

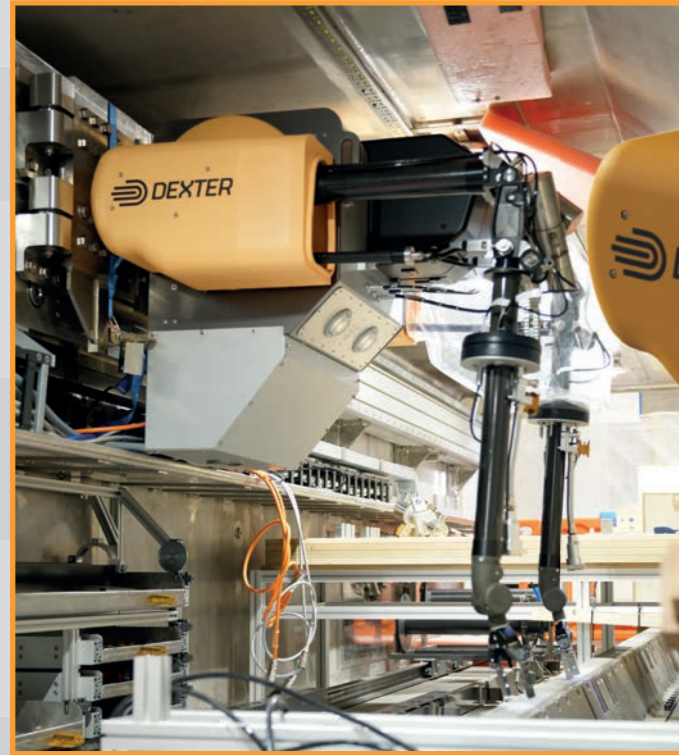


**DEXTER**

**Advanced remote manipulator system**



# Meet Dexter™



**How do you replicate the flexible, fine motor function of a human arm and the touch sensitivity of a human hand in an environment where humans simply can't go?**

## **A force feedback servo manipulator system.**

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

- Manoeuvre objects from 10kg (one arm) to 100kg (two arms with hoist attachment)
- Dispense one drop at a time from a standard pipette
- Detect the different textures of surrounding surfaces
- Use simple tools for complex tasks without the need for sensors (bolting, screwing etc.)

### **Heritage**

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 technologies and services for nuclear facility restoration, plant 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. For more information visit: [nuclearsolutions.veolia.com](http://nuclearsolutions.veolia.com)

## **Specifically designed to replicate human arms.**

The human operator can prepare for tasks and carry them out almost exactly as if they were intervening in the environment directly. Almost exactly, because the operator's capabilities are enhanced by Dexter™'s function and adaptability.

## **Dexter™ makes complex work simpler.**

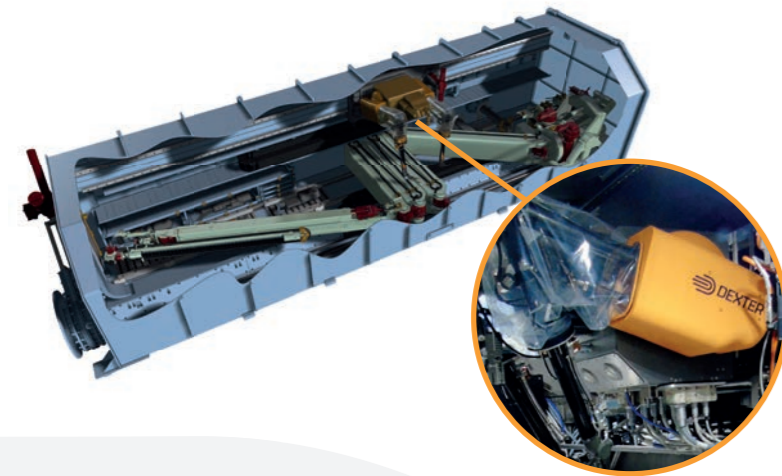
Dexter™ can operate the same hand tools that a human can, and over 2,000 tools have been adapted for the manipulator, making it possible to deal effectively with the unexpected in a remote environment.

Dexter™ allows operators to do more than they could unaided, for example with measures that reduce fatigue and increase sensitivity.

From its adjustable force-scaling to its ergonomic seated or standing operating positions, Dexter™ has been designed to make complex remote handling work simpler.

# Dexter™ in action

## Investigate after reactor core meltdown

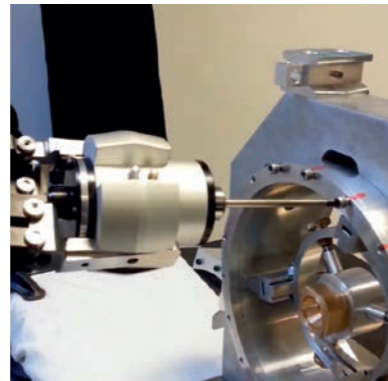


**Client:** Mitsubishi Heavy Industries

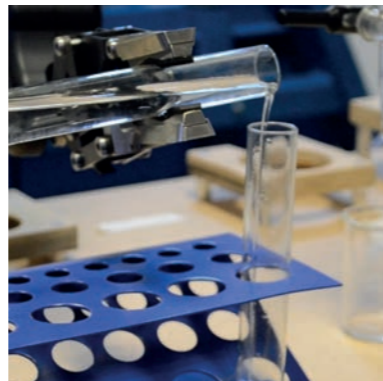
**Project objective:** To investigate the site status after Fukushima reactor core meltdown.

**Role of Dexter™:** Operators use Dexter™ to support the main robotic investigation boom:

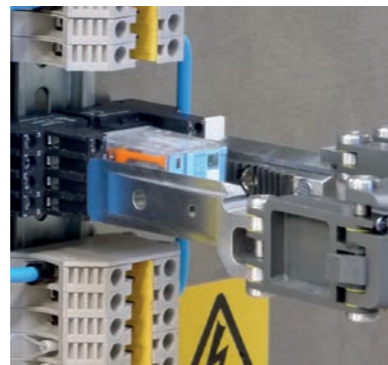
- Change inspection equipment on the boom that enters the reactor
- Post equipment into and out of the container where the boom is housed
- Operate tools inside the boom container
- Carry out maintenance on the boom.



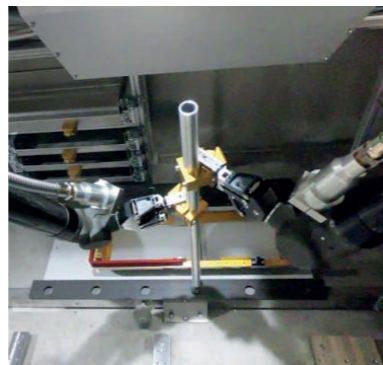
Sensitive enough to feel when a screw has been tightened



Delicately handle glassware to transfer water from a test tube



Feel when the electrical relay is plugged in, this is especially helpful when visual feedback is limited



Able to carry out complex tasks using two arms



## Save lives, prevent accidents, minimise risk

The Dexter™ project team are experts at adapting the manipulator system to new operating scenarios. Dexter™ has proven effective time and again in minimising risk to human beings in hazardous environments of all shapes and sizes.

Its capabilities have boundless potential for a huge range of applications: avoiding unnecessary work at height for construction personnel; removing humans to safer distances during bomb disposal; supporting rehabilitation therapy for stroke patients working to regain motor function.



# Technical overview

For full technical specifications, contact the Sales Team  
+44 (0) 1235 522119 | VNS-UKsales@veolia.com

## 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

The haptic feedback of Dexter™ works across every single part in the arm, and is very sensitive. The Remote manipulator detects forces equivalent to a fraction of a mouse-click, and feeds those sensations back to the operator in real time.

### Guidance

Dexter™ has guidance functionality, for example, to prevent a tool slipping off the head of a bolt.

### Collision avoidance

Dexter™ can avoid collisions, with sensitive objects, reducing risk and simplifying complex tasks and can be preprogrammed to move to specific positions.

### Human-machine interface

The human-machine interface (HMI) makes Dexter™ easy to use. It combines ergonomic seated or standing operating positions with real-world camera views and an environmental virtual reality model for operator training.

### Reliable and maintainable

Dexter™ is designed to be safe after failure (if it fails, it won't harm any other equipment around it). It's proved itself reliable in the most demanding conditions, and the system is set up to protect staff, and designed for ease of maintenance and repairs.

Dexter™ can perform many different types of remote handling task, partly because practically any tool a person can use can be easily adapted for the Remote manipulator.

## Tasks and tools

### Tasks without 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 receptacles
- Pour liquids, operate pipettes.

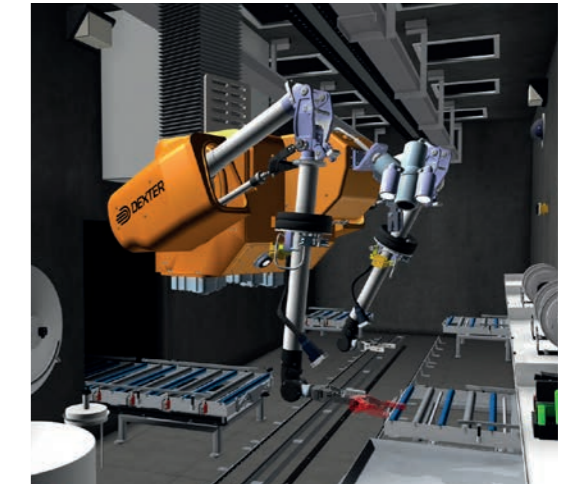
### Tasks with tools

- Cut up waste
- 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
- Inspect and take measurements.
- Weld and complete welding prep
- Cut with water jets
- Operate industrial power tools
- Apply/remove lubrication and seals
- Decontaminate with water jets
- Perform advanced inspections.

## Specifications

REMOTE MANIPULATOR			
<b>Working envelope</b> D 2360mm x W 2200mm x H 2490mm	<b>Dimensions</b> D 1215mm x W 1038mm x H 1200mm Upper arm: L 700mm Forearm: L 900mm	<b>Mass</b> <300kg (excluding equipment)	<b>Environment</b> Absolute temp: 0-40° Rated temp: 5-25° Humidity: 0-90% Ionising radiation: Max TID of 100kGy at 1kGy/hr*
<b>Maximum payload</b> Continuous at each gripper: 10kg Peak at each gripper: 20kg Hoist assisted: 100kg	<b>Axes and range of motion</b> Arm: 6 degrees of movement Gripper: 1 degree of movement	<b>Maximum operating distances</b> Remote manipulator to control cabinet: 300m Control cabinet to Local manipulator: 300m	<b>Duty cycle</b> 16hrs/day
LOCAL MANIPULATOR		CONTROL CABINETS	
<b>Working envelope</b> D 2265mm x W 2105mm x H 2395mm	<b>Mass</b> <150kg (excluding a-frame stand)	<b>Dimensions (per cabinet)</b> D 600mm x W 1000mm x H 2000mm	<b>Mass (per cabinet)</b> ~800kg

\*Remote manipulator radiation limits can be higher if required



### Digital twin

The digital twin provides an accurate representation of Dexter™ in the working environment, dynamically linked in real time and can be used for planning tasks, training operators, and enhancing live operations.

### Local manipulator



Up to 300m between Local manipulator and cabinet

### Computer station

Up to 8km between cabinet and cabinet. A computer station must be present between the cabinets for distance greater than 4km.

### Remote manipulator



Up to 300m between cabinet and Remote manipulator

Dexter™ total range up to 8.6km

## What could you do with Dexter™?

Discuss your ideas and see how the manipulator handles more challenging environments at Veolia Nuclear Solutions UK facilities.

For more information:

Veolia Nuclear Solutions Sales Team

[VNS-UKsales@veolia.com](mailto:VNS-UKsales@veolia.com)

[www.nuclearsolutions.veolia.com](http://www.nuclearsolutions.veolia.com)

