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Dexterous Remote Handling for the Nuclear Industry

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Agenda

- Introduction to Oxford Technologies
- Remote handling philosophy
- Legacy from the nuclear fusion experiments
- Potential for decommissioning and other industries

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Introduction to Oxford Technologies Ltd

Oxford Technologies Ltd

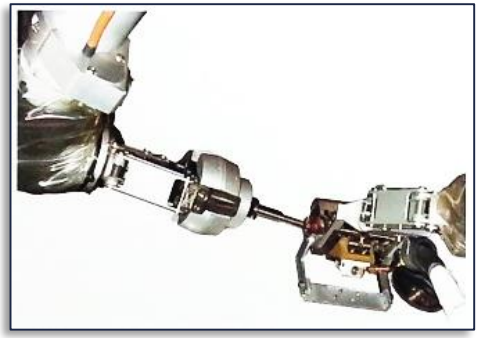
- Remote Handling Solutions
- Engineering consultancy
- Design and build
- Assembly and test hall

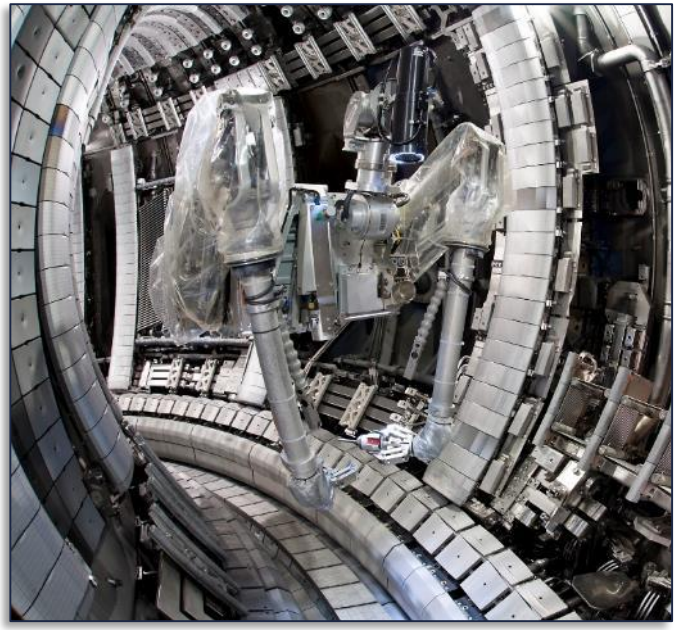
- Man in the loop robotics, not robots.

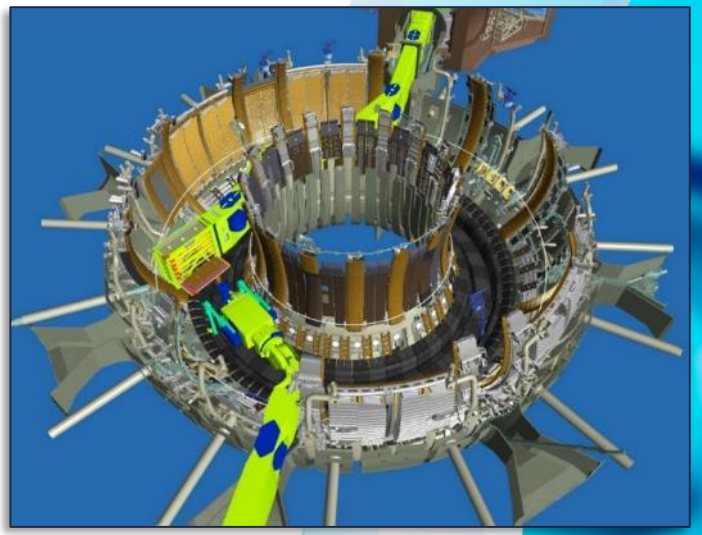
- Created in 2000 by JET remote handling engineers
- Owned by Kurion Inc. since December 2015
- 61 employees, including 56 engineers and technicians
- £5.5 million turnover

JET (Joint European Torus)

- Designed and delivered RH devices
- Developed RH Code of Practice
- World's first fully remote handling campaign inside a Tokamak in 1997.







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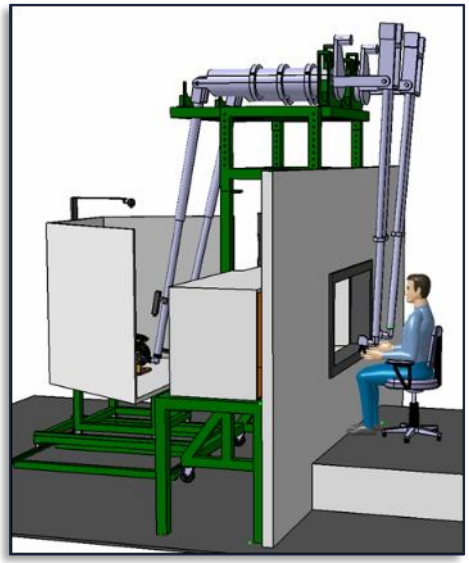
Remote Handling Philosophy

Remote Handling Philosophy

- What is remote handling?
  - Handling items and tasks from a remote distance
  - “Nuclear” connotation

Long Reach Tools



Through the wall manipulators

Remote Controlled

Remote equipment

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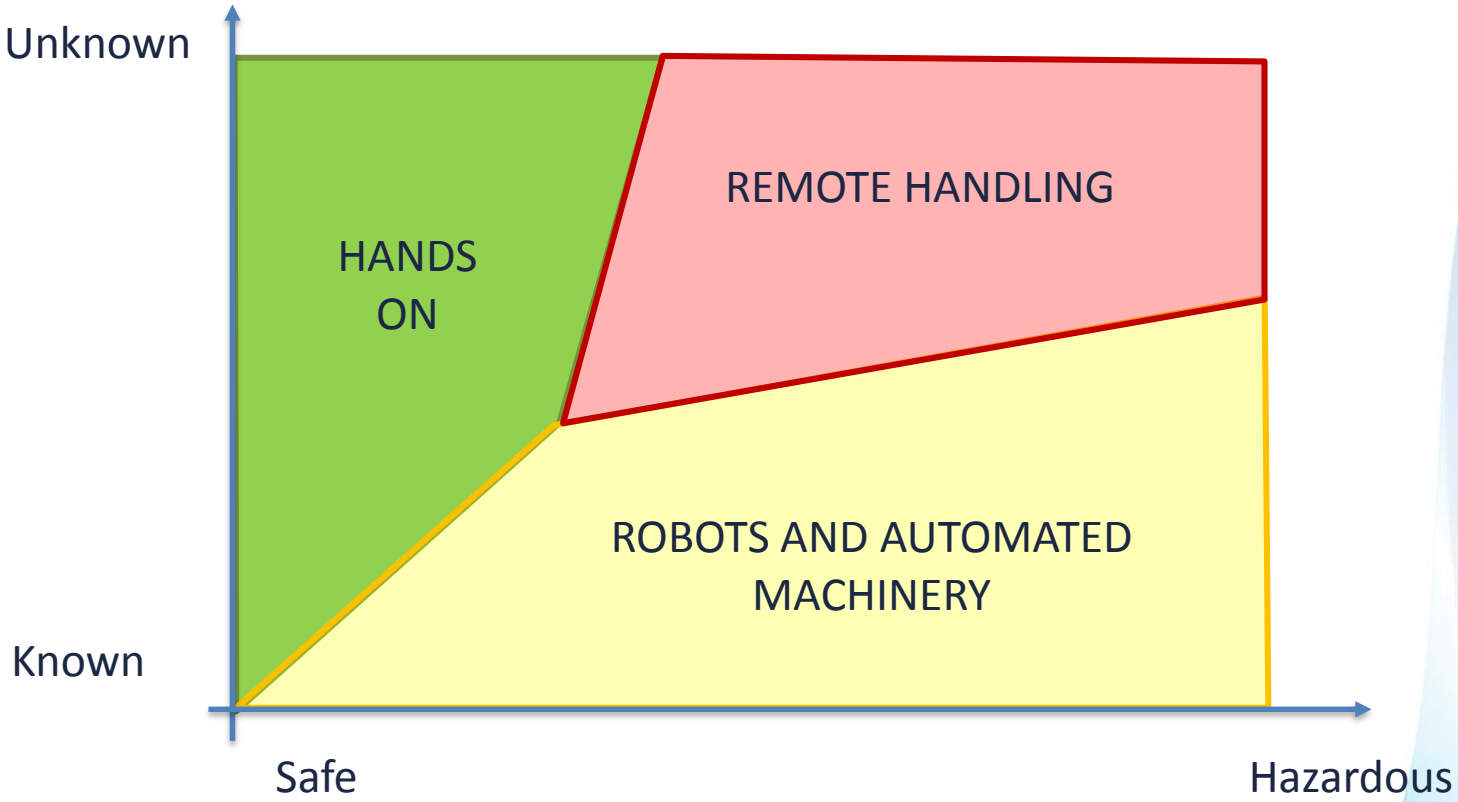
Remote Handling Philosophy

- Unknown vs Hazardous



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Remote Handling Philosophy

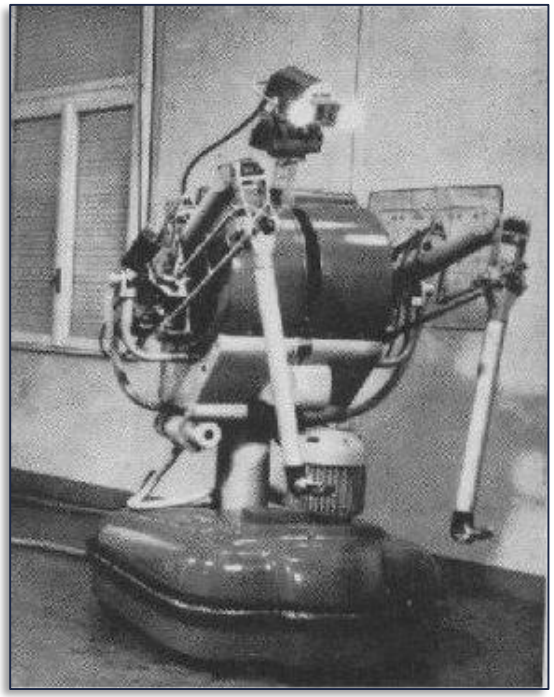
- What is important for Oxford Technologies
  - Task identification
  - Remote viewing
  - Recovery

Legacy from the Nuclear Fusion Experiments

Brief history of Mascot

- Through the wall manipulators are fixed to one location.
- MASCOT: Positionable servo manipulator
- Project started around 1958 with ENEA and CERN collaboration

1945

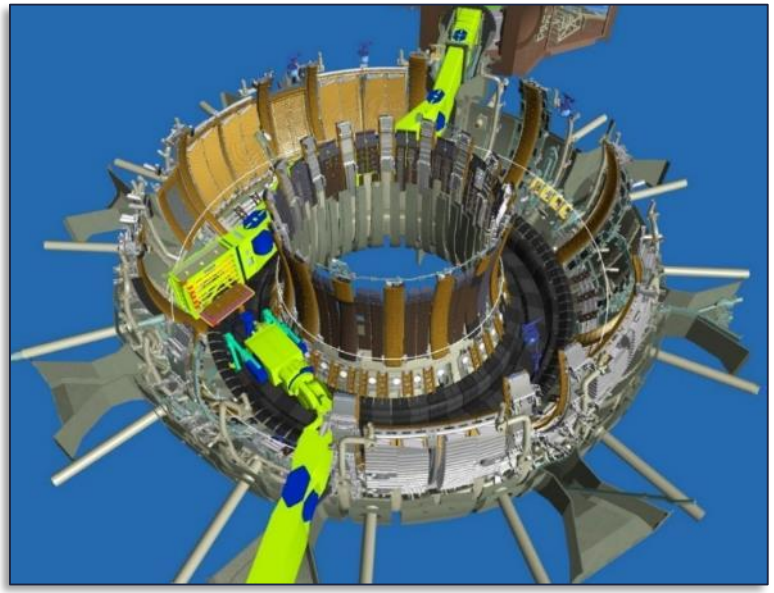


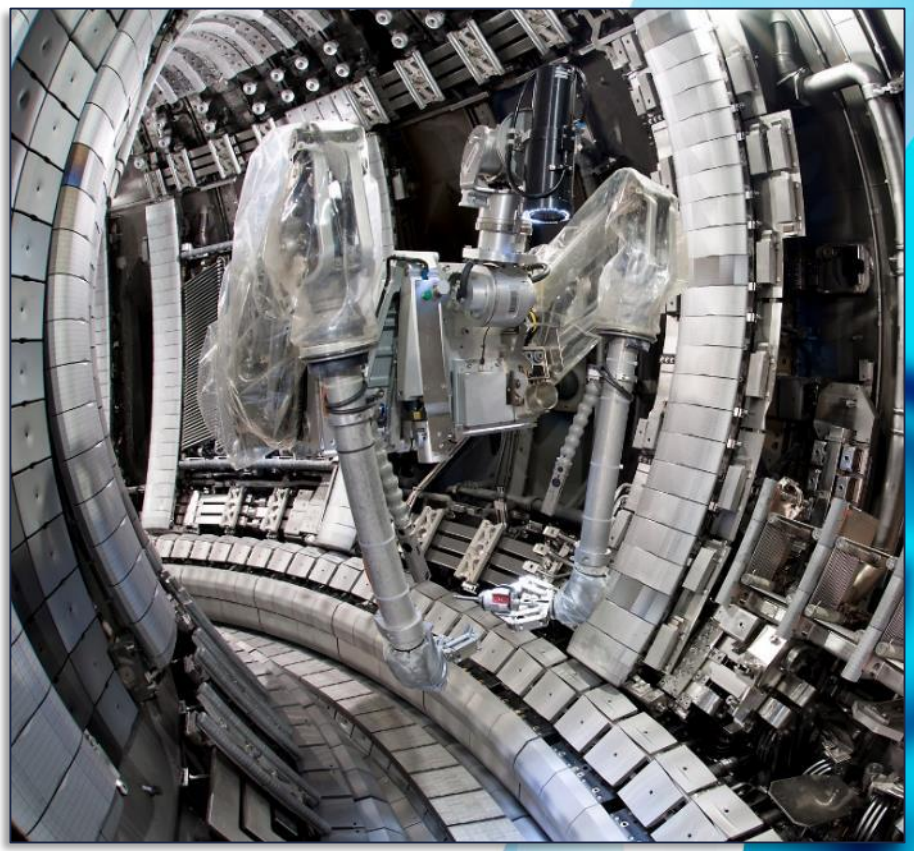
1958

Brief history of Mascot

Use of MASCOT IV at JET

- Full remote handling operation started 1997
- Positioned inside the tokamak by a transport boom
- More than 10 000 h active operation

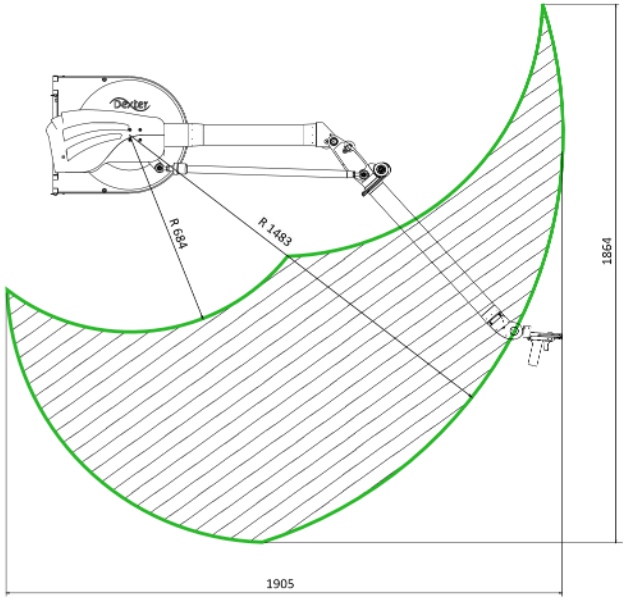


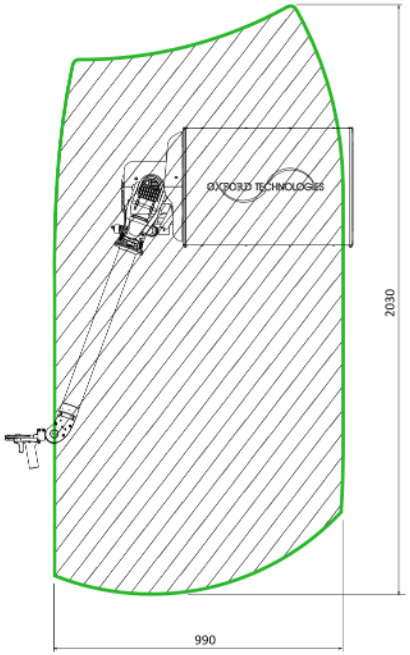


DEXTER Manipulator

Updated design of MASCOT manipulator

- High dexterity
- Highly programmable
- VR integration

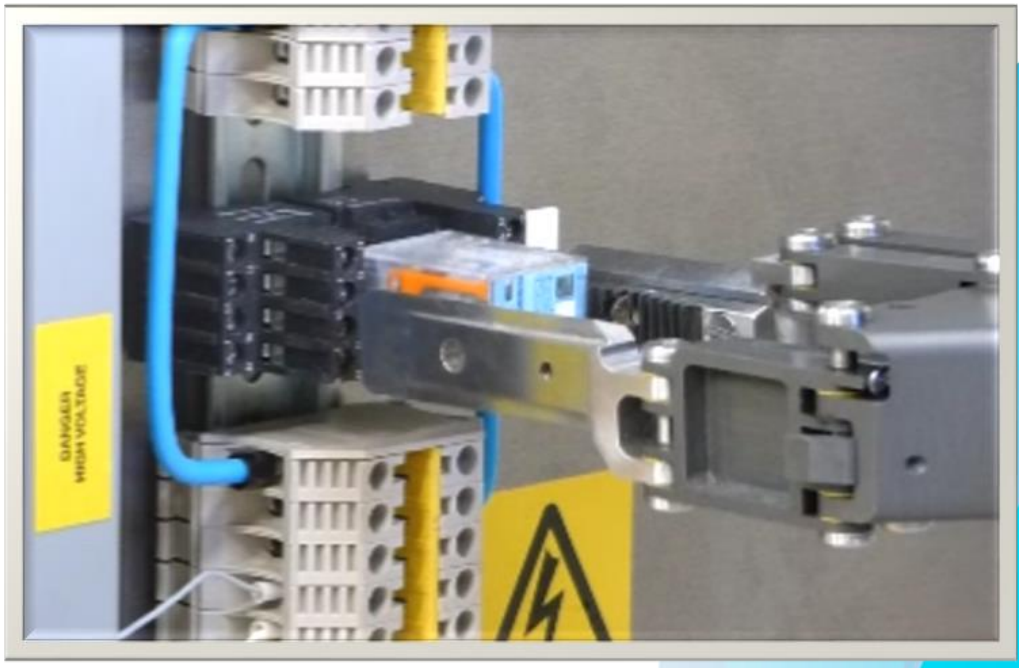


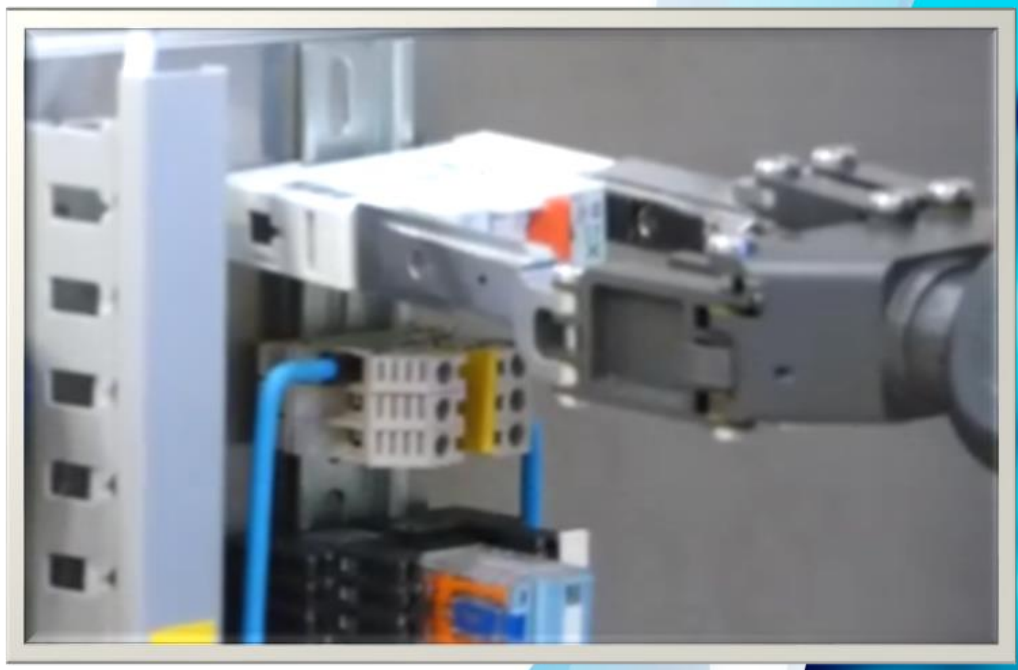


DEXTER Manipulator

High dexterity allows to perform a multitude of task without much infrastructure

- 10g sensitivity
- 10 kg payload





DEXTER Manipulator

Highly programmable

- Weight compensation
  - The weight of the arm is “electronically” removed
  - Tool weight can be removed

- Force scaling:
  - The force feedback from the slave manipulator can be decreased in order to lift comfortably more mass or for more force demanding task
  - The force feedback from the slave manipulator can be increased in order to amplify the “feel” and perform tasks with more sensitivity

DEXTER Manipulator

Highly programmable

- Active constraints
  - Use of kinematic to assist tasks such as:
    - Using an screw driver
    - Using a spanner or other orbital tools
    - Cutting / tracing in a straight line
- Virtual walls
  - Virtual environment can be created to protect equipment
- Guiding trajectories
  - “Attraction path” to guide the movement, e.g. during deployment or navigating through confined spaces

DEXTER Manipulator

Highly programmable

- Dissimilar kinematics

DEXTER Manipulator

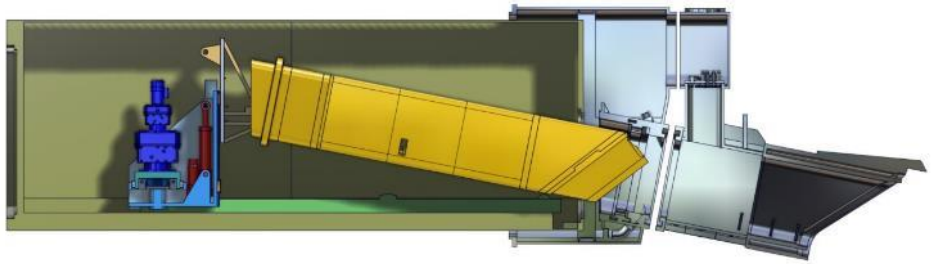
VR Integration

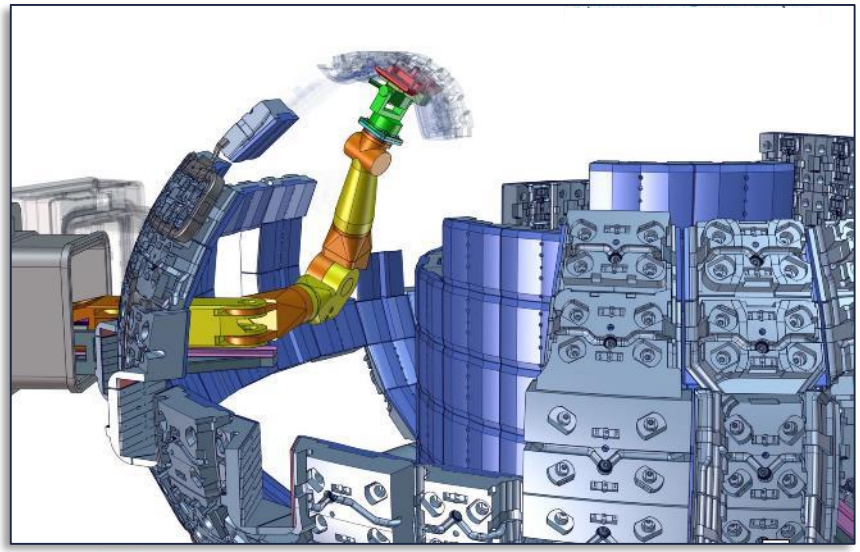
- “Real” master driving virtual slave
- Task study
- Task optimisation
- Operator training

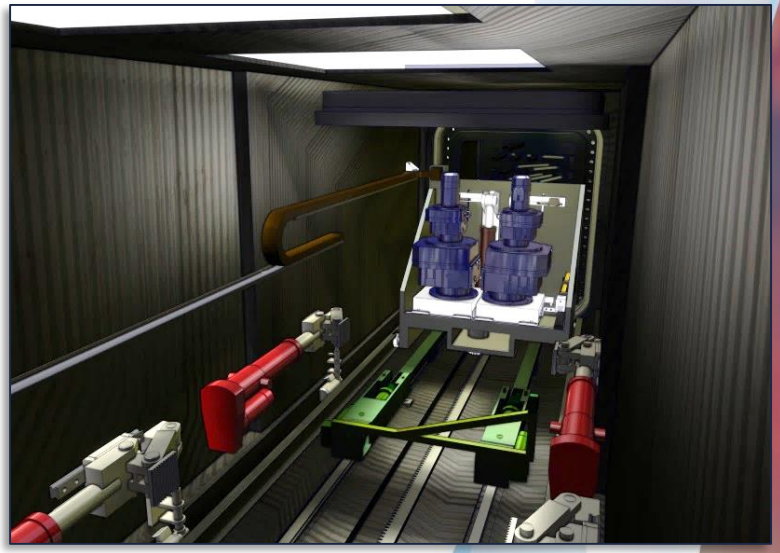
Potential for decommissioning and other industries

High Energy Physics

- Support to ITER
  - Numerous remote handling and diagnostics contracts

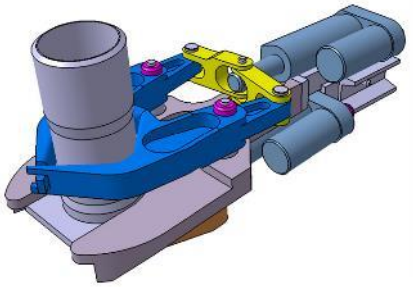


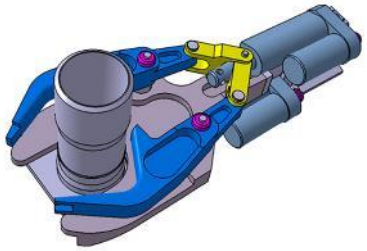


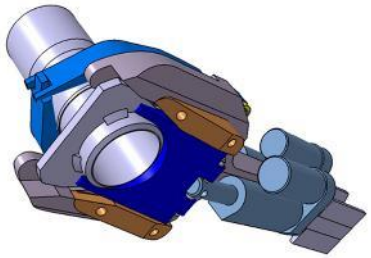


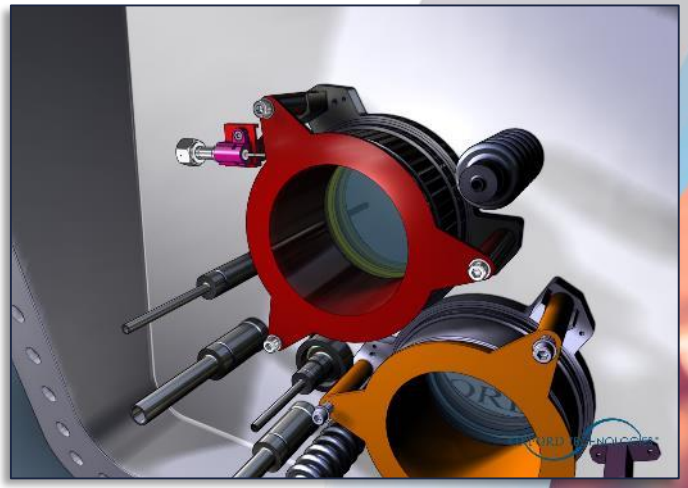
High Energy Physics

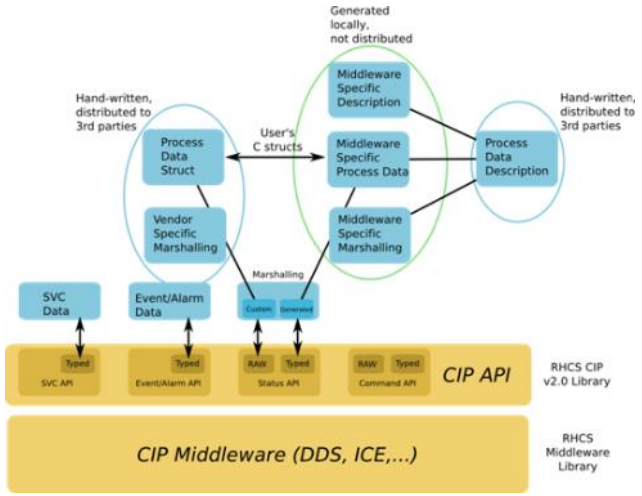
- Support to ITER
  - Numerous remote handling and diagnostics contracts

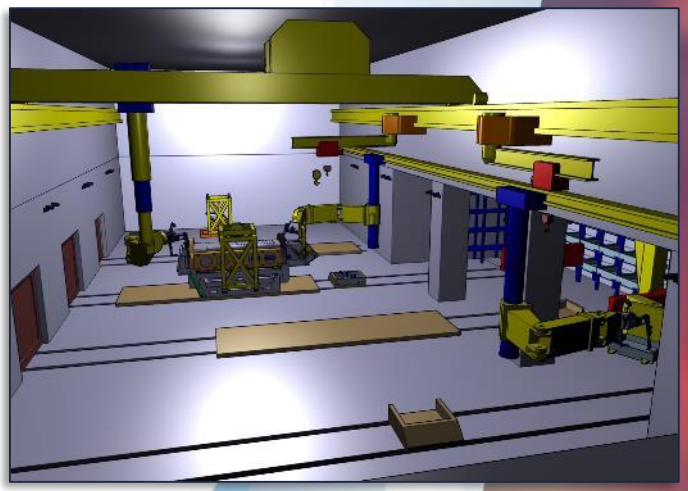










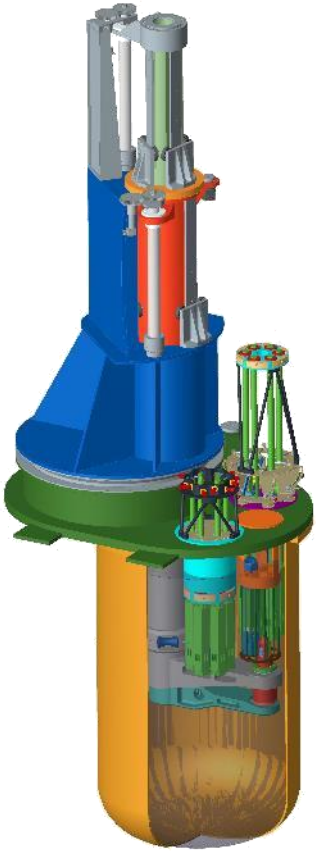


High Energy Physics

- Other international experiments

LHC (CERN)

MYRRAH (SCK)



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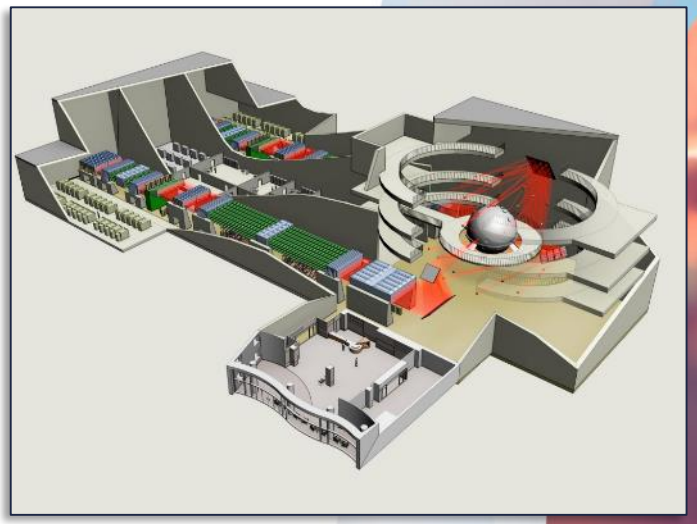


Nuclear decommissioning

- Dounreay Shaft (UK)

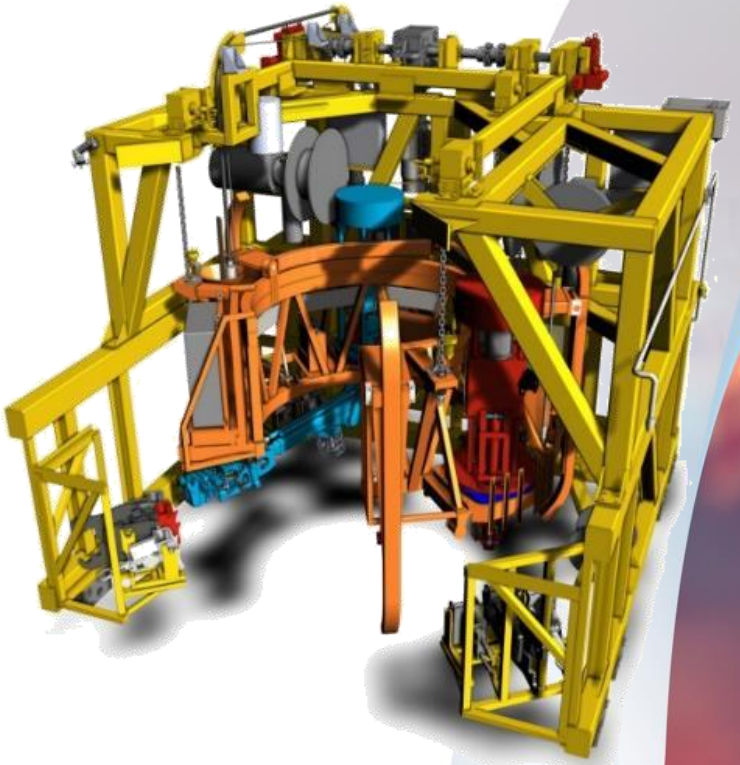
- Fukushima (Japan)

- Sellafield, FGMSP (UK)

- La Hague (France)

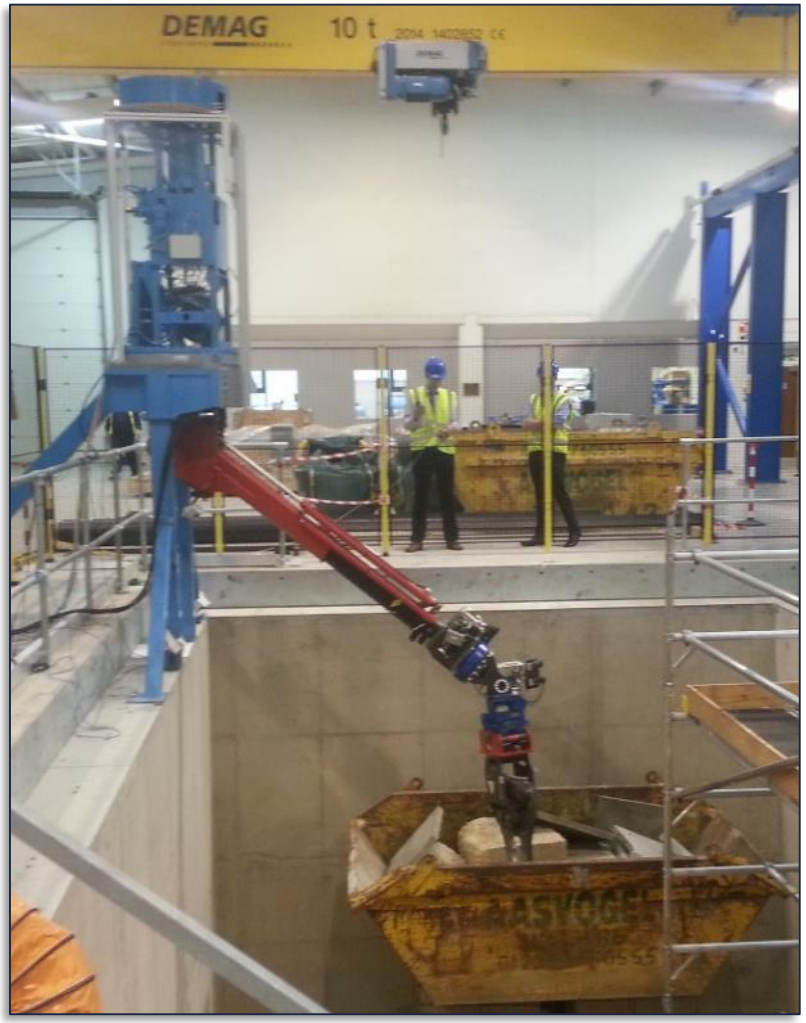
Nuclear decommissioning

- Dounreay (Waste handling, Shaft, Silo)



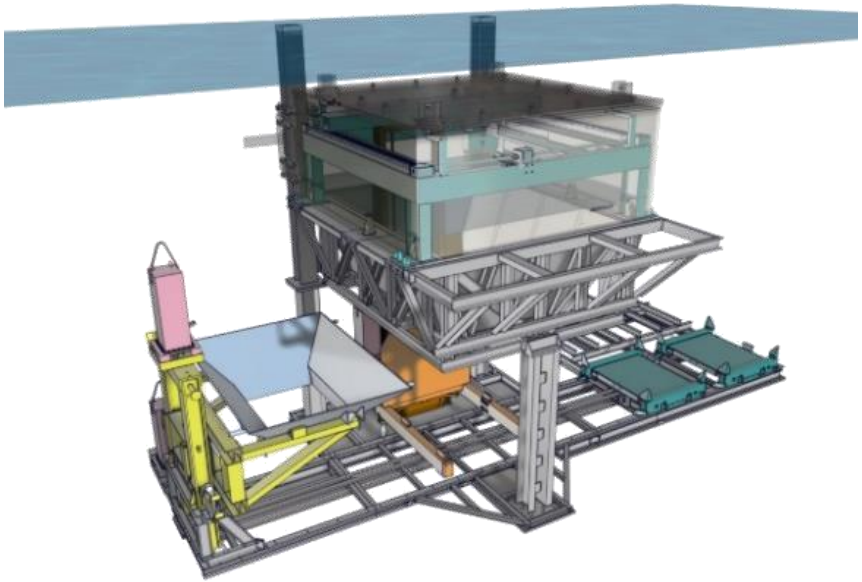
Nuclear decommissioning

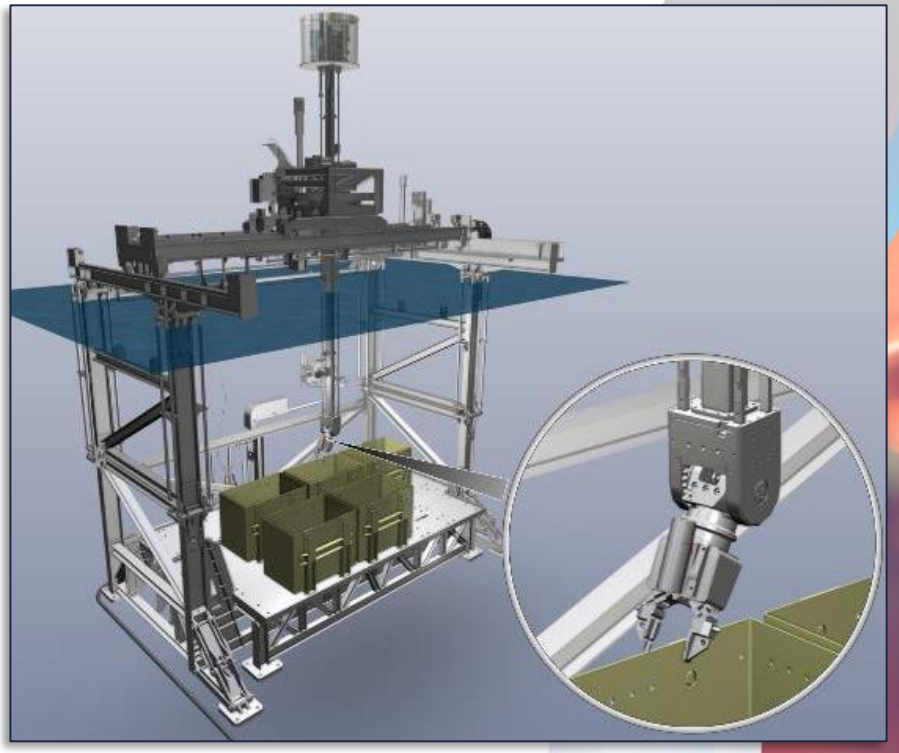
- Dounreay (Handling arm trials)



Nuclear decommissioning

- Sellafield (Pond waste handling)





Remote Dexterous Handling

- Reducing risk and exposure
- Increasing task efficiency
- Examples:
  - Hot Cell and Glove boxes with minimum penetration
  - Working above ponds with no exposure and better dexterity

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Questions Please….