Advanced remote manipulator system
Meet Dexter

A touch-sensitive remote manipulator system.

The human operator performs tasks with the master manipulator which the slave replicates exactly in real time, at the remote location. The slave can be positioned up to 8km from the master because there’s no mechanical connection between the two - just cables for power and data. It’s powerful, dextrous and sensitive enough that an operator can:

• Manoeuvre objects from 10kgs (one arm) to 100kgs (two arms with crane attachment)
• Dispense one drop at a time from a standard pipette
• Detect the different textures of surrounding surfaces.

Dexter’s legacy

Dexter started life as an indispensable part of the JET nuclear fusion programme’s remote handling operation. The manipulator you see today is the result of 20 years’ operation, development and fine-tuning by some of the brightest engineering minds in Europe.

Dexter is designed and developed by Veolia Nuclear Solutions.

Veolia Nuclear Solutions, part of the Veolia Group, is a world-class player in the clean-up of radioactive waste, nuclear facility management and operations. The company offers a comprehensive, integrated range of technical services and services for nuclear fuel cycle, power decommissioning and the treatment of low- and intermediate-level radioactive waste, supported by international teams of nuclear experts and backed by thousands of Veolia staff worldwide.
Save lives, prevent accidents, minimise risk

Dexter in action

Investigate after reactor core meltdown

Client: Mitsubishi Heavy Industries
Project objective: To investigate the site status after Fukushima reactor core meltdown.
Dexter’s role
Operators use Dexter to support the main robotic investigation boom:
- Change inspection equipment on the boom that enters the reactor
- Post equipment into and out of the container where the boom is housed
- Operate tools inside the boom container
- Carry out maintenance on the boom.

Retrieve and repackage underground waste

Client: Canadian Nuclear Labs
Project objective: To retrieve and repackage legacy waste stored underground in a variety of systems.
Dexter’s role
Operators use Dexter to sort, characterise and package waste. Dexter effectively replaces a human in the hazardous environment, carrying out almost any activity a human could do. Dexter was chosen because the two arms enable operators to:
- Separate tangled piles of mixed waste
- Open sealed containers
- Reach a wide range of spaces and retrieve items both large and small
- Manipulate waste and sort it effectively to reduce the volume of the final package
- Deal with unknown and unexpected items
- Carry out repairs to itself and other remote handling hardware in the same environment.

Investigate after reactor core meltdown

Client: Mitsubishi Heavy Industries
Project objective: To investigate the site status after Fukushima reactor core meltdown.
Dexter’s role
Operators use Dexter to support the main robotic investigation boom:
- Change inspection equipment on the boom that enters the reactor
- Post equipment into and out of the container where the boom is housed
- Operate tools inside the boom container
- Carry out maintenance on the boom.

Retrieve and repackage underground waste

Client: Canadian Nuclear Labs
Project objective: To retrieve and repackage legacy waste stored underground in a variety of systems.
Dexter’s role
Operators use Dexter to sort, characterise and package waste. Dexter effectively replaces a human in the hazardous environment, carrying out almost any activity a human could do. Dexter was chosen because the two arms enable operators to:
- Separate tangled piles of mixed waste
- Open sealed containers
- Reach a wide range of spaces and retrieve items both large and small
- Manipulate waste and sort it effectively to reduce the volume of the final package
- Deal with unknown and unexpected items
- Carry out repairs to itself and other remote handling hardware in the same environment.
Remote operation:
The operator can carry out tasks at a distance of up to 8.6 kilometres from the hazardous environment.

Weight compensation:
Dexter can compensate for the weight of a load, so the operator could use a heavy, industrial tool all day with drastically reduced strain and fatigue.

Force scaling:
Dexter can scale forces down, for example to take the strain off loosening a particularly tight bolt, or scale them up, for instance to make very lightweight components more tangible to the operator.

Haptic feedback:
Dexter’s haptic feedback works across every single joint in the arm, and is very sensitive. The slave manipulator detects forces equivalent to a fraction of a mouse-click, and feeds those sensations back to the operator in real time.

Guidance:
Dexter’s guidance functionality, for example, can prevent a tool slipping off the head of a bolt.

Collision avoidance:
Dexter can avoid collisions, with sensitive objects, and can carry out maintenance and repair. Dexter can perform many different types of remote handling tasks, partly because practically any tool a person can use can be easily adapted for the slave manipulator.

Technical overview

**Features**

Remote operation: The operator can carry out tasks at a distance of up to 8.6 kilometres from the hazardous environment.

Weight compensation: Dexter can compensate for the weight of a load, so the operator could use a heavy, industrial tool all day with drastically reduced strain and fatigue.

Force scaling: Dexter can scale forces down, for example to take the strain off loosening a particularly tight bolt, or scale them up, for instance to make very lightweight components more tangible to the operator.

Haptic feedback: Dexter’s haptic feedback works across every single joint in the arm, and is very sensitive. The slave manipulator detects forces equivalent to a fraction of a mouse-click, and feeds those sensations back to the operator in real time.

**Tasks and tools**

- Lift, move, sort objects
- Operate controls (levers, wheels, buttons, switches)
- Fit, connect and disconnect equipment
- Manipulate wires and cables, slings, hooks, ropes and lifting tackle
- Handle delicate receptors
- Point tools, operate pipettes.

Tasks with tools:
- Cut with a knife,
- Take environmental samples
- Cut and replace cables and wire
- Open doors or hatches
- Fit clips, strapping, electrical terminal blocks and other fittings
- Tighten/loosen fastenings and bolts
- Inspet and take measurements.
- Weld and complete welding prep
- Operate industrial power tools
- Apply/remove lubrication and seals
- Decontaminate with water jets
- Perform advanced inspections.

**Specifications**

**SLAVE MANIPULATOR**

- **Dimensions**
  - Working envelope: D 2056mm x W 2212mm x H 1973mm
  - Upper arm: L 700mm
  - Forearm: L 900mm
  - Dimensions: D 535mm x W 1150mm x H 620mm

- **Mass**
  - <250kg (excluding equipment)

- **Environment**
  - Absolute temp: 0-40°
  - Rated temp: 5-25°
  - Humidity: 0-90%
  - Ionising radiation: Max TID of 100kGy at 1kGy/hr

- **Maximum payload**
  - Continuous at each gripper: 10kg
  - Peak at each gripper: 20kg
  - Crane assisted: 100kg

- **Axes and range of motion**
  - Arm: 6 degrees of movement
  - Gripper: 1 degree of movement

- **Maximum operating distances**
  - Slave to control cabinet: 300m
  - Control cabinet to master: 300m

- **Duty cycle**
  - 16hrs/day

**MASTERCABINET CONTROL CABINETS**

- **Dimensions**
  - Working envelope: D 2500mm x W 2530mm x H 2300mm
  - Mass: ~500kg (excluding a-frame stand)

- **Mass**
  - <150kg (excluding equipment)

- **Environment**
  - Absolute temp: 0-40°
  - Rated temp: 5-25°
  - Humidity: 0-90%
  - Ionising radiation: Max TID of 100kGy at 1kGy/hr

- **Maximum operating distances**
  - Slave to control cabinet: 300m
  - Control cabinet to master: 300m

- **Duty cycle**
  - 16hrs/day

**For full technical specifications, contact UK Sales Director Mark Sharpe**

+44 (0) 7777 647780 (mobile), +44 (0) 1235 522119 (office) mark.sharpe@veolia.com
What could you do with Dexter?

Discuss your ideas and see how the manipulator handles more challenging environments at the Assembly, Integration and Testing facility in Abingdon.

To arrange a visit or request full technical specifications, contact UK Sales Director Mark Sharpe
+44 (0) 7777 647780 (mobile), +44 (0) 1235 522119 (office)
or email mark.sharpe@veolia.com