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GAME CHANGERS .technology

CHALLENGE: Deployment techniques to allow remote working at height in high hazardous areas

Sellafield are seeking ideas, innovations and technologies that will deliver game-changing improvements over current practices. Applications are invited for technological solutions to meet this challenge.

Application deadline: 12noon on Friday 11 October, 2019

The Situation

There are approximately 170 nuclear facilities at Sellafield which require decommissioning over the next 100 years, at an estimated cost of £85 billion.

Opportunities to undertake decommissioning activities faster, more safely and at a reduced cost are constantly being explored.

There are a diverse range of buildings, structures and gloveboxes on the Sellafield site, each having their own decommissioning challenges. Buildings can consist of many rooms, or cells, which contain a complex network of vessels, pipework and structural steel.

There are also a significant number of large (<5m high) gloveboxes which also contain a complex network of pipework and structures.

The hazardous, congested environments combined with difficult access, mean that decommissioning and dismantling radioactive cells and gloveboxes is a complex task.

Manual decommissioning is hazardous for the operator and extremely time consuming. Remote decommissioning is one option but solutions can be costly and often unreliable.

Successful development of a remote deployment capability may facilitate safer, cheaper decommissioning and reduce secondary waste generation.

Whilst there have been several ground-based robotic decommissioning solutions successfully deployed at Sellafield, there remains an opportunity for a remote modular deployment solution to address challenges that require working at height in high hazard areas.

Activities include but are not limited to characterisation, decontamination, cutting and debris removal.

Two specific opportunities are highlighted:

1. **Recovery of contaminated solids from an alpha cell** [see Image 1, page 2]. The contamination is located in multiple areas on the in-cell structures (indicated by arrows) which are situated approximately 8m above the cell floor and 3m below the cell roof. Access is possible via an inspection port in the cell roof which is approx. 150mm diameter. The solution must include the ability to deploy technology to the area of interest, characterise the area, and then remove debris, transferring to a suitable waste container (specification to be defined) within the cell.
2. **Deployment of inspection (e.g. visual), holding and cutting tools (e.g. saw, drill) within an alpha glovebox** [see Image 2, page 2]. Deployment would be via an access port (approx. 150mm diameter) with the area of interest up to 3m away from the port. The maximum lift capability of the deployment tool, at this distance would need to be >5kg.

Current Practice

Limited solutions are currently available for the target alpha cells and gloveboxes, in order to minimise risk to operators.

Typically, a bespoke solution would be required for each use case like the ones described above.

The aspiration is to develop a modular deployment toolkit which could be tailored to meet the needs of specific challenges as and when they arise. This will reduce the time-to-deployment and long-term cost.

As decommissioning activity on the Sellafield site accelerates, the requirement for a flexible, modular solution to access these more challenging areas becomes more prevalent.

Challenge Aims

Sellafield are seeking a modular deployment toolkit which is capable of:

- Providing flexibility to be deployed in multiple scenarios with simple reconfigurability.
- Remote deployment through an inspection port, approx. 150mm diameter.
- Carrying a payload of >5kg to the area of interest.
- Commercial solution should be capable of operating in a radioactive environment, with typical cell dose rates ranging from µSv/hr to mSv/hr.
- Deployment of characterisation tools, cutting and transferring material and retrieving or placing debris into a suitable waste container.
- Perform activities using a variety of end effectors attached to the deployment solution.
- Operating remotely or semi-autonomously [desirable].
- Operating beyond line of sight at height.
- Retrieval once the mission is complete.
- Minimises the impact of radiation on electronic systems without jeopardising the agility of the system.
- Having a minimal or zero maintenance regime.
- Providing a solution which minimises or eliminates contamination traps.
- Operating in an entirely consistent and predicable manner to build stakeholder confidence.

Proof of concept within the next 12-18 months and a deployable solution soon after.

Benefits to Sellafield Ltd

It is expected that a solution will bring benefits to Sellafield's Post Operational Clean Out (POCO) and decommissioning programme, including:

- Increased productivity of both the operator and machine to reduce decommissioning schedule and cost.
- Improved efficiencies and cost savings through extended working periods.
- Increased safety of operations through reduced human intervention, leading to a reduction in operator exposure to radiation.
- Accelerated deployment time through re-use of core technology toolkit.
- Reduced cost by eliminating the need for development of one-off bespoke solutions.
- Increased reliability to reduce maintenance and down time.

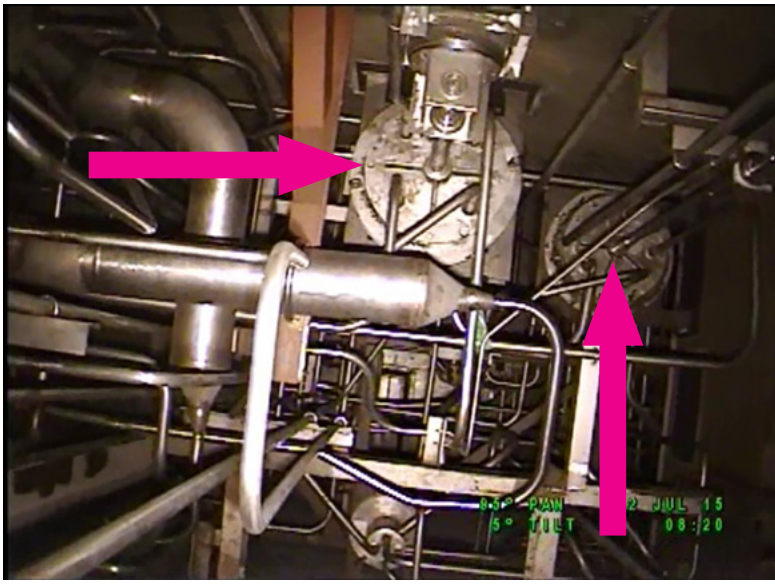

Image 1, above: Cell requiring decontamination

Image 2, below: The content of a typical glovebox

Constraints

Several constraints need to be considered when developing potential solutions, including:

Environment

- The targeted environments can be dark and humid (IP rating and on-board vision system might need to be considered).
- Radiation tolerant components or minimal on-board electronics.
- Typical radiation levels ranging from µSv/hr to mSv/hr.
- Deployment solutions should not include fans and minimise other contamination traps (risk of spreading or capturing contamination).

Access

- Access into a cell is limited with access ports approx. 150mm diameter.
- Access may be from the top or side at some distance from the area of interest.
- A solution must be able to navigate complex pipework and vessels within the cell or glovebox and operate without line of sight.
- External 'out of cell' access and space constraints.
  - Equipment may have to be carried through the building/ doorways to reach the area to be surveyed, then assembled in corridor etc.

Retrieval

- The solution should not lead to the generation of significant amounts of secondary waste.
- The solution and debris must be retrievable through the inspection port or left in containment within the cell.
- An ability to leave the deployment solution in-situ with the inspection port sealed may be desirable.
- An ability to recover failed components.

Reliability

- Minimal maintenance regime.
- Integration of proven technology may be beneficial.
- CE marking of the equipment is required for the commercial solution but not necessary for a prototype active deployment demonstrator.

Functional Requirements

The functional requirements for a portable and modular deployment solution, capable of working at height in a high hazard area should include, but not be limited to the following:

- Modular design to allow deployment, and potentially self-assembly, in multiple scenarios whilst preferably operating as a single platform.
- Capable of working at height (<25m for cells, <5m for gloveboxes) in a congested area.
- Ability for the commercial device to operate for extended periods in a radiation environment.
- Carry a total payload (end effector and debris) of >5kg, at distance.
- Ability to accept a variety of end effectors:
  - Compatible with end effectors which can perform characterisations tasks e.g. radiometric, chemical, visualisation etc.
  - Compatible with end effectors which can hold, cut, transfer and retrieve material
- Ability to be deployed and retrieved through an inspection port approx. 150mm diameter.
- Ability to operate without line of sight and communicate outside the cell or glovebox.
- Ability to be scaled [desirable].

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RAIN

What Next?

The Game Changers Innovation Programme, supported by Sellafield Ltd and in association with the Robotics and Artificial Intelligence in Nuclear (RAIN) Hub, are hosting a showcase and challenge briefing event for this and associated challenges:

Date: **Thursday 19th September, 2019**

Location: **Energus, Lillyhall, Workington, Cumbria CA14 4JW**

If you're an individual, an SME, academic institution or large organisation with new ideas or innovations which can be applied to address the challenge outlined in this document, we invite you to join us.

Attendance at the event is free and you can register your place by visiting **delivering-change-through-robotics.eventbrite.co.uk**

Proof of Concept funding is available through the Game Changers Innovation Programme for new technologies which may aid Sellafield in their mission and which demonstrate commercial potential for the innovator.

Visit **www.gamechangers.technology** to find out more about the Game Changers Innovation Programme, the application process and to download or complete an application form.

You can also request an application form by emailing us at: **apply@gamechangers.technology**

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