UK Atomic Energy Authority

UKAEA

JET Decommissioning & Repurposing

Sam Holdsworth – Project Manager

NIA Fusion Group Meeting

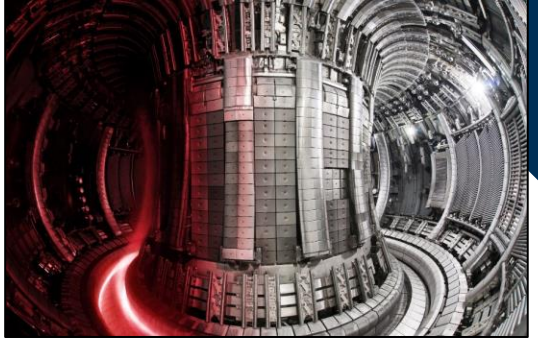
20th October 2022

Decomm and Repurposing

UKAEA

UK Atomic Energy Authority

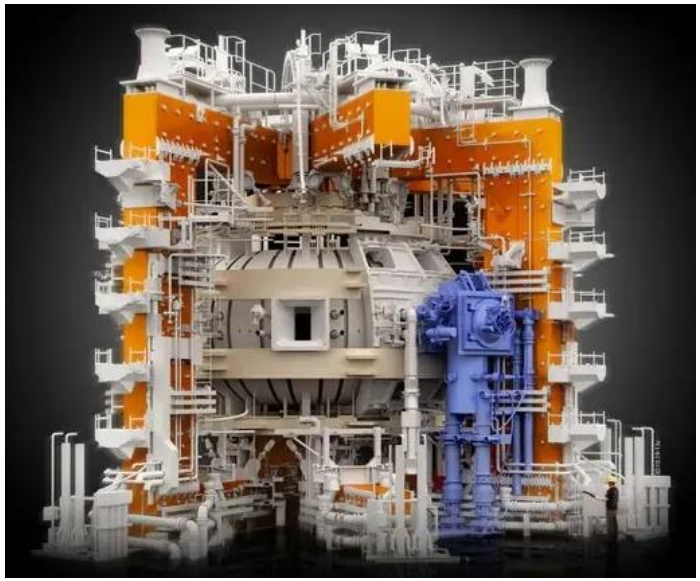
- UK government body responsible for research and delivery of nuclear fusion energy & technology
- Key goal to prepare the UK industrial sector for the move into fusion as a power source
- Based at Culham Science Centre, Oxfordshire with an additional site near Sheffield
- Around 2000 permanent employees, many more contractors and other site tenants
- Two fusion reactors on the site JET & MAST-U
- R&D facilities for materials, robotics and fusion systems



History of JET

In 1977, Culham was chosen as the site for the Joint European Torus (JET) tokamak.

- First plasma in 1983
- 5 Tritium campaigns
- JET has made major advances in the science and engineering of fusion. Its success has led to the construction of the first commercial-scale fusion machine - ITER
- JET operations will finish in December 2023
- From December 2023 JET Repurposing & Decommissioning will take over ownership of the JET estate



JET Decommissioning & Repurposing

UK Atomic Energy Authority

Mission Statement

To deliver the safe decommissioning and repurposing of the JET facilities in an ethical, innovative manner, demonstrating maximum value for money

JET Decommissioning & Repurposing

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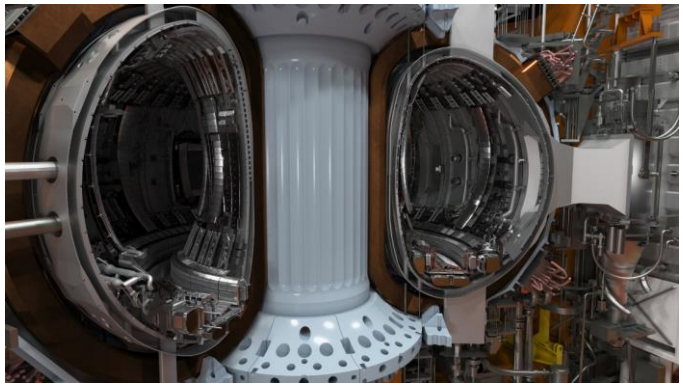
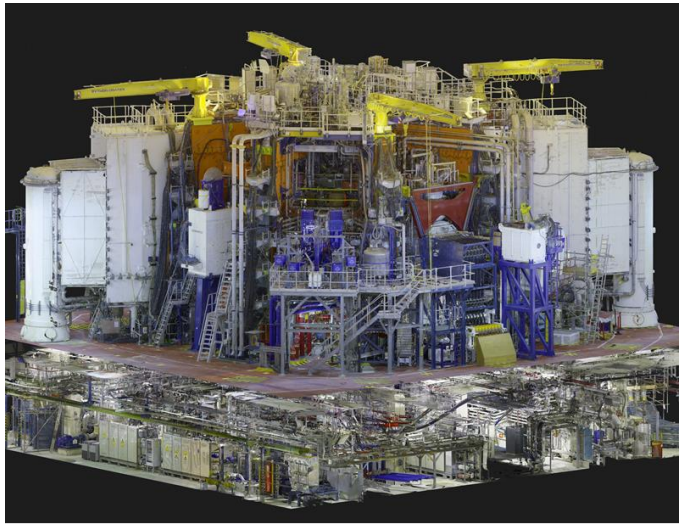
An ambitious project to undertake first-of-a-kind decommissioning of a tritiated fusion reactor to support site regeneration and to close the loop for the fusion lifecycle.

Achieving our mission through:

- Reducing our waste inventory using novel de-tritiation approaches
- Repurposing assets (buildings & equipment) for research & re-use
- Waste-led decommissioning programme with purpose built facilities





Introduction to JDR

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17 Projects over 12 years

- Waste
- Decommissioning
- Demolition
- Site Regeneration
- New Build Facilities
- Asset Repurposing
- Knowledge

Tritium

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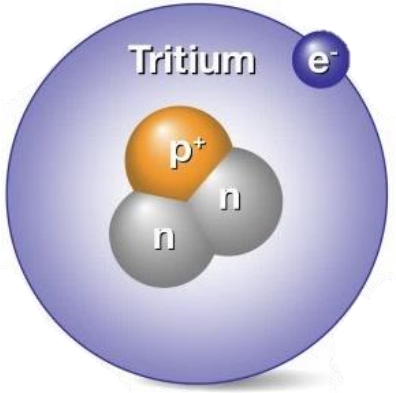
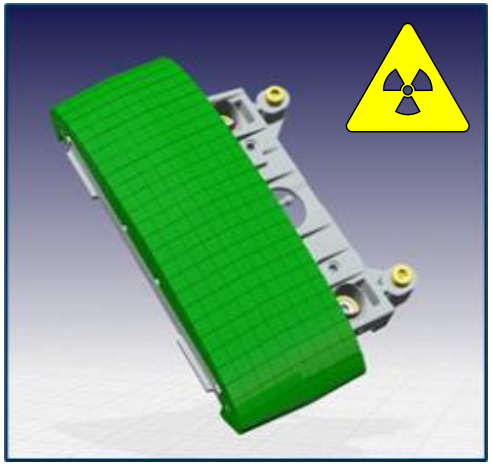
- Radioactive isotope of gaseous hydrogen and is a primary fuel for JET
- Weak beta emitter
- Decays relatively quickly (12 year half-life)
- Currently produced by CANDU-type fission reactors
- Culham has tens of grams of tritium
- Tritium gas is **highly mobile**, behaves like hydrogen & permeates through plasma facing materials
- Tritium likes to sit in paint & will be non-uniform around tritium systems
- Challenging to measure in real time with any accuracy
- Requires laboratory based destructive sampling





Tile

Waste Inventory

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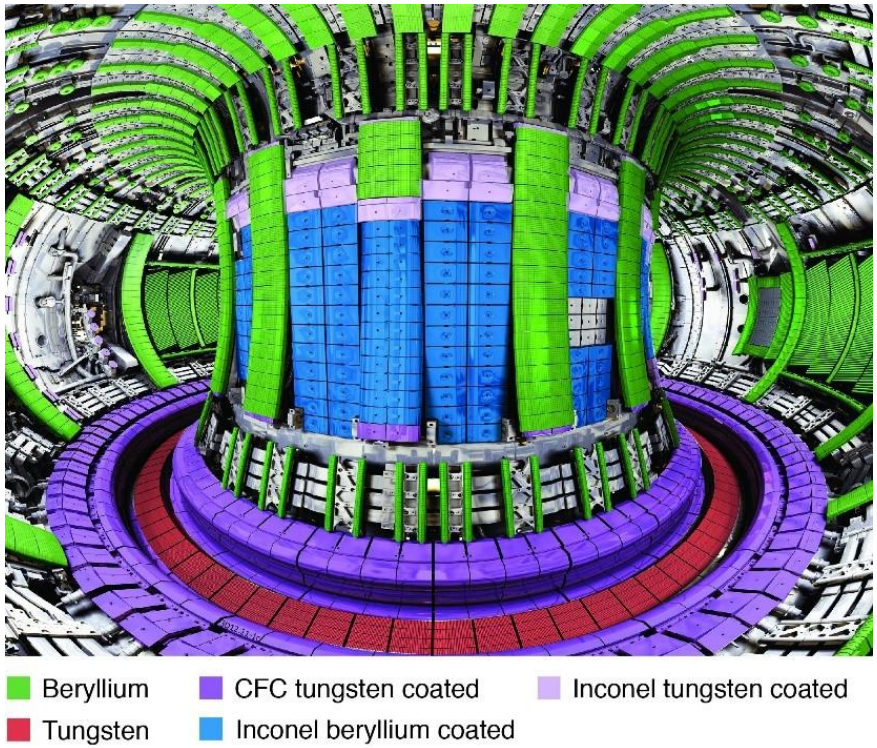
- JET's radioactive inventory is predominantly tritium with short-lived neutron activation
- The torus & surrounding equipment is neutron activated & tritiated
- Components used to contain tritium gas will be tritium contaminated

Problematic materials:

- Beryllium + beryllium dust
- Tritiated dusts
- Mixed materials



Waste Inventory

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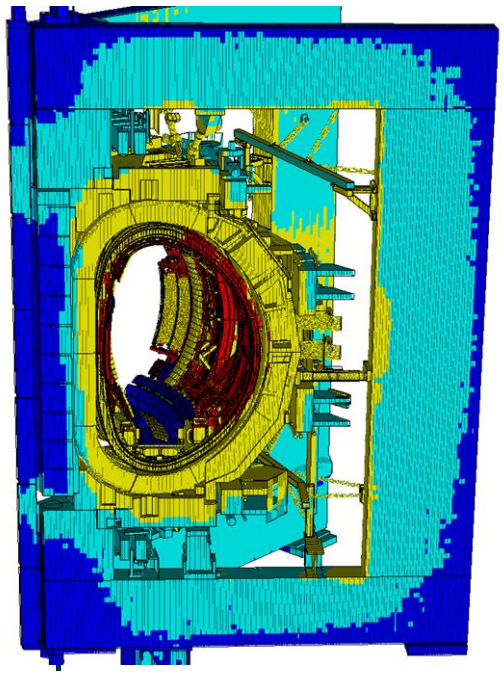
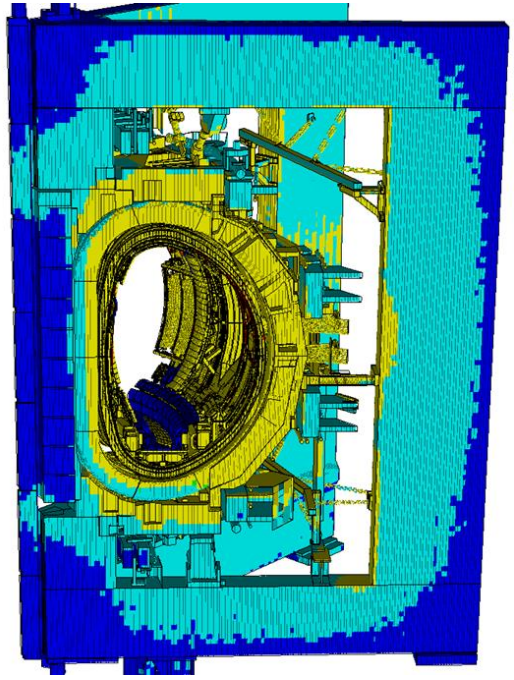
1. Neutronics modelling suggests that Intermediate Level Waste due to neutron activation will decay to Low Level Waste within a decade
2. Tritium will take significantly longer to decay to Low Level Waste from Intermediate.
   – UKAEA have developed a process to remove tritium, or we can wait for decay to prevent disposal to Geological Disposal Facility

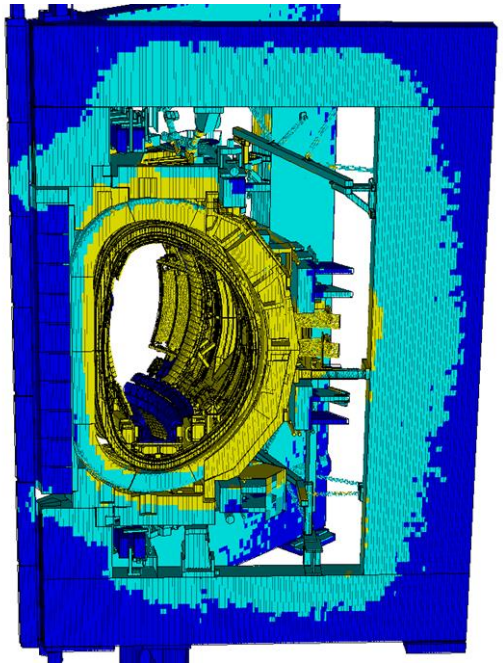
Shutdown



1 year

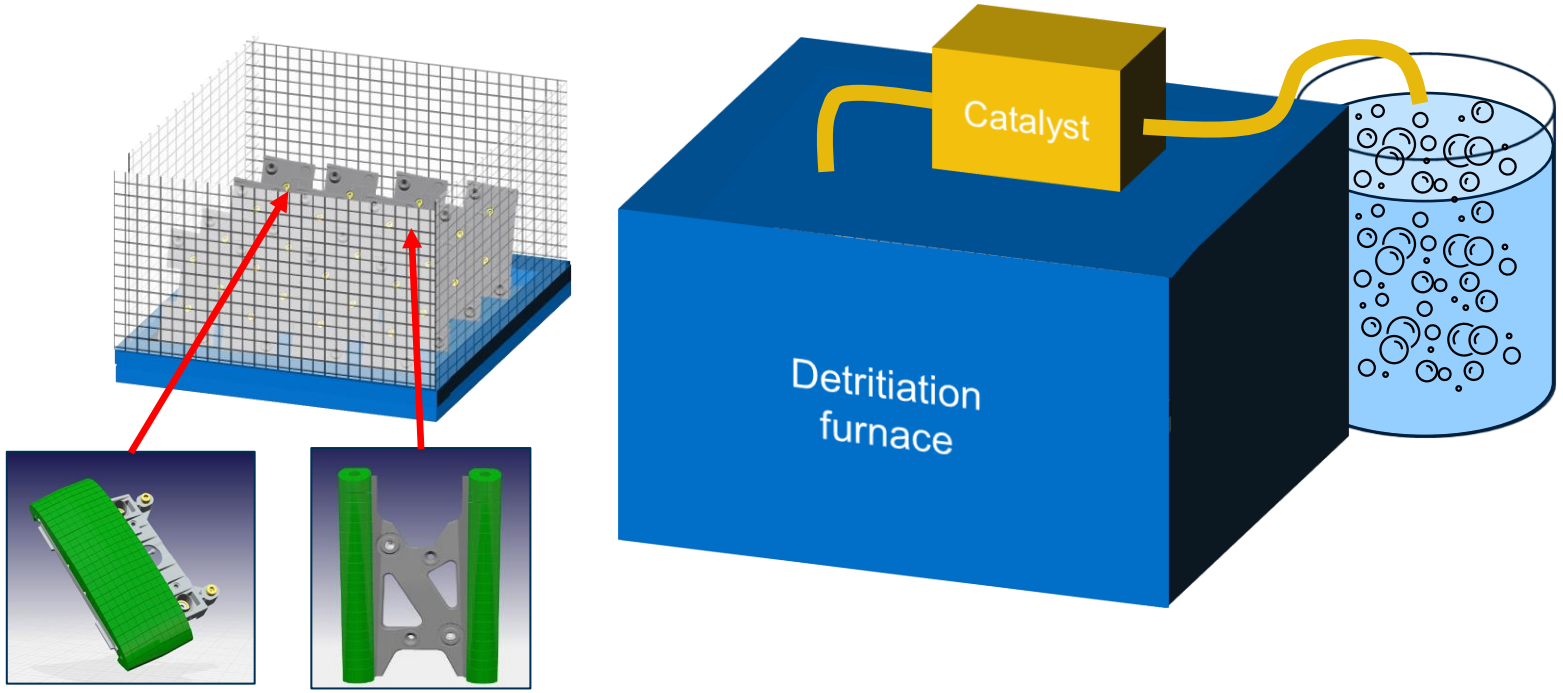


5 years



Detritiation

Furnace to bake tritium out of materials (similar to hydrogen de-embrittlement)



UKAEA have demonstrated taking Intermediate Level carbon & Inconel tile materials down to Low Activity Low Level Waste (i.e. 99.9%+ tritium removal in a single run)

Detritiation Facility

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- Innovative waste treatment option, reduces disposal & infrastructure costs:
- Designed to treat up to 150kg of hard metallic waste in one thermal run
- Thermal processing in a bespoke retort furnace with a flowing air atmosphere
- The catalysed HTO is recovered into series of water bubblers
- Successfully reducing an ILW liability to LLW or even LA-LLW
- Water Detritiation System online in near future, expected to process HTO and closed the fusion fuel cycle
- Sets a new standard for tritiated waste

In-Vessel Removals

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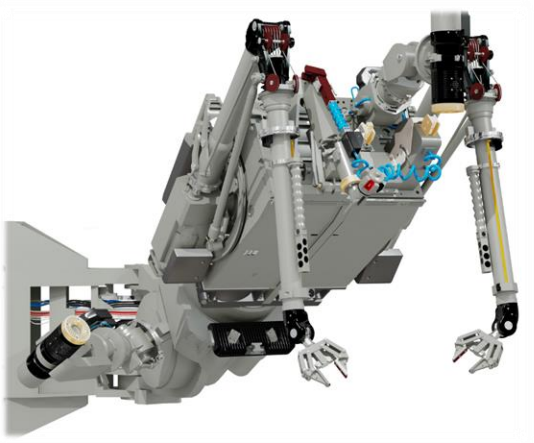
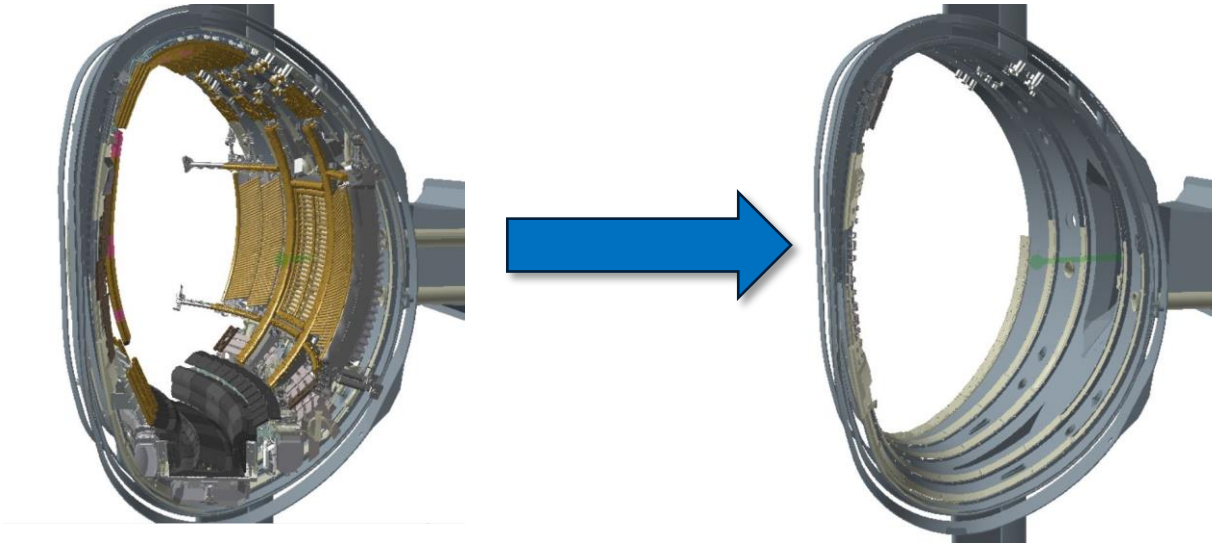
Utilise current UKAEA remote handling capability to safely & ethically deliver in-vessel removals.

- Remove wall assemblies (3279 tile assemblies)
- Cooling pipes / feedthroughs/ internal structure





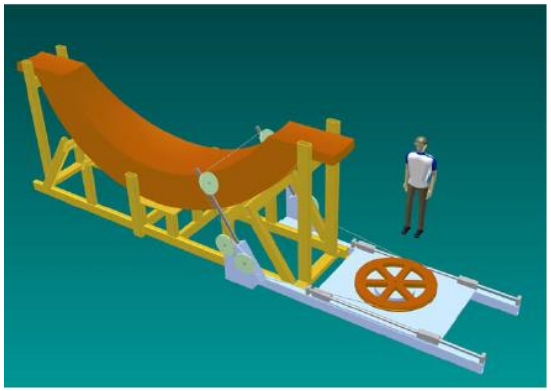
Key Procurements

- Cutting technology
- Imaging
- Electrical

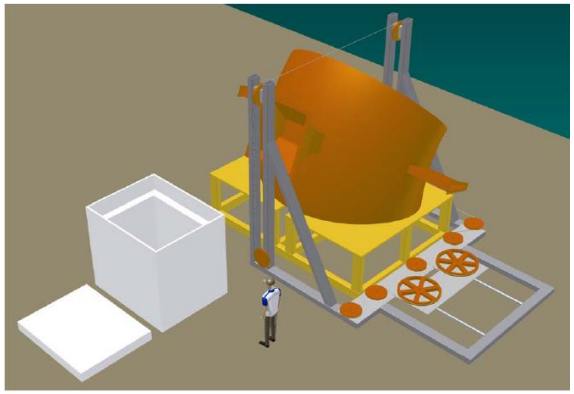
Ex-vessel Size Reduction

Large active sections (structure & diagnostics) of JET & surrounding plant will require size reduction to enable further processing or to simply fit within storage containers.

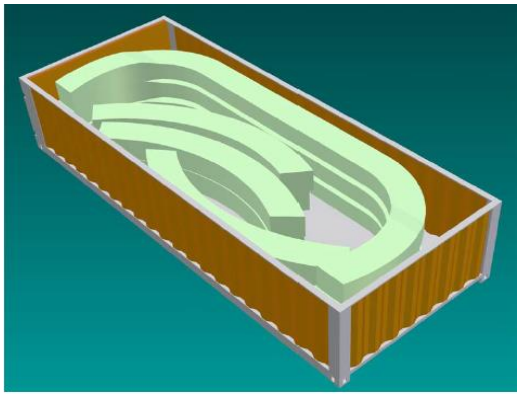
Cutting support structure



Vacuum vessel cutting



1/3 height ISO storage



Key Procurements

- Cutting equipment: diamond wire, laser
- Design & Build: Lifting jigs & cranes
- Active Vent
- Buffer storage

Post Operation Clear Out / Site Clearance

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We have a lot of Out of Scope Regulation waste which needs removal & recycling

- Huge quantities metals, concretes (pipes, beams, power supplies, etc…)
- Limited radiological exposure

Key Procurements

- Cutting equipment
- Design & Build: Lifting jigs & cranes
- Enclosures
- Radiation monitoring

Waste Processing Facilities

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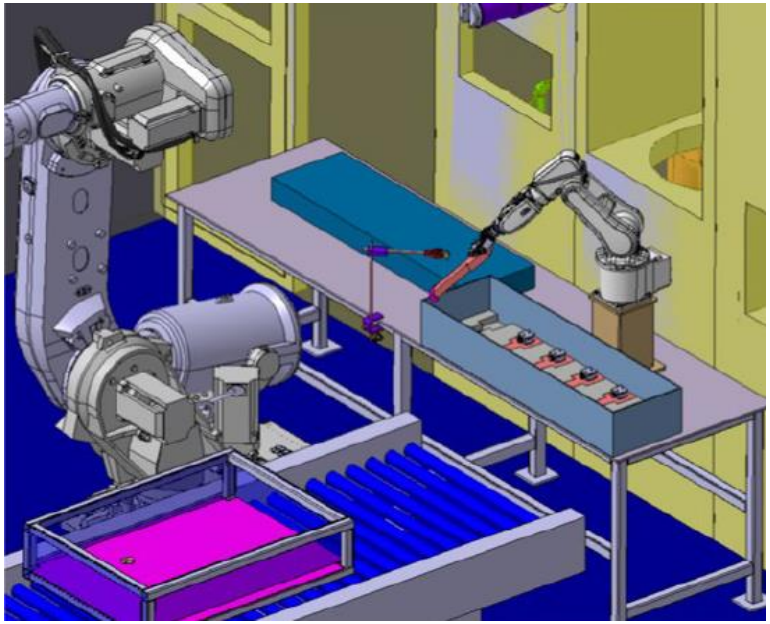
Two proposed waste processing facilities:

1. Intermediate Waste
   - Store, sort, segregate, process (including detritiation) and pack Intermediate Level Waste
2. Low Level Waste
   - Process & consign all Low Level Waste



Key Procurements

- Design & Build: Upgrade of the detritiation facility
- Design & Build: ILW / LLW Processing Facility
- Buffer storage
- Characterisation (gamma spec & Tritium analysis
- Active vent
- Radiation monitoring
- Health physics
- Enclosures
- Radiation monitoring
- Robotic manipulators
- Moducon enclosures

Radioactive Waste Routes

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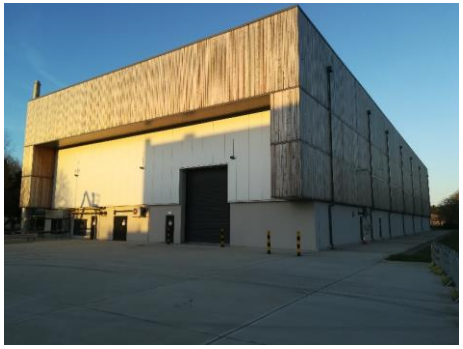
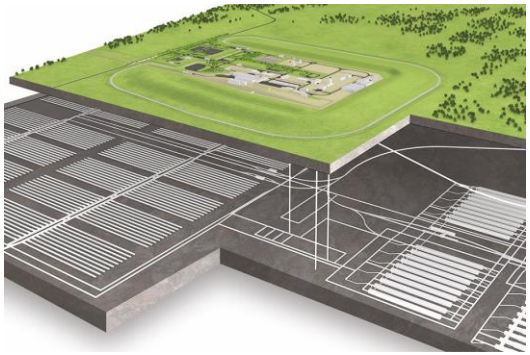
UKAEA have a unique disposal challenge as JET has no long lived Intermediate Level Waste.

ILW →



Harwell Box Store →

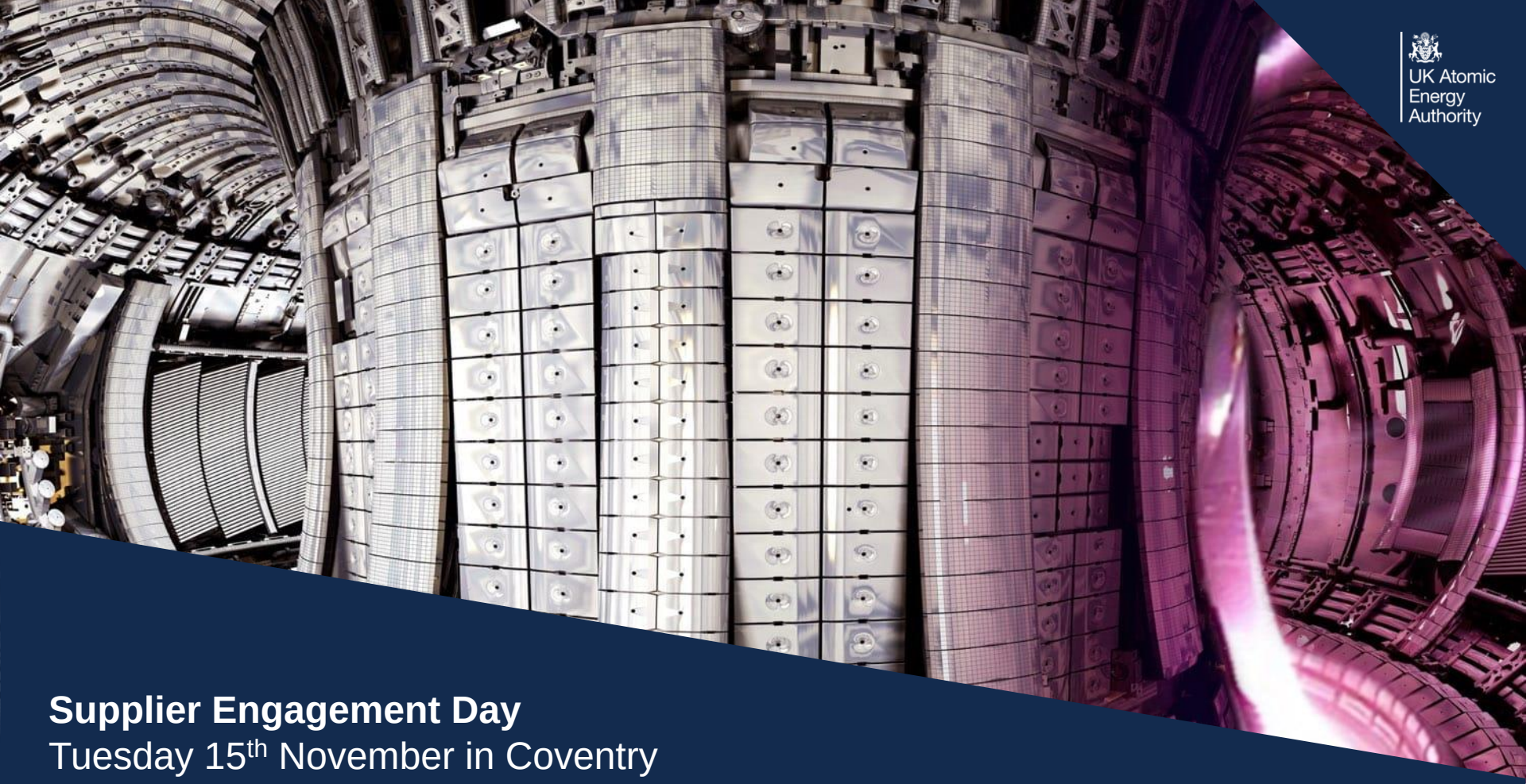


Geological Disposal Facility

LLW →

Low Level Waste Repository →

Active Landfill



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Supplier Engagement Day
Tuesday 15th November in Coventry

Contact

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