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## CHALLENGE: Remote Inspection of Special Nuclear Material (SNM) Packages

Sellafield are seeking ideas, innovations and technologies that will deliver game-changing improvements over the current SNM package inspection 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 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 of increasing throughput to at least 700 packages per year.

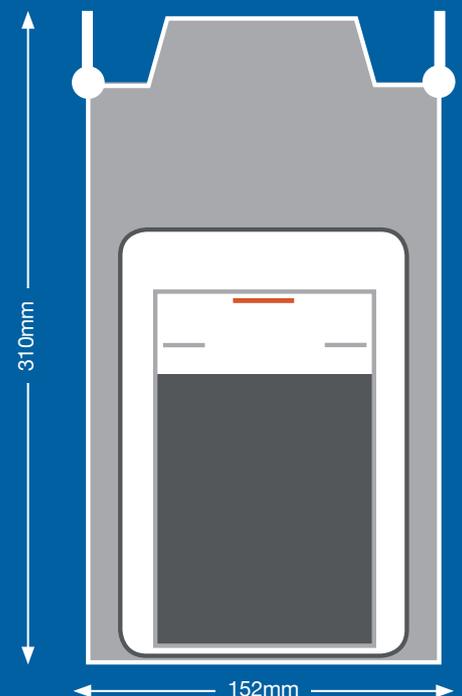
The process of removing packages from the stores and placing them into a SAFKEG includes several intermediate steps.

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

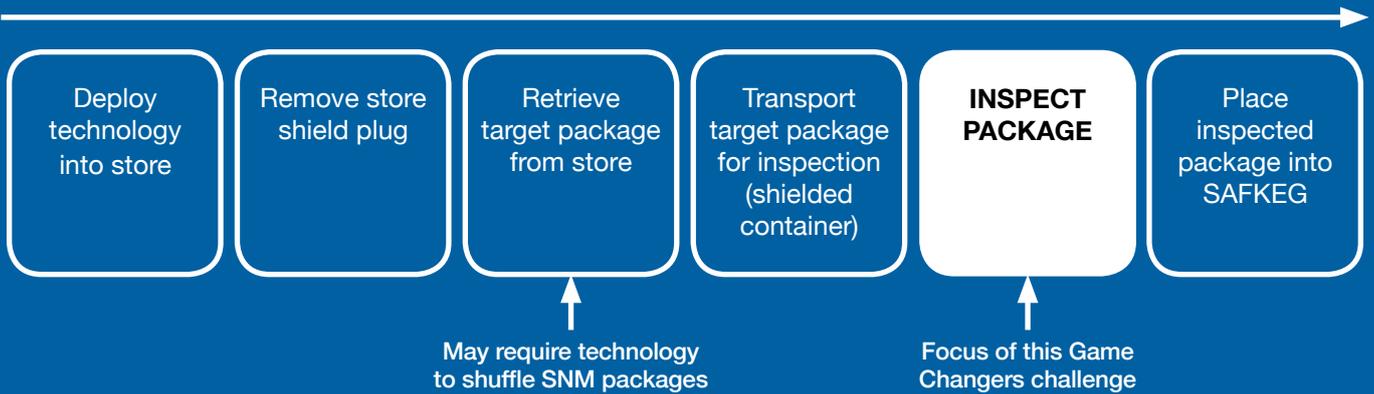


*Above: SNM package and package identification marking*

*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 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.

The inspection of SNM packages is currently carried out manually by the operator and includes activities such as weighting the package, visual inspection and manual measurement of the package.

### Challenge Aims

Sellafield are seeking ideas, innovations and technologies that will deliver game-changing improvements over the current SNM package inspection process.

- Solution must be capable of inspecting a SNM package before placing it in a SAFKEG to minimise human intervention.
- The inspection operation must be carried out autonomously or semi-autonomously, ideally online, to minimise operator exposure to radiation.
- Whilst the solution should be focused on one store configuration it should 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 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 $\mu$ Sv/hr).
- Increased productivity.
- Reduction in planning time to prepare for SNM package removal, transfer and inspection activities.
- Providing a more comprehensive, standardised record for each SNM package post inspection.
- 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, humid (70% to 80%) environment
- SNM packages are typically <math>50^{\circ}\text{C}</math>.
- Radiation levels of the packages need to be considered when developing equipment, with typical radiation levels of  $10\mu\text{Sv/hr}$

### Access

- SNM packages are stored in racks or sometimes called 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.

### Retrieval

- SNM packages may need to be transported from the store for inspection station in a shielded transfer container.
- There is no constraint on the amount of time a SNM package can reside at the inspection station.

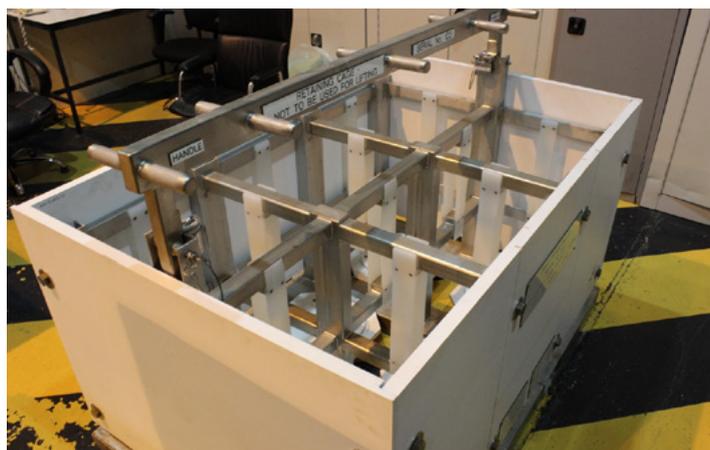
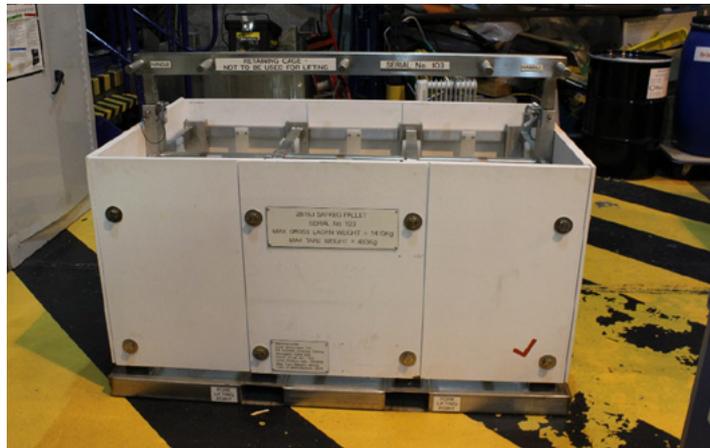
### Condition

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

## Functional Requirements

The functional requirements for the online inspection of a SNM package should include, but not be limited to the following:

- Confirmation of SNM package identification number (etched on top of the package - see page 1).
- Determination of weight of SNM package (up to 20kg).
- Provision of photographic image(s) of whole external surface of the package, with consistency of image quality between different packages.
- Visual inspection to record:
  - Defects include scratches / dents
  - External surface corrosion
  - Internal surface corrosion [desirable]
- Swabbing of the package [desirable]
- Measurement of key geometric information:
  - Shape
  - Physical dimensions of package (including length, diameter along its length and package wall thickness) to an accuracy of  $1\text{mm} \pm 0.1\text{mm}$ .
- Use of artificial intelligence (AI) to build up a capability to distinguish between a substantiated and non-substantiated package. [desirable]
- Ability to be modular and accept new inspection sensors (if appropriate)



Left: SAFKEG

Right: SAFKEG stillage

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## What Next?

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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 19<sup>th</sup> 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](http://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](http://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](mailto:apply@gamechangers.technology)



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