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**GAME
CHANGERS**
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CHALLENGE: Autonomous or semi-autonomous removal of Special Nuclear Material (SNM) packages from the store to a transport container for export

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

Application deadline:
12noon on Friday 11 October, 2019

The Situation

There are a significant number of Special Nuclear Material (SNM) packages currently situated in multiple stores on the Sellafield site in west Cumbria, each containing materials that are the result of nuclear reprocessing activities over the past 60 years.

As part of the decommissioning of the Sellafield site, there is a requirement to remove these SNM packages, from the stores and export into long term storage.

SNM packages vary in size and mass (up to 20kg), and typically consist of an outer body, which has a lid, and an inner sealed body which contains nuclear waste.

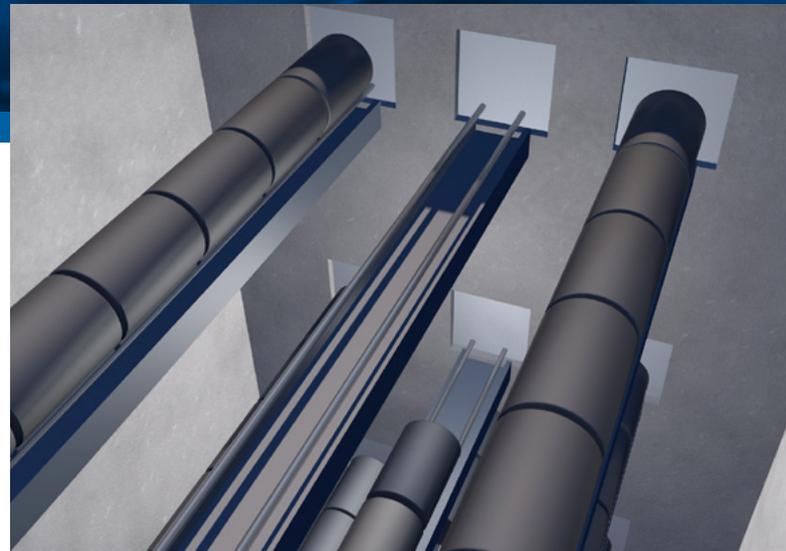
Both are constructed from 316L stainless steel with some having additional LDPE or Viton rubber protective layers.

This challenge will be focused, in the first instance, on a Magnox SNM package as illustrated opposite.

Sellafield wish to retrieve these SNM packages from the stores (see over) and are seeking a solution capable of replacing their manual labour-intensive process, currently capable of removing and inspecting 200 packages per year, with a system capable of increasing throughput to at least 700 packages per year.

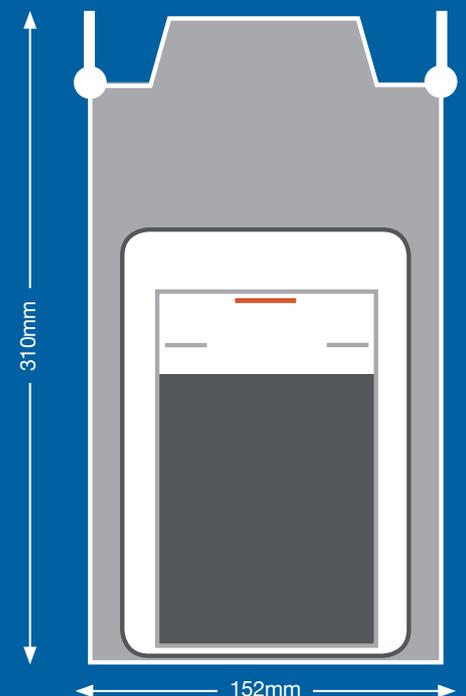
The process of removing packages from the stores and placing them into a SAFKEG and stillage includes several intermediate steps.

The steps relevant to this challenge are depicted in the diagram on page 2 of this document.

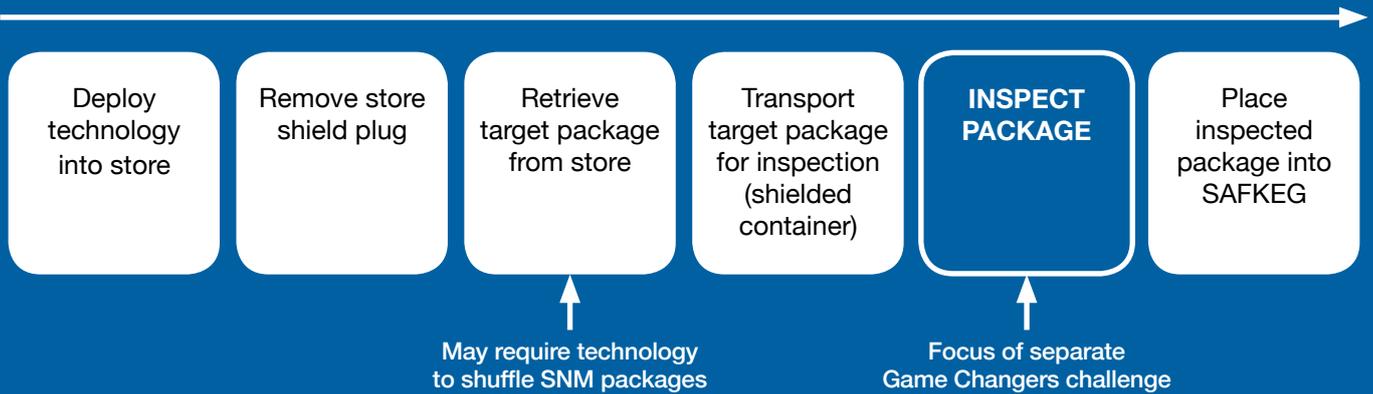


Above: Illustration of SNM packages in-situ in the store.

Below: Magnox SNM package (post 1975).



SNM Package Retrieval Process



Current Practices

The current practice of removing, shuffling, inspecting and exporting SNM packages is labour intensive, manual and requires significant coordination across several organisations including the Office for Nuclear Regulation (ONR), Euratom and Sellafield.

Operations are limited in permitted duration due to the nature of the radioactive environment and, to-date, the current practice has resulted in the removal and export of 200 SNM packages per year.

Challenge Aims

Sellafield are seeking a solution that has the potential to deliver game-changing improvements over the current practice.

- Solutions must be capable of safely removing target SNM packages from the store and, once inspected, place them into a SAFKEG to minimise human intervention.
- Operations should be carried out either autonomously or semi-autonomously to minimise operator exposure to radiation.
- Whilst the solution should be focused on one store configuration it would be desirable to be adaptable for other similar store configurations.
- The commercial solution must be capable of operating in a radioactive environment.
- The solution must operate in an entirely consistent and predictable manner to build stakeholder confidence.
- The solution must not damage the SNM package or modify the surface or material properties.

Sellafield are seeking a non-active proof of concept within the next 12-18 months and a deployable solution by 2025.

Benefits to Sellafield Ltd

It is expected that a solution will bring benefits to Sellafield's decommissioning programme, namely:

- Increased safety of operations through reduced human intervention, leading to a reduction in operator exposure to radiation (typically 10 μ Sv/hr)
- Increased productivity
- Reduction in planning time to prepare for SNM package removal, transfer and inspection activities
- Improved efficiencies and cost savings through extended working periods



Typical SNM package store configuration

Constraints

A number of constraints need to be considered when developing potential solutions, including:

Environment

- SNM packages are stored in a dark and humid (70% to 80%) environment
- SNM packages are typically 50°C.
- Radiation levels in the SNM package store need to be considered when developing equipment, with typical radiation levels of $10\mu\text{Sv/hr}$.
- Containment and ventilation need to be considered in the store i.e. a suction device to remove SNM packages is not desirable.

Access

- SNM packages are stored in racks, sometimes referred to as channels. These channels can only be accessed through 150mm diameter ports which are at varying positions. Ports are configured vertically, never more than 4 high.
- Each 150mm port has a polyethylene shield plug (typically 150mm diameter, up to 800mm deep and approx. 30kg) which needs to be removed in advance of accessing the SNM packages.

Retrieval

- SNM packages are stored in channels which hold approximately 12 packages, stored end to end.
- SNM packages are stored in multiple channels, each channel accessed via a separate port.
- SNM packages may require shuffling in order to retrieve the target package.
- No more than one SNM package at any one time can be out of engineered containment and in the transfer process between the SNM store and SAFKEG.

Condition

- The condition of the SNM packages is variable and could be delicate.

Functional Requirements

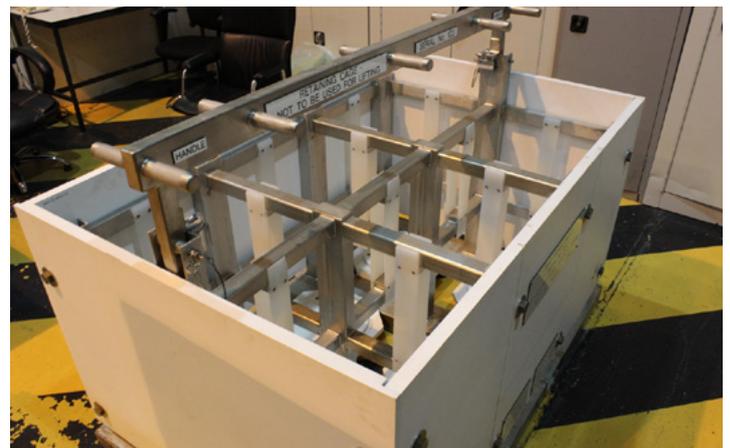
The solution should be capable of:

- Considering the existing store furniture and geo-referencing within the SNM store.
- Remotely removing the polyethylene shield plug.
- Removing and shuffling packages to retrieve a target package, noting that each port can have up to 12 packages which are stored end to end.
- Placing a non-target package into another port.
- Autonomously or semi-autonomously transporting the package from the store to the inspection table, which may be some distance away.
- Transferring the SNM packages which may need to be in a shielded transfer container.
- Placing the inspected SNM package into a SAFKEG (see image below).
- Placing the SAFKEG into a stillage (see images below).



Right: SAFKEG

Below: SAFKEG stillage



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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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