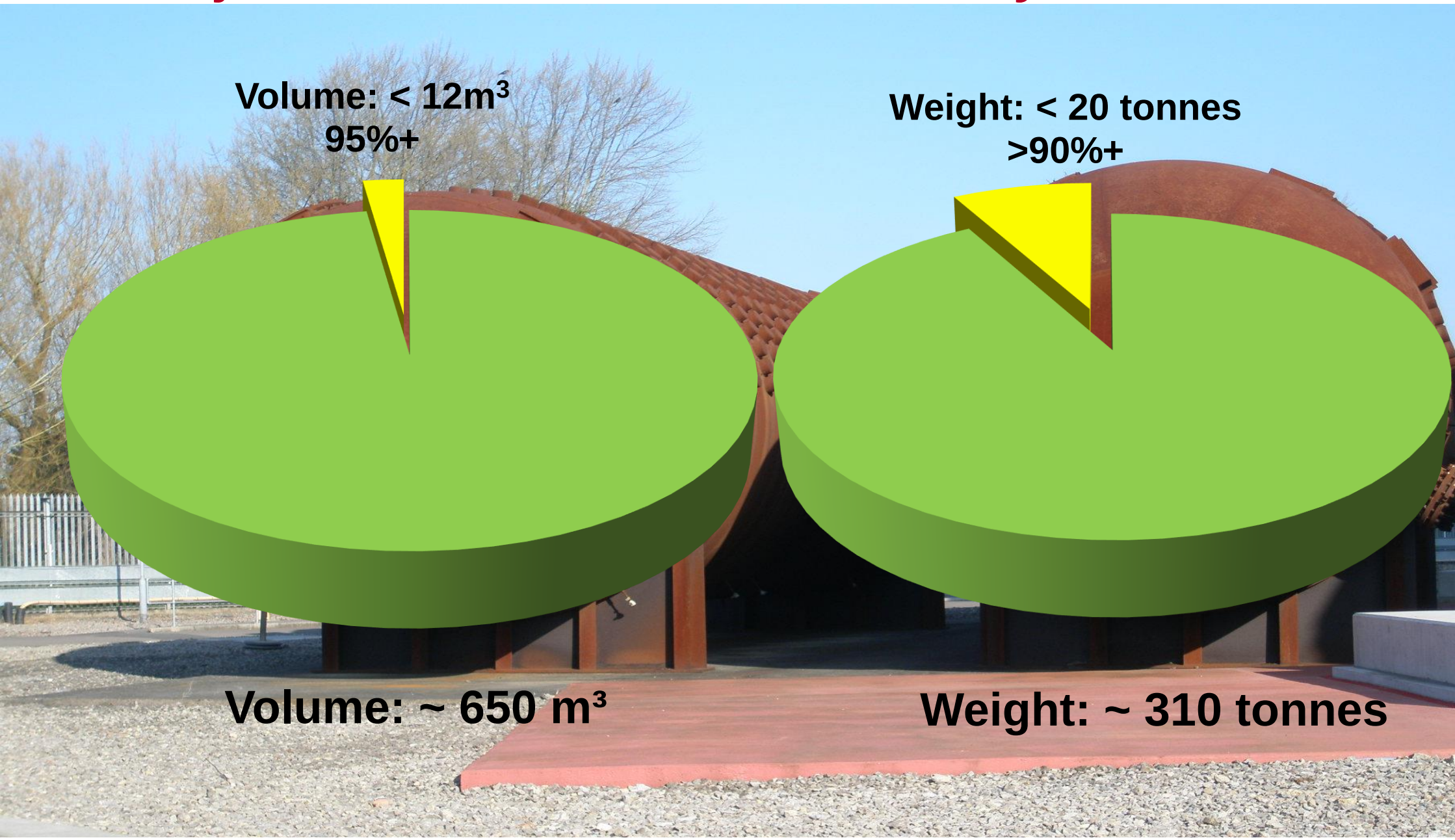
Processing

- Recovery of loose material
- Size reduction
- Decontamination of internal surfaces
- Smelting
- Casting of ingots for free release
  - Melting of metal ensures robust characterisation analysis
  - Representative sample “pucks”
  - Metal is released as per Studsvik license

Secondary Waste Management

- Volume reduced waste consists of ;
  - Grit blasting dust from decontamination
  - Dust from ventilation systems
  - Slag from cutting and metal melting
  - Ash and dust from incineration
- All secondary waste packages are gamma analysed for radiological content
- Existing residual dust (including graphite) analysed for Carbon – 14.
- A comprehensive Final Report is generated during processing with radiological analysis data
- Use of standard packages for return of secondary waste

Project Outcomes – Secondary Waste



Lessons from Treatment

Transport Category – SCO1

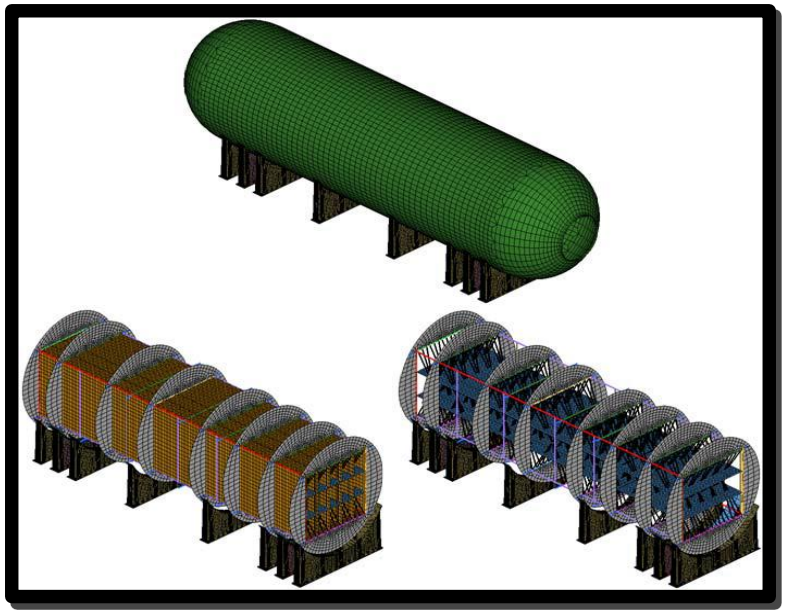
Lot 1 Original Assumptions – Conservative

- Based upon micro-shield modelling activity was assumed to be x2 Magnox fingerprint i.e. 71GBq.
- Only surface area of the boiler shell was considered for contamination distribution i.e. 3,520,000cm².

From Treatment Results

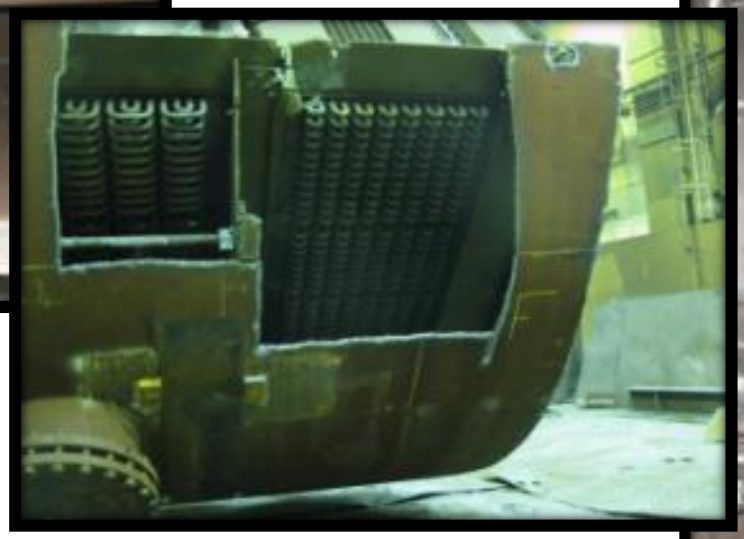
- Activity based upon measurements of all ingot batches and every secondary waste drum = 14 to 22GBq.
- Internal structures excluding tube fins account for more than 130,000,000cm²
- External dose rates correlated well to measurements during treatment

Considered for Lot 2 & supported by Regulators



Lessons from Treatment

- Very small amount (5kg) of residual material so far from 12 boilers.
- Internal components and materials have not deteriorated.
- Flanged assemblies contain Metaflex gaskets (Asbestos)



Lessons from the Project

Early evaluation of project

- Identification of uncertainties and risks
- Early enabling / preparatory works

Early engagement of stakeholders (international)

- Regulators
- Interested Groups
- Site personnel
- Client(s)
- Contractors

Collaboration between all parties

- Joint Risk Register
- Single schedule
- Weekly progress review
- Daily interaction

NDA Supply Chain Award for Best Collaborative Project

Conclusions

Lot 1

- First five Boilers completed
- 3 x HHISO LLW & 3 x HHISO LALLW

Lot 2

- All boilers delivered to Sweden by 31st March 2013
- Seven boilers now completed
- Treatment & return of secondary waste will complete by December 2014

Magnox Gas Circuit Large Components

- Can be safely transported
- Can be effectively recycled
- Small amount of secondary waste

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